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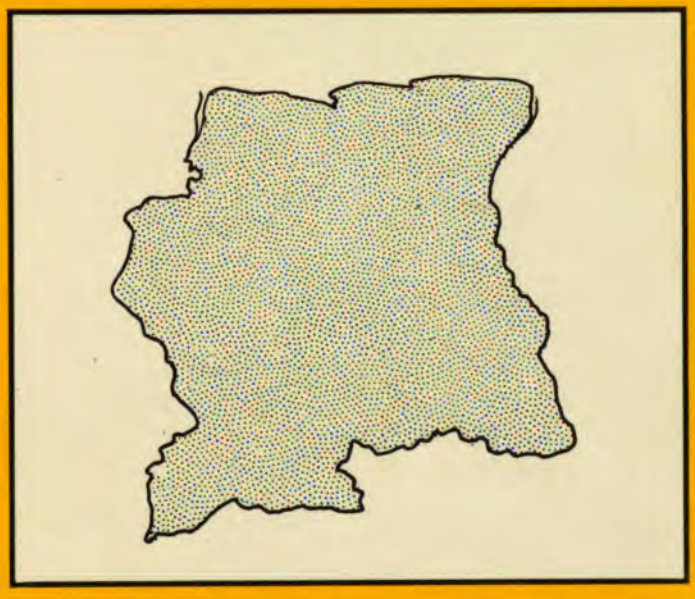
# SURINAME



## AGRICULTURAL INVESTMENT ALTERNATIVES TO OIL PALM



IICA OFFICE IN SURINAME
AND
CENTER FOR PROGRAMS AND INVESTMENT PROJECTS (CEPPI)

# SURINAME: AGRICULTURAL INVESTMENT ALTERNATIVES TO OIL PALM

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## PREFACE

The Inter-American Institute for Cooperàtion on Agriculture (IICA), through its Offices and the Center for Programs and Investment Projects (CEPPI), provides support to the member countries for developing sectoral studies and elaborating investment projects at the request of the governments or international financial institutions. These studies seek to contribute to the design of the development strategy for the agricultural sector, and serve as a preliminary basis for negotiations with international financial agencies.

The main objective of this study is to identify potential crops and livestock alternatives to replace oil palm on the oldest state-owned plantation in Suriname: Victoria. Oil palm production has become an important activity in the country's agricultural sector during the past two decades. However, it has been affected by a disease called spear rot, which has so far devastated the Victoria plantation, one of three state-owned oil palm estates. The Common Vegetables Oils and Fats Companies Limited (GPOV), which administers the plantations, requested IICA to identify investment alternatives to replace oil palm on this estate until a permanent solution to spear rot is found.

In executing the study, a technical mission coordinated by CEPPI visited Suriname between June 1 and 19, 1992. During that period, the mission collected background information on the agricultural sector and the oil palm sub-sector, visited the Victoria plantation to evaluate the agroecological conditions for alternative agricultural activities, and discussed some preliminary findings with the GPOV. The final report was prepared at IICA's headquarters in San Jose, Costa Rica.

The report is divided into five chapters and seven annexes that contain information on the oil palm sector and investment alternatives for Victoria. Chapter I provides a background to the Suriname economy and its agricultural sector. Chapter II discusses the oil palm sub-sector, including the institutional structure, economic aspects of production, public policy towards the sector and development constraints. Chapter III identifies, evaluates and estimates the costs and returns of potential alternative crops and livestock activities for the Victoria Plantation. It also discusses several policy and institutional factors that could affect the choice of alternatives. Chapter IV presents a strategy for implementing the suggested alternatives, and Chapter V provides a summary and the conclusions of the study.

IICA would like to thank several institutions in Suriname that provided information for the preparation of this report. These include the GPOV, the Ministry of Agriculture, Animal Husbandry and Fisheries, the Central Statistical Office, the Plan Bureau of Suriname and the University of Suriname.

## TECHNICAL MISSION

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## SUMMARY

Suriname is mainly an agricultural-based economy with rice, bananas, oil-palm, sugar, citrus and livestock the major sub-sectors in agriculture. Oil palm is one of the main activities developed by the government to diversify agriculture, enhance import substitution and contribute to export earnings. In the 1970s, three state-owned plantations (Victoria, Phedra and Patamacca) and a 300 hectare small-farmer scheme were developed to produce oil palm. Processing facilities were set up at Victoria to produce crude and refined palm oil for the domestic and export markets. The sub-sector has been declining since 1985. Fruit production has dramatically fallen by more than 80%, resulting in underutilization of plant and equipment. Two major factors, the spread of spear rot disease and the rebel insurgence, have contributed to this decline. Although spear rot has been found in all three plantations, it has affected Victoria the most, where about 80% of the cultivated area has been abandoned and fruit production has declined by more than 90%.

Research findings show that the Victoria plantation should not be immediately replanted with oil palm, because of the possibility of a quick reappearance of the disease. One alternative is to cultivate disease-resistant hybrids, but their productivity is lower than that of the variety currently cropped in Suriname. Due to its investments in land improvement, equipment and other infrastructure, the Common Vegetable Oils and Fats Companies, Ltd. (GPOV) would like to utilize the resources to develop alternative agricultural activities in the interim period, until a long-term solution to spear rot can be found. An identification exercise was conducted to select agricultural alternatives for oil palm at Victoria plantation.

Several crops and livestock activities were considered, and a number of agroecological, technical and economic criteria were used to select those with the best potential. Other factors were also considered, such as the compatibility of alternatives with current GPOV activities, the financial and other resource constraints of the company, and prior experiences with other crops and livestock activities at Victoria. The activities were selected using a two-step process, in which each alternative was ranked against the various criteria considered. In the first, a number of crops and livestock activities were pre-selected, based on their adaptability to agroecological conditions. In the second, technical and economic criteria were considered to select the best alternatives from the pre-selected group. The selection process recommended that two annual crops (soybean and peanut), two fruit crops (peach palm and passion fruit), and five livestock production enterprises (two cattle fattening models, two dairy breeding stock and milk production models and one sheep fattening system) as the most suitable alternatives.

Costs, returns and cash flow were estimated for each alternative, and peach palm was identified as the best option. Although it has the highest investment and operating costs as well as elevated foreign exchange needs compared to the other alternatives, its labor needs are low, it has the highest returns per hectare and it contributes the most to foreign exchange

earnings. Another advantage this crop holds over others is that a foreign investor has already shown interest in developing this crop and marketing its product abroad. Passion fruit is also of high financial viability, given the local market potential, but only if yields can be increased. Soybean and peanut were considered good import substitutes, and they can be easily integrated with oil palm and livestock activities, but their financial and economic viability are low. They are risky enterprises requiring prior research, technology validation and assessment of production feasibility.

Of the livestock activities, cattle and sheep fattening have very good potential. A low-cost natural pasture already exists to fatten cattle and sheep, and the production systems proposed require low investment and operating costs, as well as reduced foreign exchange and labor requirements. There is a good local market for mutton, but there is a constraint on exporting the meat because Suriname's processing facilities do not meet export market standards. The financial feasibility of the dairy production models is lower, given the high costs of investment and operations, the need to use more sophisticated technology and the high foreign exchange requirements.

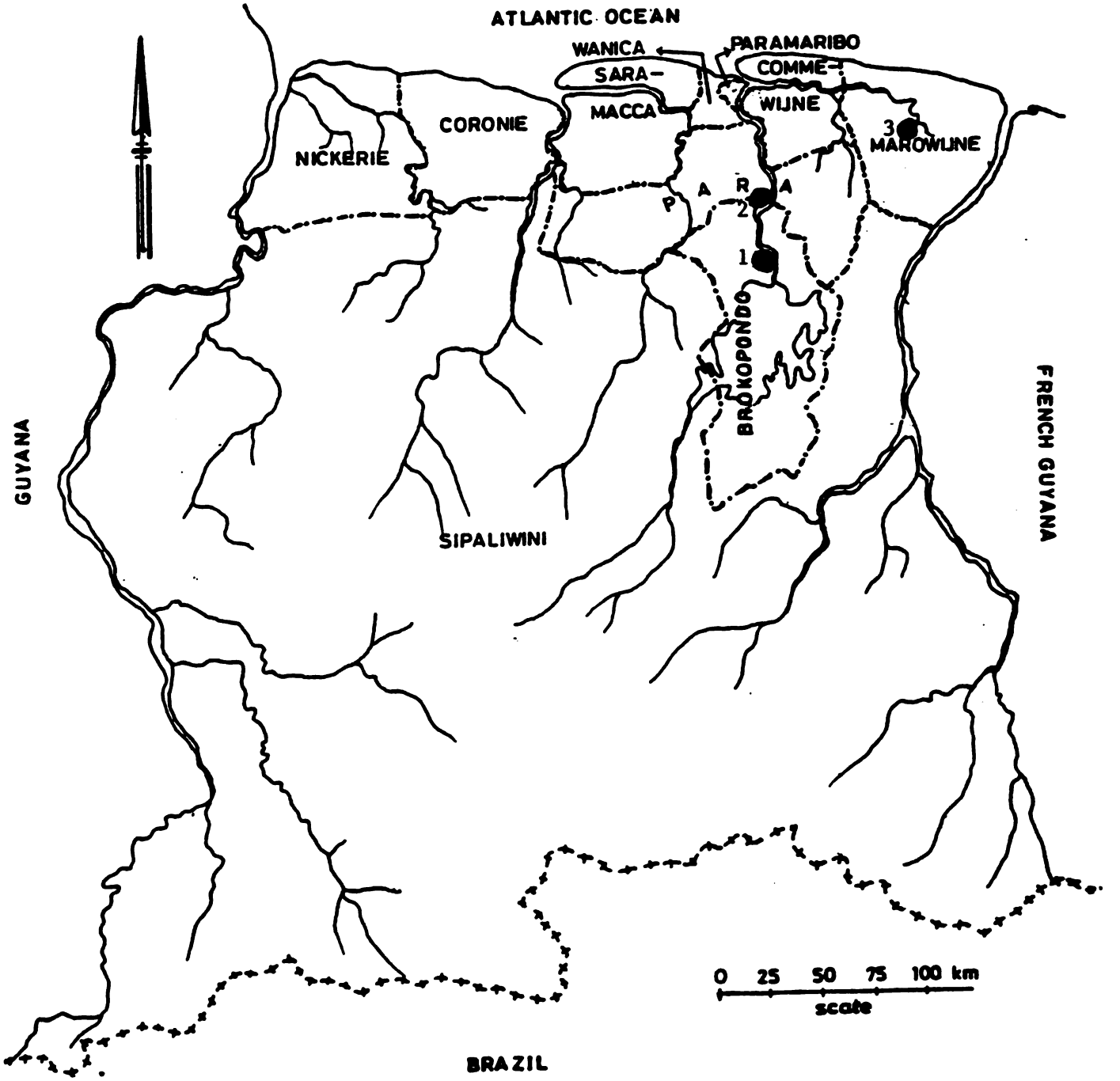
The implementation strategy regarding the proposed enterprises recommends that 350 hectares of peach palm be developed over a 4-year period, using imported seed. Seedlings would be produced in nurseries at Victoria. The peach palm would be processed in a factory to be established at Victoria, and hearts of palm would be canned for export. Soybean and peanut would be developed over a 7-year period; the first two years would concentrate on research and development. In the commercial phase of operation, these crops would rotate with oil palm, natural pasture and cultivated pastures. By year five of the project, it is expected that 300 hectares would be cultivated in soybean and 150 hectares in peanut. For passion fruit, the proposal is to rehabilitate 13 hectares previously cultivated with this crop, modify the production system to boost yields, and sell the output on the local market.

The livestock production alternatives would be developed in four phases. Phase one would concentrate on planning, information generation and identification of resource needs, and phases II, III and IV would focus on development of the production models. Two cattle fattening models to produce meat for export were recommended. The first would be developed in phase two, and would utilize 277 hectares of natural pasture. The second model would be developed in phase III, and it proposes utilization of 80 hectares of natural pasture only, employing additional technology and providing supplemental feeds to accommodate a higher stocking rate. Both dairy production models recommend utilizing 52 hectares. Grass pasture would be the main feed source, to be supplemented by other feeds. Equipment and other infrastructure would be required; milk would be the main output to be sold on the domestic market. The sheep fattening system proposes producing mutton for sale on both the local and export markets. Its main input requirements would be 9 hectares of land, improved pastures, supplementary feed, and infrastructure for pasture maintenance and herd management.

In addition, several recommendations were made for

strengthening the financial and economic viability of the alternatives proposed, as well as of oil palm production. The most important of these include: improving production efficiency at GPOV; evaluating the trade-offs between expanding oil palm cultivation and investing in alternative agricultural enterprises; establishing a separate entity, or collaborating with local and foreign investors, to develop the alternative enterprises; adopting a more efficient pricing policy with reduced government intervention; developing an effective market strategy; intensifying research efforts with local and international institutions to address the spear rot problem; and reducing distortions through macroeconomic and sectoral policy reform.

MAP OF SURINAME




● Oil Palm Plantations:

1. Victoria 2. Phedra 3. Patamacca

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## ACRONYMS

| | |
|---|---|
| AU | Animal Unit |
| CELOS | Center for Agricultural Research |
| CIS | Central Importing Service |
| ER | Extraction Rate |
| FFA | Free fatty acid |
| FFB | Fresh fruit bunches |
| FPB | Foundation Plan Bureau of Suriname |
| GDP | Gross Domestic Product |
| GOS | Government of Suriname |
| GPOV | Common Vegetable Oils and Fats Companies Limited |
| HVA | Amsterdam Trade Association |
| IICA | Inter-American Institute for Cooperation on Agriculture |
| LRS | Long Rainy Season |
| LVV | Ministry of Agriculture, Husbandry and Fisheries |
| R & D | Research and Development |
| SF | Suriname Guilders |
| SML | Wageningen Foundation for the Development of Mechanized Agriculture |
| SRS | Short Rainy Season |
| SURALCO | Suriname Aluminum Company |
| SUREXCO | Suriname Rice Exporting Company |
| SURLAND | Suriname Banana Company |
| VAL | Victoria Agriculture Ltd. |

# I. FRAME OF REFERENCE

## 1.1 Overview of the Economy

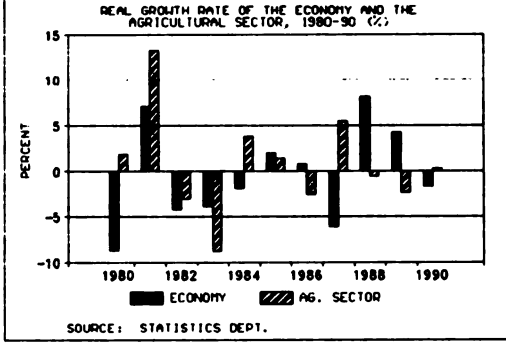
The economy of Suriname experienced rapid economic growth in the 1960s and 1970s, mainly due to expansion in the bauxite and alumina industry, the main economic base of the country. In the 1980s, however, the economy deteriorated significantly, growing at an average negative real rate of 0.4%. In the 1980-90 period, real per capita income declined by 14%, the inflation rate averaged nearly 14% per year and the currency became severely overvalued[1]. Among other factors, the economic contraction of the 1980s was caused by: (i) a decline in bauxite production[2]; (ii) suspension of Dutch development aid in 1982; (iii) distortions in production and trade, induced primarily by poor economic policies; (iv) the impact of a rebel insurgence in the country; (v) capital flight; and (vi) migration[3].

During the last decade, agricultural output fluctuated much as did total economic output (**Figure I.1**). The contribution of agriculture to GDP remained relatively stable, averaging about 9.5%, while the real output of the sector improved modestly (0.8% per year). The relative importance of the services sector increased steadily due to a sharp rise in public sector employment and growth of financial services. The contribution of the services sector to GDP increased from approximately 45% in 1980 to about 63% in 1990.

As the economic situation gradually worsened during the 1980s, it strongly

FIGURE I.1

REAL GROWTH RATE OF THE ECONOMY AND THE AGRICULTURAL SECTOR, 1980-90 (%)




SOURCE: STATISTICS DEPT.

eroded output of the domestic secondary sector (manufacturing, construction, electricity generation, distribution and commerce). This was attributed mainly to the high import component of those sectors, a sharp reduction in both overall investment and real purchasing power, and a severe scarcity of foreign exchange for imports. In addition, overvaluation of the exchange rate and rising real labor costs, combined with increasing foreign exchange scarcity since 1983, contributed to the closure of many manufacturing enterprises, while others became increasingly engaged in import substitution. The manufacturing sector, which employs about 10% of the labor force, was also affected by a gradual deterioration of supporting infrastructure and the rebel insurgence between 1986 and 1989.

Suriname's external situation was severely affected by the decline in bauxite exports, the reduction of Dutch aid and by government's economic policies. Traditionally, bauxite and alumina exports contributed between 70% to 80% of foreign exchange revenues. Export earnings peaked in 1980, but declined rapidly thereafter due to the weak external bauxite market.

The country's external financial situation deteriorated further with the suspension of Dutch aid in late 1982 and the continued growth in government

[1] The parallel market price for the US dollar increased by more than 800% in the 1980-90 period.

[2] Bauxite production declined by almost 25% between 1980 and 1986, exports dropped by 50% and the mining sector's contribution to GDP fell from 9.2% in 1978 to 3.3% in 1988.

[3] Suriname has had high migration rates since the 1970s but this accelerated after the military coup of 1979. The rebel insurgence ended in 1990.

spending, that fueled the fiscal deficit and drained foreign reserves. This reduced the country's access to external savings. By 1983 reserves were depleted, and the country was forced to adjust by implementing trade restrictions and foreign exchange controls. These measures reduced imports substantially, resulting in a trade balance in 1985 and 1987, and surpluses in 1986 and 1988.

In recent years, the economy has experienced more favorable growth rates, averaging 3.5% per year since 1988. Nevertheless, exports declined due to the country's reduced competitiveness in international markets, and smuggling of goods to neighboring countries such as Guyana and French Guiana[4]. Inflation grew by about 26% in 1991, compared to an increase of 22% in 1990 and 1% in 1989, and the parallel market rate for foreign exchange increased by an estimated 20% in 1990. In addition, there was a marked shift in the distribution of the labor force, from the productive sectors to formal services, and from the private to the public sector, as well as increases in part-time employment.

## 1.2 Agricultural Sector

### 1.2.1 General Characteristics

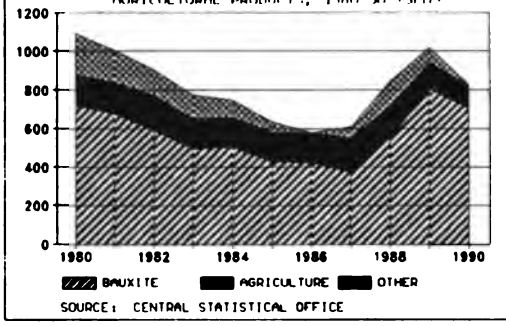
The agricultural sector[5] plays a significant role in Suriname's economy. In 1990 it accounted for nearly 9.5% of GDP, about 18% of export earnings (**Figure I.2**) and employed an estimated 14% of the labor force, second only to the government sector. Agricultural activities are concentrated mainly on the country's coastal plain, with the main exception of oil palm and timber production activities which are located further inland. Rice is

[4] It is estimated that the value of unregistered exports is as large as the foreign net income of the bauxite sector.

[5] including forestry and fisheries.

FIGURE I.2

VALUE OF TOTAL EXPORTS, BAUXITE AND AGRICULTURAL PRODUCTS, 1980-90 (US$M)




SOURCE: CENTRAL STATISTICAL OFFICE

Suriname's principal agricultural product; it occupies about 50% of the cultivated land and almost 85% of the total cropped area. Moreover, a large portion of the output is exported. Bananas, shrimp, palm oil, sugar and timber are also important products. Much of the banana, timber and shrimp output is exported while sugar, palm oil, meat, dairy products and fish are produced mainly for domestic consumption.

The country's agriculture consists primarily of large farms occupying about 70% of total cropped land (**Table I.1**). A large part of this area is owned by state enterprises (parastatals), including the Wageningen Foundation for the Development of Mechanized Agriculture (SML), which owns more than 10,000 ha. of rice in Nickerie; the Mariënburg Sugar Company with more than 2,000 ha. under sugar cane; SURLAND, which has about 2,800 ha. in banana production; and the Common Vegetable Oils and Fats Companies Limited (GPOV), with about 5,500 ha. under oil palm. There are also a number of large private farms, mostly devoted to rice cultivation in the Nickerie area. The remaining 30% of the cropped area is in small holdings measuring less than 10 hectares. These often yield a return that is insufficient to support the

TABLE I.1
AGRICULTURAL LAND USE BY FARM SIZE AND UTILIZATION

| FARM SIZE (HA) | CROP PRODUCTION | | GRASS LAND | | TOTAL | |
|---|---|---|---|---|---|---|
| | NO. OF FARMS | AREA | NO. OF FARMS | AREA | NO. OF FARMS | AREA |
| LESS THAN 1.0 | 6,138.0 | 1,756.0 | 1,173.0 | 267.9 | 7,311.0 | 2,023.9 |
| 1 - 2 | 5,261.0 | 4,693.0 | 1,718.0 | 1,401.2 | 6,979.0 | 6,094.2 |
| 2 - 5 | 5,426.0 | 8,568.8 | 2,674.0 | 4,903.4 | 8,100.0 | 13,472.2 |
| 5 - 10 | 2,123.0 | 8,512.2 | 776.0 | 2,762.1 | 2,899.0 | 11,274.3 |
| 10 - 20 | 836.0 | 6,315.1 | 289.0 | 1,751.2 | 1,125.0 | 8,066.3 |
| 20 - 100 | 414.0 | 8,181.3 | 198.0 | 3,092.0 | 612.0 | 10,273.3 |
| 100 - 500 | 85.0 | 9,686.8 | 35.0 | 1,919.3 | 120.0 | 11,606.1 |
| 500 - 1000 | 27.0 | 12,901.2 | 7.0 | 874.0 | 34.0 | 13,775.2 |
| MORE THAN 1000 | 18.0 | 25,689.1 | 6.0 | 4,021.7 | 24.0 | 29,710.8 |
| TOTAL | 20,328.0 | 86,303.5 | 6,876.0 | 20,992.8 | 27,204.0 | 106,296.3 |

SOURCE: MINISTRY OF AGRICULTURE (1981 CENSUS)

owners financially, many of whom are civil servants who supplement their income with part-time farming.

The sector employs a large number of foreign workers (mainly from Guyana and Haiti), particularly in the sugar, oil palm and banana sub-sectors. To some extent, the foreign labor has contributed significantly to sustaining agricultural production, by replacing the successive waves of Suriname citizens migrating to Holland during the last two decades. The employment situation is complex due to a number of factors such as: a large number of foreign laborers, many of whom are unregistered; increasing importance of part-time employment among workers who hold other jobs; and the sector's inability to attract labor despite the country's high unemployment rate.

The Suriname economy, and particularly its agricultural sector, is largely state controlled. It has a large number of parastatal organizations engaged in production, processing, distribution, as well as in price determination and trade regulation. The state owns an estimated one-third of the arable land, is the sole producer of bananas, sugar and palm oil, and processes all milk and shrimp[6]. SML is the largest producer of rice, accounting for about 25% of total output, and the government extended its heavy involvement to include rice marketing and input supply by establishing the Suriname Rice Exporting Company (SUREXCO). It is also involved in fertilizer supply through the Central Importing Service (CIS). The state participates in fruit production and processing, the production of beef, fish and milk, and it operates one of the largest lumber enterprises. It controls the prices of most agricultural products, and provides agricultural infrastructure as well as aircraft services to sow rice at subsidized rates.

With regard to the sector's development, the government's main policy objectives include the following[7]: (i) diversify the overall economy and the agricultural sector in order to reduce the dominance of bauxite and rice; (ii) enhance import substitution and increase the level of self-sufficiency in food supply; (iii) increase agricultural production and

[6] The government is also responsible for part of the shrimp catch..

[7] Multi-Annual Development Plan for the 1988-93 period.

productivity to satisfy the country's needs and expand exports; (iv) boost agricultural employment and farm incomes; and (v) improve the skill level of the sector by intensifying education and training activities. The priorities for development are concentrated in the following export and import substitution areas: rice (drainage and irrigation infrastructure); bananas; fats and oils (oil palm and soybean); livestock (dairy and beef); fruits and vegetables; and small-scale agro-processing.

### 1.2.2 Performance

In contrast to the steady growth registered in the 1970-80 period, the sector's performance in the last decade was characterized by an almost stagnation in agricultural production and exports. Between 1980 and 1990, the real growth of agriculture averaged a modest 0.8% per year. The growth rate peaked in 1981 at about 13% and real output experienced relatively wide fluctuations in the ensuing years, but always remained below the 1981 level (**Figure I.1**). Output fell in 1982, and decreased further in 1983 when the Dutch aid stopped but recuperated in the next two years. It declined again in 1986, then was followed by a strong improvement in 1987, only to fall again for the remainder of the decade. By 1990, real output was approximately at the same level as that of the early 1980s.

Within agriculture, the sub-sectors also showed varied growth performances during the last decade, with overall improvements in crop and livestock production and deterioration in forestryand fisheries (**Table I.2**). Except for bananas, production of the major crops declined during the latter part of the 1980s. Output of rice paddy fell by more that 30% between 1987 and 1990, and there were sharp decreases in sugar cane and palm oil production. However, strong growth was experienced in root crops, vegetables and fruit crops. With regard to the livestock and fisheries sub-sectors, wide fluctuations in output were also observed, but an overall upward trend occurred for milk, beef, pork, chicken and shrimp.

The poor production performance of agriculture was also reflected in the sluggishness of the sector's exports. Since 1983 rice exports have been generally lower than the average for the 1980-82 period, with the exception of 1985. Exports of processed and unprocessed wood were less than half that at the outset of the decade, due to the insurgency which reduced accessibility to many production areas.

On the other hand, the export value of shrimp and fish grew to double the level achieved in the early 1980s, but net foreign exchange earnings grew by

TABLE I.2
ESTIMATES OF THE REAL GROWTH RATE
OF AGRICULTURAL SUB-SECTORS, 1980-90 (PERCENT)

| SECTOR | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CROPS | 6.2 | 22.2 | -3.6 | -9.7 | 13.3 | -1.3 | -6.6 | 12.6 | -3.8 | 0.8 | -4.5 |
| LIVESTOCK | 2.3 | 2.3 | 2.3 | 2.0 | 3.0 | 15.9 | -8.6 | 3.1 | 8.4 | 9.9 | 5.8 |
| FORESTRY | -9.7 | -12.0 | -8.5 | -15.6 | -7.6 | 18.7 | -17.7 | -27.7 | 55.0 | -31.2 | -2.1 |
| FISHERIES | -3.7 | 20.7 | -2.1 | -10.1 | -13.7 | -13.5 | 32.7 | 4.7 | -18.0 | -8.9 | 11.7 |

SOURCE: CENTRAL STATISTICAL OFFICE

only approximately 10%. Banana exports have also done well despite transportation and packing problems. The sluggish growth of agricultural exports since 1983 was accompanied by an increase in the demand for imported agricultural commodities, mainly food, and this contributed to a decline in the sector's role as a traditional supplier of foreign exchange.

### 1.2.3 Constraints

In general, the sector's development has been affected largely by structural, institutional and economic policy constraints. Structural constraints include: (i) the small size of the economy and scale of operations which limits the development of exports; (ii) the current comparative disadvantage of other agricultural products as compared to rice; (iii) a land ownership and distribution system through which the country is dominated by a small number of large farms, operated by both the public and private sector, and which focus almost entirely on a few cropping activities; and (iv) lack of entrepreneurial capacity and shortage of qualified human resources in technical fields.

With regard to institutional constraints the principal ones are: (i) the high level of government involvement in the sector and its control of a large proportion of the major export crop activities; and (ii) weaknesses of the institutions engaged in production and in providing support services to the sector[8].

Due to a decline in other sectors of the economy, the agricultural sector has gradually increased its share in total output since 1978, with relatively good performance in rice and banana production, and fishing. However, among other factors, the sector was affected severely by both macroeconomic and sectoral policies in the last decade. The productivity and profitability of agricultural production and exports declined due to an overvalued exchange rate, price controls and increased labor costs. Price controls on several agricultural products including milk, meat, edible oil contributed to increasing food imports. In addition, smuggling of agricultural products to and from neighboring countries has grown, and the growth of the parallel economy has resulted in higher market prices for some food products and has diverted domestic production away from potential export markets.

The government's involvement in the sector has been a drain on the public budget. Several state enterprises incur huge financial losses, estimated at more than 25% of the public budget allocated to the sector. The government's tight fiscal situation and shortages of foreign exchange have affected operations in many enterprises, including those of SML, the oil palm company, and Marienburg. The financial situation has also slowed completion of major supportive projects such as the multipurpose Corantijn irrigation project.

## II. THE OIL PALM SECTOR

### 2.1 Background

Oil palm production is one of the main agricultural activities of Suriname that is not concentrated on the coastal plain. The first commercial cultivation was established in 1970 by the Victoria Oil Palm Company on 1,600 ha. in the Brokopondo area[9]. Between 1970 and

[8] This includes operational and administrative inefficiency of government-owned companies and foundations.

[9] The project was originally social in nature, its intention being to establish the oil palm estate to provide employment to local people displaced by the Van Blommestein Lake. Signing of the cooperative agreement between the GOS and the Amsterdam Trade Association (HVA) of Holland gave rise to the Victoria Oil Palm Company in 1969.

1979 two further developments took place: the Government of Suriname (GOS) established 30 ten-hectare plots as a smallholder settlement scheme, and developed a second estate on 877 ha. at Phedra in the Brokopondo area. In 1982, cultivation started on a third large plantation at Patamacca in the eastern region, where the soil and rainfall conditions are said to be more favorable than those at Victoria. Currently, about 3,000 ha. of a proposed 5,000 ha. are under cultivation at this site.

An African-type of oil palm "**Tenera Elaeis guineensis**" is cultivated in Suriname from seeds imported from New Guinea, Ivory Coast and Benin. Harvesting is a labor-intensive operation, which requires systematic and intensive monitoring and control to minimize losses. The first harvesting of the oil palm fruit occurs three years after planting, and this continues throughout the year at eight to ten-day intervals (about 45 times per year), for approximately 18 years. The average yield of fresh fruit bunches (FFB) per tree ranges between 1.0 to 2.5 metric tons (mt) per hectare per year. In the peak harvesting period, the yield is about 1.75 mt per hectare. Maximum yield can be reached after the seventh year, which ranges from 15 to 20 mt/ha/year.

Processing of oil palm started later at Victoria with establishment of a crude palm oil factory in 1974, a refinery in 1977 and a kernel extraction plant in 1983. Fruits produced by the Victoria and Phedra plantations and by small farmers are processed at Victoria. The Victoria plant is an integrated operation and consists of a crude oil processing factory with a total capacity of 10 mt. FFB/hour, a kernel extraction unit with a capacity of one-half ton of kernels/hour, and an oil palm refinery with a capacity of 1 ton oil/hour. For a few years in the mid 1980s, the processing of FFB at Patamacca was done at two stork mills, each with a capacity of 1.5 tons/hour.

## 2.2 Institutional Structure

The palm oil sub-sector activities are controlled by GPOV, a parastatal enterprise, created in 1987, with the objective of promoting the development and growth of the vegetable oils and fats sector[10]. To pursue its objective, GPOV manages and coordinates three state-owned estates (subsidiaries) engaged in oil palm cultivation as well as in the production and processing of crude and refined palm oil and related products: the Victoria Agriculture Ltd. (VAL), Phedra Agriculture Ltd., and Patamacca Agriculture Ltd. GPOV is also responsible for strategic planning, policy direction, R&D, technical support, marketing and overall coordination of oil-palm related activities.

The GOS is the only shareholder in GPOV. Its shares are held primarily by the Ministry of Agriculture, Husbandry and Fisheries (LVV) and by the Foundation Plan Bureau of Suriname (FPB). GPOV is governed by a Board of Commissioners appointed by LVV and FPB, while responsibility for its day-to-day operations, overall administration and financial management, as well as policy and decision-making lie with a Managing Director. Assistant managers (who are also sub-directors of GPOV) are responsible for operations at the Victoria, Phedra and Patamacca plantations.

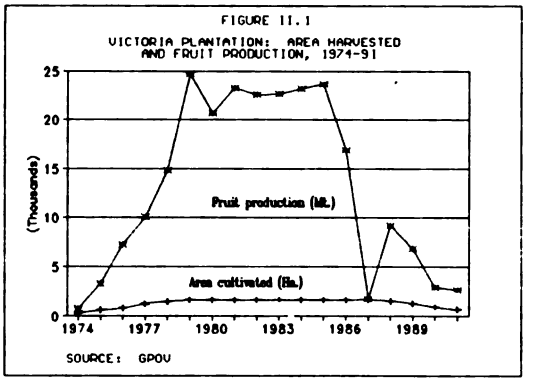
### 2.2.1 Victoria Agriculture Ltd.

The Victoria Agriculture Ltd. is located in the Brokopondo area, about 90 kilometers south of the country's capital of Paramaribo. It operates the Victoria

[10] Particular emphasis is given to crop cultivation and production and processing of fats and oil products.

plantation and the three oil palm processing facilities. VAL is managed by a sub-director of GPOV, who is in charge of the day-to-day plantation and processing operations.

Cultivation began in 1969 and expanded in stages as additional plots were planted with tress. By 1975, the area cultivated was 1,424 ha, which increased to 1,700 ha by 1985. Fruit production gradually increased in the 1970s as more trees matured, with output peaking in 1985 at almost 24,000 mt, and comprisiing 62% of total fruit production by GPOV (**Figure II.1**). With regard to productivity, average output was less than 12 mt of FFB/ha for most years since 1970, except for 1979 when the yield was 15.4 mt/ha. This is much less than the 18 to 20 mt/ha anticipated, and is mainly attributed to problems in the early years related to soil fertility and management, unsuitability of planting material and the general lack of experience in oil palm cultivation.




Fruit production dramatically declined since 1987, due to the rebel insurgence which affected field operations, and which also contributed to a rapid spread of spear rot throughout the farm. Although the disease was discovered at Victoria in 1979, actual devastation of the plantation occurred over the last six years.

Large areas were abandoned beginning in 1987, and it is estimated that only 250 ha were under production in May 1992, about 15% of the total area cultivated (**Table II.1**).

TABLE II.1
AREA ABANDONED AT VICTORIA (HA)

| YEAR | AREA UNDER PRODUCTION | AREA ABANDONED | TOTAL AREA ABANDONED |
|---|---|---|---|
| 1987 | 1700 | 117 | 117 |
| 1988 | 1583 | 281 | 398 |
| 1989 | 1302 | 140 | 538 |
| 1990 | 1162 | 517 | 1055 |
| 1991 | 645 | 303 | 1358 |
| 1992 (MAY) | 250 | 92 | 1450 |

SOURCE: GPOV

The Victoria plantation was established more than 20 years ago. Thus, while it is thought that spear rot contributed to the death of many plants, it is also true that most had reached the end of their life cycle. If the trees had gone through their normal life span, an estimated 1,200 to 1,400 ha should have been replanted by 1992.

Recommendations from an international conference on spear rot suggested that replanting the plantation with oil palm was not a viable alternative because the disease would reappear quickly[11].

The plantation has other constraints also, of which a shortage of both labor and capital are the most important. Total field labor has declined by about 65% over the past ten years, from 380 workers in 1981 to 131 in 1991. This reduction was mainly due to reduced fruit production as more plots became affected by spear rot, and the departure of

[11] See "Spear Rot Of Oil Palm in Tropical America," Proceedings of the First International Seminar on Identification and Control of Organisms Causing the Spear Rot Syndrome, Paramaribo, Suriname, March 1988.

many workers with the onslaught of the rebel insurgence. Although the plantation's current labor needs have been reduced it has been unable to fully replace needed workers. As indicated before, the financial viability of VAL has declined considerably and its operations have been heavily subsidized by the government. The country's fiscal situation may preclude sustained state support to the enterprise, and this is likely to further affect the company's operations.

Victoria has invested heavily in infrastructure and other support services for oil palm production including land clearing and preparation, roads, bridges, field and factory equipment and machinery, buildings, housing facilities for workers, water and electricity services, etc. In view of this sizeable investment and the unlikely possibility of replanting the farm with oil palm, GPOV would like to utilize the resources in the interim in alternative activities until a long-term solution and cure can be found for spear rot.

### 2.2.2 Phedra Agriculture Ltd.

The Phedra Agriculture Ltd. is the second oil palm estate developed by the GOS. It was established in 1978, and is located in the Brokopondo district, about 60 km. from Paramaribo and 50 km. north of Victoria. In 1979, 53 ha. were planted; by 1982, this had increased to 844 ha. where the area cultivated has since stabilized. Harvesting began in 1981, and both the area harvested and FFB output peaked at 877 ha. and 10,363 mt. respectively in 1985. After 1986, production declined dramatically, then increased to more than 50% of the 1985 level in 1989. In the last two years, output decreased again, as a result of the insurgence, labor shortages and strikes, lack of transport and closing of the Victoria factory. The FFB are processed at Victoria; however, transport costs are high, mainly due to the lack of adequate facilities.

### 2.2.3 Patamacca Agriculture Ltd.

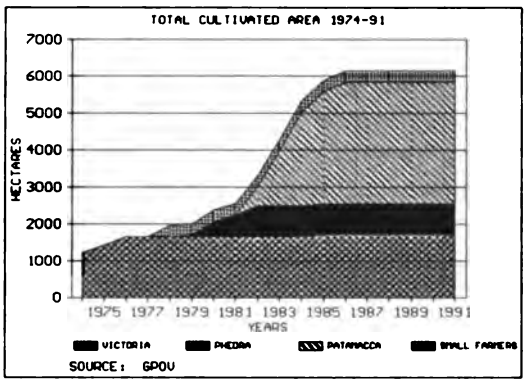
The Patamacca Agriculture Ltd. was established in 1980, in the district of Manowijne in the north-east part of Suriname. The objective of this plantation was to cultivate 5,000 ha. and produce crude oil for the export market. It was also envisaged that it would contribute considerably to income and employment growth in the north-east region, thus preventing migration of people to Paramaribo and French Guiana. However, 3,295 ha. were cultivated by 1985, and the rebel insurgence prevented further expansion. FFB output was low because the trees were in their initial production stage. Harvesting began in 1984, and by 1986 when production stopped, total output for the three years was about 5,000 mt.

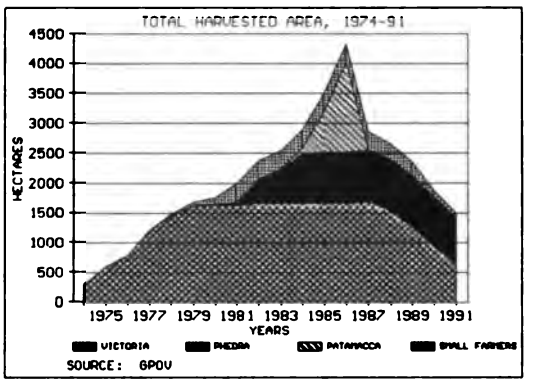
## 2.3 Economic Aspects

### 2.3.1 Production and Utilization

After growing at a moderate rate in the 1975-80 period, total cultivated area with palm oil in Suriname expanded rapidly until 1985 and then, remained relatively stable at approximately 6,000 ha. **(Figure II.2)**. In contrast to this behavior, total harvested acreage experienced consecutive growth until 1986 and then fell sharply in 1987-91. As **Figure II.2** shows, while harvested acreage at Phedra remained more or less stable over the 1986-91 period, that of Victoria plantation declined by more than 70%, and harvesting stopped at Patamacca in 1986. Among other factors the major forces behind the drop in total harvested area were the spread of spear rot disease, the rebel insurgence, and the shortage of foreign exchange needed for the purchase of equipment and spare parts.

FIGURE II.2
OIL PALM: TOTAL CULTIVATED AND HARVESTED AREA
1975-91



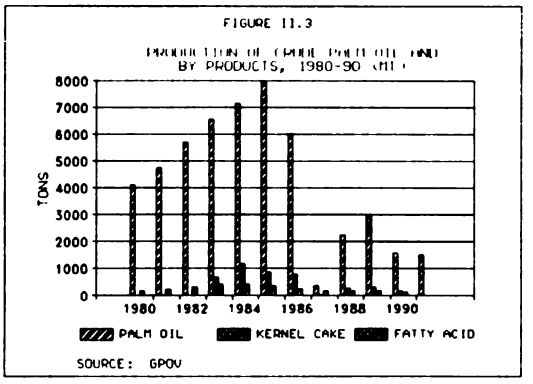




Productivity has likewise declined in recent years. When the first plantation was established, yields of 20 mt. of FFB were anticipated. However, soil variability, original selection of planting material and labor shortages constrained attainment of the anticipated yield. After the first year of transplanting, yields ranged between 1.0 and 2.4 mt/ha at Victoria, 0.2 and 2.7 mt at Phedra, and 0.5 and 1.3 mt at Patamacca. On the smallholder farms and at Phedra, yields were closer to 10 mt/ha in the fourth year of production. Both Victoria and Phedra plantations achieved the average maximum yield after the seventh year, ranging between 13.0 and 18.7 mt, and 12.2 and 19.1 mt respectively. It is thought that productivity increases were just beginning to be realized at Victoria and Phedra due to tree maturity, but this was set back by the insurgence and the spear rot disease. Yields at Patamacca were expected to be even higher than those in the Brokopondo area, projected to range between 18 or 20 mt/ha.

Given the behavior of both total harvested area and palm oil yields, fruit production grew steadily until 1985 when it peaked at 38,237 mt of FFB; after that, it declined dramatically. In 1991, total output was about 7,000 mt. only one-fifth of the level achieved six years earlier.

The trend in fruit processing and in the production of crude oil, kernel cake and fatty acids followed that of FFB output. Between 1980 and 1985, crude oil production almost doubled from 4,090 mt to nearly 8,000 mt. (**Figure II.3**). Crude oil production was highest during this period, averaging almost 6,000 mt per year, while the output of kernel cake peaked at 1,180 mt in 1984. Subsequently, output of palm oil declined to less than 2,000 mt, while production levels of kernel cake and fatty acids in 1991 were about 25% of those in 1984. The processing efficiency of FFB and palm kernels was fairly stable over the period, retaining an extraction rate of about 20.5% and 32%, respectively, but the extraction rate at the refinery level, for both crude palm and kernel oil declined by more than 50% in recent years.

With the exception of some crude oil, fatty acids and palm kernel exported in previous years, all the crude oil is refined for sale on the domestic market and the by-products are used by local industry. In recent years, a larger




proportion of the oil sold domestically has been of the mixed variety, a blend of refined palm oil and kernel oil. Kernel cake is sold as livestock feed while shortening (sterine) and fatty acids are sold to local soap manufacturers.

The domestic market for edible palm oil is estimated to be 6 million liters/year. However, current output of edible palm oil can only satisfy one-sixth of domestic needs. With the decline in oil production and the smuggling to neighbor countries, a large proportion of domestic market needs is being met by imports of other edible oils, financed in part by Dutch government aid and through a PL 480 program with the U.S. since 1987.

In view of lower local production and increased domestic refining levels of crude oil, Suriname has not exported palm oil in recent years. Exports peaked in 1985, with most going to Holland. Sales generally consisted of barter deals at world market prices, which are lower than production costs in Suriname.

The European market is Suriname's main export market for palm oil and it is a very competitive one. Malaysia supplies more than one-half of total exports to this market, at production costs far below those of Suriname.

### 2.3.2 Public Policy

Development of the oil palm subsector has been one of the main components of the diversification and import-substitution strategy of the GOS for the agricultural sector. The government has become involved in the production of oil palm and its derivatives through GPOV, and has intervened in the industry through three mechanisms: transfers and subsidies, price policy and research support.

The financial and economic viability of oil palm production and processing have been severely undercut by: (i) a decline of more than 90% in fruit delivered to the factory between 1985 and 1991; (ii) underutilization of plant capacity, estimated at about 75% in 1992; (iii) increased production costs due to high inflation and currency overvaluation; (iv) unremunerative output prices; and (v) the growing debt burden of GPOV. These factors together have reduced production efficiency, making it necessary for the state to provide large financial transfers and subsidies to continue operations. In 1987, more than SF 6 million were given as subsidies, of which about 46% were provided to Victoria and 44% to the Patamacca plantation (**Table II.2**). The level of subsidies fell between 1988 and 1990, mainly because of rebel activities, but it rose to more than SF 8 million in 1991, with a substantial increase in the amount of subsidies for processing.

Victoria Agriculture Ltd. has also been dependent on substantial transfers from the government and borrowed capital. By late 1987, the company owed more than SF 14 million (capital and interest), of which more that 60% was to the GOS and about one-third to commercial banks (**Table II.2**). The debt of VAL continued to be high during 1988-91, and would have been higher if SF 5.4

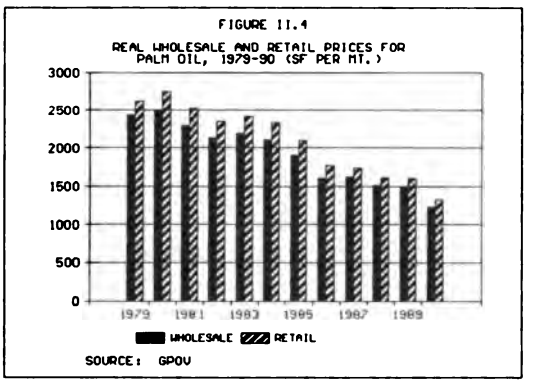
TABLE II.2
SUBSIDIES TO OIL PALM PRODUCTION, AND TOTAL DEBT OWED BY VICTORIA AGRICULTURE, 1987-91 (SF,000)

| | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| SUBSIDIES: | | | | | |
| VICTORIA: | 2,873.8 | - | - | 0.7 | 4,733.0 |
| CULTIVATION | 2,873.0 | - | - | 0.3 | 2,191.0 |
| PROCESSING | 0.8 | - | - | 0.4 | 2,542.0 |
| PHEDRA | 689.0 | 607.0 | 850.0 | | |
| PATAMACCA | 2,745.0 | 1,375.0 | 707.2 | 1,756.4 | 3,317.8 |
| TOTAL | 6,308.8 | 2,982.0 | 1,557.2 | 1,757.1 | 8,050.5 |
| DEBT OF VICTORIA: | | | | | |
| GOVERNMENT OF SURINAME | 8,203.0 | 4,307.0 | 5,050.0 | 7,883.0 | 7,902.0 |
| COMMERCIAL BANKS | 3,096.0 | 3,304.0 | 2,974.0 | 6,158.0 | 3,525.0 |
| OTHER CREDITORS | 742.0 | 1,071.0 | 1,201.0 | 2,367.0 | 1,328.0 |
| SUB-TOTAL | 12,041.0 | 8,682.0 | 9,225.0 | 16,408.0 | 12,755.0 |
| INTEREST: | | | | | |
| GOVERNMENT OF SURINAME | 2,212.0 | 569.0 | 753.0 | 957.0 | 1,176.0 |
| COMMERCIAL BANKS | 378.0 | 563.0 | 800.0 | 1,090.0 | 1,358.0 |
| TOTAL DEBT | 14,631.0 | 9,814.0 | 10,778.0 | 18,455.0 | 15,289.0 |

SOURCE: GPOV

million owed to the GOS had not been converted to equity in 1987.

As for many basic food products in Suriname, the GOS fixes the domestic wholesale and retail prices of palm oil based largely on production costs. Between 1979 and 1990, real wholesale and retail prices of edible palm oil declined consistently, while real production costs are estimated to have increased by more that 35% (**Figure II.4**).




In addition to the above aspects, the government has intervened in the sector providing support for research in oil palm. In 1983, Victoria started a research program on spear rot in coordination with the research unit of the national university and the LVV oil palm research unit. However, many critical problems in the sector have not been resolved; consequently, the research program has progressed slowly due to a lack of adequate funding and technical personnel.

## 2.4 Constraints

The spear rot problem constitutes the major threat to the oil palm sector in Suriname. The causal agent of spear rot is still unknown and control measures are still at an experimental stage worldwide. This serious disease was first discovered in Suriname at Victoria in 1979. It starts with a chlorosis on the lower leaflets of the youngest leaves until it reaches the older ones. As it progresses, all the spear leaves break halfway or near their base and hang down from the palm. The rotting of tissue proceeds to the base of petisles, causing newly formed spear leaves to rot before

they can emerge. This affects fruit production and the plants may die after some time. Some experiments with hybrids from African and American palms have shown signs of spear rot resistance so far, but their yields are low[12].

The economic viability of oil palm production and processing is also limited by other factors including: labor shortage, pricing, markets, the debt situation of GPOV and the general economic climate. Cultivation and harvesting are labor-intensive operations that require a constant supply of workers. Since production activities are located far away from urban centers and large communities, the plantations have had to provide housing and other amenities to retain a large labor pool. In the past, migrants, particularly from Guyana, represented a ready source of labor. However, the labor situation has changed in Suriname in recent years and with Guyana's economy on the recovery path, shortages have begun to occur as other sectors compete for workers.

The pricing policy and the market strategy for palm oil are inadequate for developing the sector. The domestic market price is heavily subsidized to benefit consumers, and price controls have been a disincentive to production. Consequently, the cost to the government in providing subsidies and other types of financial support has been high. In addition, domestic market needs have not been carefully evaluated in production planning, and the market could become easily saturated if Phedra and Patamacca expand production to full capacity.

The debt situation and the lack of investment capital are also critical constraints to Victoria's operations. With regard to the economic situation, the distortions induced by macroeconomic and other policies have indirectly affected the sector's efficiency and resource allocation.

[12] Less than 3 tons of crude oil/ha.

## III. EVALUATION AND CHOICE OF INVESTMENT ALTERNATIVES

### 3.1 Annual Crops

Some trials with alternative annual crops had been done before on the Victoria plantation, but the results were generally discouraging. More recently, these efforts included the cultivation of 2 ha of peanut and 4 ha of pumpkin and tannia. The pilot venture with peanut failed due to low yields and poor drying facilities. With regard to pumpkin, productivity was very low and the plants suffered from nutritional deficiencies, partly because the fertilizer was applied too late. In addition to these factors the poor results of these efforts can be explained in part, by the lack of adequate planning, execution (from a technical standpoint) and follow-up on the experiments.

#### 3.1.1 Selection Criteria

Several criteria were used for selecting possible alternative crops for Victoria. They are grouped into four categories as follows:

(a) **Agroecological considerations**: soils, (soil texture, structure, fertility, slope, altitude, latitude and drainage); climate (rainfall, temperature, humidity, hours of sunshine) and availability of water for irrigation.

(b) **Biological considerations**: crop species and cultivars, pests, Diseases, weeds and soil microorganisms.

(c) **Technological considerations**: possibilities for mechanization, enterprise compatibility, skill requirements, product integration and processing requirements.

(d) **Economic factors**: existing infrastructure, labor needs, foreign exchange requirements for investment, local and export market opportunities for the products, costs and profitability of the enterprise.

In addition to the above aspects, consideration was given to the type of activities carried out by the GPOV, and the extent to which alternative crops could be easily assimilated into the production system. Since the company's principal mandate is to produce and distribute fats and oils, alternative enterprises consistent with this were considered to be important. Besides the technical and economic feasibility of such enterprises, the capability of GPOV to deal with the various challenges associated with new production ventures was also considered to be critical.

A two-step process was used to select the most suitable annual crops. The first examined the technical feasibility for cultivation, based on agroecological conditions at Victoria. In this step, a number of crops were preselected and each crop was given a rank value[13]. Those ranking highest were selected and then evaluated in the second step, in which several technological and economic factors were considered. The results of this selection procedure is presented next[14].

**Agroecological factors**: Nine crops (maize, sorghum, cowpea, soybean, peanut, pumpkin, melon, tannia and other vegetables) were pre-selected for their adaptability to agroecological conditions. Each crop was given a rank value for each agroecological criterion. A value of 3 is indicative that the crop is very suitable, and a value of 1 as being very unsuitable. Crops with a higher nitrogen-fixing capacity were rated higher, because of existing soil conditions and the high cost of imported fertilizer. The summary ranking indicates that cowpea, soybean, peanut, pumpkin and tannia are the most suitable crops, with peanut ranking the highest (**Table III.1**).

**Biological factors**: The main biological factors considered were pests, weeds and diseases. In the absence of adequate information, no detailed evaluation on pests was done. However, it was assumed that the pest-disease complex will approximate that which exists in areas with similar agroecological conditions, and that appropriate pest and disease management techniques would have to be employed. Weeds are anticipated as a major problem for all crops; therefore, minimum tillage and other weed management techniques are recommended. In addition, the important symbiotic relationship between Rhizobium module-forming bacteria and leguminous plants gives cowpea, peanut and soybean a higher rank. These crops can fix over 50% of their nitrogen requirements, resulting in significant savings in both production costs and foreign exchange.

**Technological factors**: Considerations were given to the possibilities for crop mechanization, the level and quality of labor needs, the compatibility of crops with oil palm activities and the extent to which the outputs can be processed.

[13] Annex 2 defines the criteria used to define the rank value.

[14] For supporting information on the results see Annex 2.

TABLE III.1
AGROECOLOGICAL FACTORS CONSIDERED FOR SELECTION OF ANNUAL CROPS

| | FERTILITY | DRAINAGE | TEMP. | RAINFALL | HUMIDITY | SOIL TEXTURE | LATITUD | ALTITUDE | ALTITUDE | AGGREGATE RANKING |
|---|---|---|---|---|---|---|---|---|---|---|
| PEANUT | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 22 |
| COWPEA | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | 21 |
| SOYBEAN | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 20 |
| PUMPKIN | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 20 |
| TAYER | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 19 |
| MELON | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 | 3 | 18 |
| SORGHUM | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 3 | 3 | 18 |
| MAIZE | 1 | 2 | 2 | 3 | 1 | 1 | 1 | 3 | 2 | 14 |
| OTHER VEG | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 13 |

NOTES:

(1) KEY: 3 - CROP WILL ADAPT WELL TO EXISTING CONDITIONS
2 - MODERATE ADAPTABILITY
1 - NOT WELL SUITED

(2) ONLY UPPER TERRACE SOILS (MAPPING SYMBOL 4.1 AND 4.2) AND SOME MIDDLE TERRACE SOILS (MAPPING SYMBOL 3.1) RECOMMENDED FOR USE.

(3) TEMPERATURE, RAINFALL AND HUMIDITY - SEASONAL VARIATIONS OF THESE MAY FAVOR PRODUCTION IN ONE SEASON ONLY.

(4) FERTILITY - CROPS WITH N FIXING CAPACITY WERE RATED HIGHER BECAUSE OF THE SOIL CONDITIONS AND THEIR CONTRIBUTION TO LOWER FERTILIZER COST.

**Economic criteria**: Economic criteria, along with technological factors, were assessed in the second step of the selection process. Eight factors were considered for evaluating the nine preselected crops. Each crop was given a rank value for each factor, ranging from 5 (very favorable) to 1 (very poor). The economic factors are:

- **Foreign exchange requirement**: the foreign exchange needed for the particular crop, either for initial investment or for ongoing operations. This includes imports of machinery and equipment, fertilizers, biocides etc. A high rank value indicates a lower foreign exchange requirement.

- **Enterprise capability**: the ease with which a new crop or enterprise can utilize existing infrastructure, plant and other facilities. A high value indicates the new crop could readily employ existing assets.

- **Available skills**: special skills that would be required for certain new enterprises, e.g., row crop mechanization. A high rating implies the crop does not require such skills.

- **Labor needs**: the amount of labor required for a crop. Labor shortage problems in the area makes it advantageous to introduce an enterprise requiring a low labor input. A higher rating implies a lower labor requirement.

- **Mechanization**: the extent to which mechanization is possible given the

labor constraint. A high value indicates the crop could be mechanized easily.

- **Market potential**: this is based on sustainable local and/or export markets. A high value implies there is high market potential for the product.

- **Processing**: this factor indicates the extent to which a product can be processed in order to increase its value added. A high value indicates that the product has very good processing potential.

- **Cash flow**: This indicates the stream of positive cash flow or early returns on investment. A high value indicates that the particular crop provides an early positive return.

### 3.1.2 Selected Crops

Taking into account the agroecological and biological situation at Victoria, tannia, soybean, peanut and pumpkin showed the best potential among the preselected crops. However, when these four annual crops were rated according to the technological and economic factors, soybean and peanut stand out as the best alternatives, based on their summary ranking (**Table III.2**). Both melon and tannia have a good rating with regard to foreign exchange, level of skills required and early returns on investment. Moreover, tannia has good local and export market potential because of its use in the national diet and the existence of ethnic markets in Europe[15].

[15] GPOV has indicated an interest in cultivating Pomtayer. It could be cropped on middle terrace soils and soils of medium texture; wet, poorly drained soils should be avoided, however, because of the danger of root rot. Further research on its production potential, technical and economic feasibility is needed.

However, labor demands are high at planting and harvesting, and the scale and scope of the export market for these products must be further researched.

Given the above, and the experiences of neighboring countries (Guyana, Venezuela and Brazil) with similar agroecological conditions, it is recommended that the two oilseed crops, **soybean and peanut,** be introduced into the production system at Victoria. In addition to the foregoing selection criteria, this recommendation is based on the following considerations:

- These crops fit in well with the GPOV's operations in fats and oils, since they can easily complement palm oil as an additional source of edible oil. It is assumed that minor modifications of the existing plant at Victoria will be needed to equip it to process soybean and peanut.

- Soybean and peanut are good import substitutes. Suriname imports all its soybean and soybean derivatives, as well as about 50% of the total amount of peanuts consumed. Soymeal is the major ingredient in monogastric livestock feeds, which could be obtained from processing the soybean. Soybean could also be used as a supplementary input for other ruminant/livestock activities.

- These crops could easily complement livestock activities in rotation with natural pastures and with established Brachiaria pastures to enhance soil fertility and productivity.

- The two crops could yield a higher return on capital investment within a short period, because of their

TABLE III.2
TECHNICAL AND ECONOMIC FACTORS CONSIDERED FOR SELECTION OF ANNUAL CROPS

| | FOREIGN EXCHANGE REQUIREMENT | ENTERPRISE COMPATABILITY | AVAILABLE SKILLS | LABOUR NEEDS | MECHANIZATION POSSIBILITY | MARKET POTENTIAL | PROCESSING | CASH FLOW BASIS | SUMMARY RANKING |
|---|---|---|---|---|---|---|---|---|---|
| SOYABEAN | 2 | 5 | 2 | 4 | 5 | 5 | 5 | 2 | 30 |
| PEANUT | 1 | 4 | 3 | 3 | 4 | 5 | 4 | 2 | 26 |
| MELON | 4 | 2 | 4 | 2 | 2 | 2 | 1 | 3 | 20 |
| COWPEA | 2 | 1 | 2 | 4 | 5 | 2 | 1 | 2 | 19 |
| PUMPKIN | 2 | 2 | 4 | 2 | 2 | 3 | 1 | 3 | 19 |
| TAYER | 4 | 2 | 4 | 2 | 1 | 3 | 1 | 3 | 19 |

NOTES:
(1) KEY: 5 - VERY FAVORABLY RATED. 1 - VERY POORLY RATED
(2) CANDIDATE CROPS: THE CROPS IN THIS TABLE ARE CONSIDERED THE BEST CANDIDATES BASED ON THEIR AGROECOLOGICAL SUITABILITY.

short cropping cycle (3 to 4 months) and the possibility of harvesting 2 crops per year.

- Pre-production costs would be low, since no major land clearing or development works would be necessary.

- Both crops can be easily mechanized, which is compatible with the need to keep labor use as low as possible.

In addition, these crops have ample scope for further development in Suriname. Some basic information is already available on both from prior research, and they have been grown on a commercial scale at various times. In the case of peanut, there is a tradition of small-scale production in Suriname; in 1987, Smolders estimated that local peanut production stood at about 300 tons/year[16].

Soybean has been cultivated less extensively than peanut, but over a longer period of time, primarily by Indonesian immigrants. According to Noordam (1988), the possibility exists for it to be cropped on a large scale on the loamy soils of the interior, based on previous field trials[17]. Furthermore, a National Soybean Working Group is already in place, with linkages to the Brazilian Enterprise for Agriculture Research (EMBRAPA) and other international agencies involved in soybean research.

Nonetheless, some factors could militate against the success of these crops at Victoria, including:

- Lack of experience with their cultivation and row cropping.

- High foreign exchange needs for investment in specialized farm equipment and importation of chemicals.

- Relatively high requirements of field technology and management capabilities.

[16] Smolders, J.W.J: The Effect of Mechanical Shelling Storage Time and Fungicide Treatment on Seed Quality of Groundnuts (A.hypogaea), De Suriname Landbouw. Vol. 35, no. 1, 2 & 3, 1987.

[17] Noordam, D.: A Greenhouse Study on the Effect of Liming and Phosphorus Fertilization on the Yield of Soyabean. De Suriname Landbouw, Vol. 36, No. 4., 1988.

## 3.2 Fruit Crops

Two major attempts had been made earlier to grow fruit crops at Victoria. In the early 1970s, the HVA collaborated with other national and international agencies to establish the first fruit cultivation plot (see **Annex 3**). The second effort was made in the late 1980s, to cultivate passion fruit and pineapple on 30 ha in the northern part of the plantation, where a large area had been abandoned due to the spear rot disease and high cleaning and maintenance costs. Both attempts were unsuccessful. It is felt that the experience gained from the first trial, particularly that pertaining to cultivation and production, was not utilized in the second set of trials.

### 3.2.1 Selection Criteria

In considering fruit crops for Victoria, the following four criteria were used to select potential alternatives:

**Agroecological factors**: These include crop adaptability to the soil texture, structure and fertility, pH and drainage, as well as to temperature, humidity and rainfall conditions.

**Know-how**: This refers to expertise and accumulated experience based mainly on in-situ experiments. Included in this category are factors such as ease of propagation, accessibility of planting material, as well as production, harvesting and post-harvest treatment and practices.

**Market potential**: This includes market demand, price, competition, the "marketing edge", as well as the possibility of meeting the demand for fresh or processed products on the domestic and/or external markets.

Based on the agroecological conditions, 13 fruit crops were pre-selected as having good potential because of their adaptability. These include brazil nuts, cocoa, carambola, grapefruit, guava, Tahiti lime, papaya, passion fruit, peach palm, pineapple, rambuttan, soursop, and West Indian cherry (**Table III.3**). Other fruit crops such as Curacao-apple (Syzigium samarangense), pomerac (Syzigium malaccense) and mangosteen (Garcinia mangostana), which are also suited to the ecological conditions at Victoria, were not considered because of their limited commercial potential, problems in obtaining planting material, long gestation periods and other factors that may limit cultivation on a commercial scale.

### 3.2.2 Fruit Crops Selected

The 13 pre-selected fruit crops were evaluated using several agronomic and commercial criteria. The procedure to select the crops was similar to that used for the selection of annual crops. Each crop was given a rank value for each factor considered, based on the suitability of the particular factor for cultivation of the crop. Analysis of the 13 crops showed that there are serious agronomic and/or economic constraints for cultivation of fruit crops on a commercial scale. Based on agronomic criteria only, peach palm (Guilielma gasipaes), West Indian cherry, guava and pineapple are the most suitable crops. However, when cultural practices and economic criteria are used to evaluate all the pre-selected crops, papaya (processed) ranks the highest, followed by processed rambutan and West Indian cherry (**Table III.4**).

Given the constraints on large-scale cultivation of most of the pre-selected crops, peach palm and passion fruit are considered the best fruit crop alternatives for Victoria. Because of the appearance of spear rot on the Phedra and Patamacca plantations, and the possibility that alternatives may have to be

TABLE III.3
AGRONOMIC CRITERIA CONSIDERED FOR SELECTION OF FRUIT CROPS

| SPECIES | CLIMATE (*) | PH | SOILS DRAINAGE | PEST | DISEASE | MECHANIZ. CULT. PRACT. BEFORE HARVEST | LABOUR REQUIRE-MENT | BEARING PRECOCITY | | EASE FOR PROPAGATION | PROPAGATION TECHNIQUE | SUMMARY RANKING |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | START | COMMERCIA-LIZATION | OBTAINING PLANTING MATERIALS | | |
| BRAZIL NUTS | 4 | 3 | 4 | 4 | 3 | 3 | 4 | 0 | 0 | 3 | 2 | 30 |
| CACAO | 4 | 3 | 4 | 3 | 2 | 1 | 3 | 2 | 1 | 4 | 3 | 30 |
| CARAMBOLA | 4 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 31 |
| GRAPEFRUIT | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 4 | 30 |
| GUAVA | 4 | 3 | 4 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 33 |
| LIME (TAHHITI) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 4 | 33 |
| PAPAYA | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 4 | 31 |
| PASSION FRUIT | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 4 | 32 |
| PEACH PALM | 4 | 3 | 4 | 4 | 4 | 1 | 4 | 3 | 2 | 3 | 4 | 36 |
| PINEAPPLE | 4 | 3 | 4 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 4 | 34 |
| RAMBUTAN | 4 | 3 | 4 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 31 |
| SOURSOP | 4 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 4 | 3 | 32 |
| W.I.CHERRY | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 35 |

NOTES:

(1) KEY: 1 - POOR, MARGINAL OR UNSUITABLE
2 - SUITABLE WITH IMPROVEMENT NEEDED
3 - GOOD
4. CRITERIA IS IDEAL, VERY GOOD OR EASY

(2) KEYS FOR PESTS AND DISEASE ARE:
1 - ENDEMIC.
2 - OCCASIONAL
3 - NOT SIGNIFICANT
4 - NOT EXISTING

(3) CLIMATE REFERS TO TEMPERATURE, RAINFALL AND RELATIVE HUMIDITY
(4) A HIGH VALUE FOR LABOR SUGGESTS THAT THIS INPUT REQUIREMENT IS LOW.
(5) THE VALUES FOR BEARING PRECOCITY REFERS TO YEARS.

TABLE III.4
CULTURAL AND ECONOMIC CRITERIA CONSIDERED FOR SELECTION OF FRUIT CROPS

| CROPS | | MECHANIZ. OF HARVEST | HANDLING OF FRUIT | SHELF LIFE | MARKET SITUATION | | | | COMPETITIVE EDGE | | SUMMARY RANKING | TRANSPORTATION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | DOMESTIC DEMAND | EXPORT DEMAND | COMPETITION | | | | | |
| | | | | | | | INTERNAL | EXPORT | INTERNAL | EXPORT | | |
| BRAZIL NUTS | F | 1 | 4 | 4 | 2 | 3 | 3 | 1 | 3 | 3 | 24 | 4(A) |
| | P | 1 | 4 | 4 | 2 | 3 | 2 | 1 | 3 | 3 | 23 | 4(S) |
| CARAMBOLA | F | 1 | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 3 | 21 | 2(A) |
| | P | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 24 | 4(S) |
| CACAO | P | 1 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 18 | 4(S) |
| GRAPEFRUIT | F | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 20 | 3(S) |
| | P | 2 | 4 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 22 | 4(S) |
| GUAVA | F | 1 | 3 | 2 | 2 | 2 | 3 | 4 | 3 | 1 | 21 | 3(S) |
| | P | 2 | 3 | 2 | 3 | 2 | 4 | 2 | 3 | 1 | 22 | 3(S) |
| LIME TAHITI | F | 1 | 3 | 3 | 1 | 1 | 4 | 2 | 1 | 1 | 17 | 2(A) |
| PAPAYA | F | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 20 | 1(A) |
| | P | 1 | 3 | 3 | 3 | 2 | 4 | 3 | 4 | 3 | 26 | 3(S) |
| PASSION FRUIT | F | 1 | 3 | 2 | 4 | 2 | 3 | 2 | 1 | 1 | 19 | 2(A) |
| | P | 1 | 4 | 3 | 4 | 2 | 3 | 2 | 3 | 2 | 24 | 3(S) |
| PEACH PALM | P | 1 | 3 | 2 | 1 | 2 | 4 | 3 | 4 | 4 | 24 | 3(S) |
| PINEAPPLE | F | 1 | 3 | 3 | 4 | 2 | 2 | 1 | 2 | 1 | 19 | 2(AS) |
| | P | 3 | 4 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 21 | 3(S) |
| RAMBUTAN | F | 1 | 2 | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 25 | 2(A) |
| | P | 1 | 3 | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 26 | 3(S) |
| SOURSOP | F | 1 | 3 | 2 | 2 | 1 | 3 | 4 | 3 | 2 | 21 | 1(A) |
| | P | 1 | 3 | 3 | 3 | 2 | 3 | 4 | 3 | 3 | 25 | 3(S) |
| W.I.CHERRY | P | 2 | 2 | 1 | 4 | 3 | 3 | 4 | 3 | 4 | 26 | 3(S) |

NOTES:

(1) KEY: 1 - HIGH
2 - VERY HIGH
3 - LOW
4 - VERY LOW

(2) F - FRESH. P - PROCESSED.

considered for them too, it is also recommended that trials with other fruit crops be made on these farms to accumulate the necessary experience and evaluate their economic viability.

The recommendation to cultivate peach palm and passion fruit is supported by the selection criteria considered above, and some additional factors outlined below.

**Peach Palm**:

(i) Peach palm would adapt well to the environment of Victoria. It can be cultivated on the clay soils on the recent river plain and the lower and middle terraces, even where drainage is insufficient.

(ii) The outputs of the peach palm are fruit and stems (canned "palm heart" or palmito) produced by a processing facility.

(iii) It is a crop that would make good use of the existing infrastructure, such as the internal roads and the current transport modes (mules, tractors/trailers and trucks). Mules could be used to transport the palm stems from the fields to the main roads; there they could be loaded onto trucks or trailers for delivery to the factory.

(iv) Preliminary findings suggest that the production costs of peach palm are significantly lower than of other alternatives. Currently, oil palm trees are still standing and thus limited land preparation is required for cultivation of this crop. A considerable cost saving could be realized as the trunks of the oil palm could remain in place without affecting peach palm cultivation.

(v) Labor demand for maintenance of this crop is low, which means this crop has a significant advantage over most other crops, given the present labor shortage situation at Victoria. As of the second year after planting, the high planting density (4,000 trees/ha) and quick growth of peach palms make enough canopy to form a complete vegetative cover, which reduces weed development and growth. From the third year on, the most important labor-related activity would be harvesting. In addition, no pests and diseases have been found so far that affect the peach palm.

(vi) The peach palm is a perennial crop that produces basal suckers which sequentially replace the harvested mature stem, as in the case of bananas. Therefore, once the crop is established, production is continuous for a period of 15 to 20 years, after which replanting should be done.

(vii) Another advantage of this crop is the relative short period between plant establishment and harvesting. Production begins at the end of the second year after planting and continues to increase up to the fifth year, after which output stabilizes for the next 10 years.

(viii) The cropping system could be considered an agro-forestry operation rather than farming. Its perennial nature allows it to contribute significantly to conservation of the environment.

(ix) The processing of peach palm avoids the problem of perishability. Once canned, the palm has a long

shelf-life and can be easily transported. Furthermore, wastage at the processing plant is minimal because a large part of the uncanned stem can be used as animal feed.

(x) Palmito is a relatively new product on the market. The external market demand has been growing steadily and it exceeds current supply. Demand is estimated at 20,000 mt/year and only a few countries compete in the external market, the most important being Brazil, Costa Rica and Venezuela. Present world production of palmito is based mainly on wild palm species (e.g., Euterpe oleracea). However, production is gradually shifting from the wild palm to the cultivated peach palm, because of increasing harvesting costs and environmental concerns.

(xi) Although prices vary considerably, they mainly depend on the quality of the product (e.g., fibrous vs. non-fibrous) and the producer's marketing ability. A foreign enterprise which currently produces palmito in Guyana for export to the European market has shown much interest in peach palm production in Suriname. This company has indicated its willingness to enter into a joint venture with a local partner to produce palmito for the export market.

**Passion Fruit**:

(i) The Victoria plantation has acquired some experience with passion fruit, as it is being cultivated on a small scale there. Although productivity is fairly low, the potential to increase yields through improved cultivation and management practices is good, especially because the specific causes for previous low yields have been already identified.

(ii) One of the largest components of the production cost for passion fruit is the infrastructure needed for the trellis system. The Victoria farm has already established 13 ha with this infrastructure, of which 4 ha are being planted, 3.5 ha are under production, and 5.5 ha have been taken out of production and need to be replanted.

(iii) The demand for this product and its price on the domestic market is good. Increases in processing capacity and wider acceptability of passion fruit juice on this market are indicators of a steady increase in demand and of the likelihood that this trend will continue in the mid-term.

### 3.3 Livestock Alternatives

Experiments with livestock production on the Victoria plantation have been relatively recent, and they have concentrated on feeding animals with Sara Sara grass (Panicum trichocladum). The practice of cutting and burning infected palm trees and undergrowth to control spear rot gave rise to the appearance of this grass on about 900 ha of the abandoned areas of the plantation. Laboratory tests show that its average dry matter content is 32% with 7% of crude protein, and its nutritional value and potential use are very similar to other tropical grasses as well as those being consumed presently by cattle in Suriname. Its palatability and consumption were tested at Victoria, and it was observed that the grass is consumed by mules, cattle and sheep; nonetheless, information on its

response to animal grazing and the response of animals that consume it is not available. About 40 mules that transport the oil palm fruit are currently managed and fed with this grass, and some trials are being done with 31 head of cattle and a flock of 43 sheep.

### 3.3.1 Potential Livestock Systems

One important factor to consider in a livestock production system is the type and source of feed. Grass is considered the main feed source for ruminant animals, and both cattle and sheep can transform this forage easily into products such as milk and meat. Considering the importance of feed and the availability of natural grass, the following livestock production systems could be considered as potential alternatives.

(a) **Cattle**:

**Cow-calf:** This beef production system has weaned calves as the main output. Live animals such as culled cows, bulls and excess heifers could also be produced for sale. A cow herd is continuously exposed to bulls or is exposed during a controlled breeding season. After the calves are born, they remain with their mothers until the weaning age. Cows and calves are managed under grazing conditions and some animal health care is provided. Salt and minerals are also provided with supplemental feed.

**Dual purpose**: This system produces either milk or meat, depending on the prices of these products. If the price of milk is relatively high, the main output would be milk, with calves and culled bulls and cows being the by-products. On the other hand, if the price of meat is high, a large proportion of the milk output would be consumed by calves to produce a heavy animal at weaning age. Cow herds under this system have a better capability to produce milk than under the cow-calf production system. Pasture is the main source of feed but if milk is the main output, supplementary feed is needed to stimulate production. Other herd management practices in this system are similar to those of the cow-calf system.

**Breeding stock**: This production system produces high quality animals as breeding stock for sale. Animal prices are high because of their quality. The herd can be a pure breed or one of high-grade animals which could be utilized by farmers as starting or replacement stock. A good record system on growth, production and reproduction is the most important requirement of this system. Herd management is also similar to the cow-calf system, and supplementary feeding is required. Skilled personnel and labor are also needed to manage this system.

**Fattening**: The main objective of this system is to produce an animal with an average weight of 400 kilograms (kg) for meat, to be sold either on the local or external market. Animals could be supplied from beef or milk herds, and could be fattened either by grazing or by feedlot operations. Under grazing conditions, animals of 9 to 12 months of age and having about 130 kg of body weight are exposed to high-quality pasture. Minerals, salt and animal health care are provided until the animals reach the desired weight. If agricultural

by-products are available, they can be provided as supplementary feed to increase the daily weight gained and to shorten the fattening period. Under feedlot conditions, animals of 300 kg of body weight are fed in pens with a high-quality ration, in order to add about 100 kg. in a short period of time. Culled cows and bulls could also be fattened to improve the quality of their meat.

**Milk production**: The main outputs of this system are milk and culled calves, with cows and bulls being secondary products. The herd is characterized by pure breed or high-grade milking animals, with the main feed ingredients being high quality forage and supplementary feeds. Animal health practices are required for milking and maintaining the health of the herd. Within the livestock production system, milk production requires more skilled and well-trained personnel for system management and maintenance. Milking is done either by hand or by milking machines twice a day. A good reproduction performance by the herd is needed to ensure consistent calving and milk production.

**(b) Sheep System**

**Ewe-kid fattening**: Of all ruminants, sheep are the most prolific animals for reproduction, and tropical sheep can have three lambings in two years. In this system, kids are produced, fattened and sold for meat. Ewes are exposed to rams during a controlled breeding season. The complete production cycle consists of 5 months gestation after birth, and lambs are weaned at 4 months of age. Ewes mature at 1 year of age, when the female is ready to be bred. A fattened animal having a body weight of 25 kg is considered ready for sale.

The main feeding sources for sheep are grass and legumes. Sheep flocks are managed either under grazing conditions or with zero grazing, where forage is cut and offered in the pens, or under a combination of both. Minerals (calcium and phosphorous) and salt should be supplied **ad libitum** to the flock. By-products should be offered to pregnant and lactating ewes, and those animals being fattened. Internal and external parasites are the main problems of the sheep production system, and these need to be carefully monitored and controlled.

The following constraints and limiting factors could affect the aforementioned production systems:

- High dependance on imported feed and other inputs.
- Shortage of locally available feed inputs.
- Scant use of available technology for pasture production and management, as pastures are the main feeding source for ruminants.
- Local supply of high-grade animals for milk, beef and sheep production is poor and prices of imported animals are high.

- Prices for livestock products and by-products are determined by the government. Farmer's production is based on inputs purchased on the black market, while outputs have to be sold at state-regulated prices.

- Inadequate support services for technology generation and transfer.

- The local market for livestock products is small and information on the export market is limited.

- Existing slaughterhouse and meat processing facilities do not meet export market standards.

### 3.3.2 Selection Criteria

Several factors were used to evaluate the livestock production systems considered to be most appropriate for Victoria. These are classified in four categories as follows:

**Ruminant vs. non-ruminant**: Cattle and sheep were selected because they are ruminants which gives them the ability to transform forage easily into products such as milk and meat. Victoria already produces natural forage, having approximately 900 ha of grass on sandy soils. Non-ruminant animals (poultry and pigs) were not considered because they can not consume forage, and their production depends on high-quality imported feed and by-products.

**Ecological factors**: Soil type, rain and temperature were considered as critical factors because they may affect grass production and animal performance. Animals imported from a temperate zone into a tropical zone could be affected by temperature, humidity and rainfall. Soil conditions are also a very important factor for grass production and as a source of minerals for the animals.

**Resource availability**: The resources considered were: land for pasture production, by-products to be used as supplementary feed (produced either in the country, by the oil palm company or imported); the source of animals and labor requirements.

**Economic factors**: The main economic factor considered was the market potential (local and external) for the outputs. Beef has a very low local demand but a potential export market exists in French and Dutch colonies in the Caribbean. However, there is a high local demand for both mutton and milk.

### 3.3.3 Production Systems Selected

Five cattle and one sheep production systems were considered as livestock alternatives for Victoria. These systems were evaluated against the various criteria discussed above, and the selection process used was the same as for annual and fruit crops. Result indicate that cattle fattening ranks as the best production system, followed by sheep fattening and the cow-calf production system (**Table III.5**). On that basis, the following two livestock production systems are recommended:

(i) A system to fatten cattle, produce milk and raise breeding stock. Four models are considered in this system, as follows:

- Model I for fattening cattle, with two sub-models,

TABLE III.5
FACTORS CONSIDERED FOR SELECTION OF POTENTIAL LIVESTOCK PRODUCTION SYSTEMS FOR VICTORIA

| FACTORS | ECOLOGICAL | | | | | | RESOURCE AVAILABILITY | | | | ECONOMIC | | AGGREGATE RANKING |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOIL | | TEMPERATURE | | RAIN | | | | | | DEMAND | | |
| | ANIMALS | GRASS | ANIMAL | GRASS | ANIMAL | GRASS | LAND | LOCAL BY-PRODUCTS | LOCAL SOURCE OF ANIMALS | LABOR NEEDS | LOCAL | EXTERNAL | |
| SYSTEMS: | | | | | | | | | | | | | |
| 1. CATTLE | | | | | | | | | | | | | |
| COW-CALF | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 34 |
| DUAL PURPOSE | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 1 | 31 |
| BREEDING STOCK | 3 | 2 | 1 | 3 | 1 | 3 | 3 | 3 | 2 | 1 | 3 | 1 | 26 |
| MILK PROD. | 1 | 3 | 1 | 3 | 1 | 3 | 3 | 2 | 1 | 1 | 3 | 1 | 23 |
| FATTENING | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 35 |
| 2. SHEEP | | | | | | | | | | | | | |
| EWE KID FATTENING | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 34 |

NOTES: (1) KEY: 1 - UNFAVORABLE; 2 - FAVORABLE; 3 - VERY FAVORABLE.
(2) A HIGH VALUE FOR LAND, LOCAL BY-PRODUCTS AND ANIMAL SOURCE INDICATES THAT THEY ARE ADEQUATELY AVAILABLE.
(3) LABOR NEEDS - A VALUE INDICATES LOW SKILL REQUIREMENT FOR THIS ACTIVITY.
(4) A HIGH VALUE FOR DEMAND INDICATES A HIGH MARKET DEMAND.

Alternative "A" and Alternative "B".

- Model II for dairy breeding stock and milk production, with two sub-models, also Alternative "A" and Alternative "B".

(ii) A sheep production system for ewe-kid fattening (Model III).

The production systems recommended are based largely on the suitability of the agroecological conditions and economic factors. Justification for these systems can be summarized as follows:

- Ruminant production (cattle and sheep) is based on forage with a low supplementary feed requirement. Victoria already has a large area under natural grass (Sara Sara), which can be used as a good, low-cost feed source.
- Cattle and sheep are the livestock animals that can most efficiently utilize existing forage resources available at Victoria.
- Ecological conditions favor grass production with little use of fertilizer to improve soil fertility.
- The livestock production system can be integrated with the palm oil production system. Kernel cake, a by-product of processed palm oil, can be a good feed supplement for ruminants.
- There is an adequate supply of animals from local sources to establish the production systems, particularly for animal fattening.
- Except for milk production, the systems recommended require a low level of skilled labor.

- There is a potential external market for beef, if Suriname can meet export standards. Assuming that this occurs, the beef production system would bring in additional foreign exchange earnings.

- The milk production system would contribute to reducing milk imports. Current domestic milk demand exceeds supply from local sources. Suriname is about 9 million liters of milk short per year, which is supplied largely by imports of powdered milk and milk by-products.

- There is a high local demand for mutton.

## 3.4 Costs and Returns [18]

### 3.4.1 Annual Crops

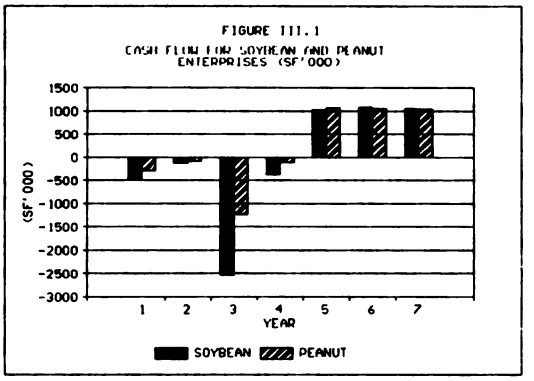
The estimated costs of production, returns and cash flow for producing soybean and peanut are presented in **Annex 4.** Costs have been computed for both the research and development (R & D) and the commercial phases. Total costs for the R & D phase are estimated at SF 0.91 million, of which SF 0.79 million are for year 1 and SF 0.22 million for year 2 respectively. About 75% of the total cost in this phase is to purchase machinery, equipment and miscellaneous tools. The R & D costs for soybean and peanut are SF 0.62 million and SF 0.39 million, respectively. It is assumed that there will be no output sale during this phase.

[18] The cost of imported inputs for all crops and livestock alternatives were computed based on a foreign exchange rate of US$ 1.00 = SF 20.00.

Total equipment cost for 5 years is estimated at SF 5.06 million, of which about 67% is incurred during the first year of operation. Most investment inputs can be used in both the soybean and peanut enterprises, except for the soybean combine (for soybean only), and the peanut digger and peanut combine (for peanut only). With the exception of the specialized machinery, equipment utilization in each crop is estimated at 54% of the total value for soybean, 32% for peanut and 16% for other cultivation activities.

**Soybean:** Total production cost (variable cost) per hectare is SF 5,887.6, of which non-labor costs account for 96%. Total labor requirement is 4 man days/ha, 60% of which is skilled personnel. It is assumed that the capital equipment for the soybean enterprise depreciates at SF 794/ha per year over a 10-year period, and soybean is valued at SF 5,040/mt, which is the current CIF world spot price. The net return is estimated at SF 878.4/ha, based on an output yield of 1.5 mt/ha. If the yield is 2.0 mt/ha, net returns increase to SF 3,398/ha.

Total returns are SF 0.5 million in year 3, SF 1.44m in year 4, SF 2.82 million in year 5 and SF 2.9 million thereafter. The increase in returns is based on the following assumptions: (i) the cultivated area would increase from 200 hectares after year 4 to 300 hectares per year; and (ii) the average yield would increase from 1.0 million t/ha to 1.5 million t/ha. in the long rainy season and 1.2 million t/ha in the short rainy seasons of year 4, and then to 2.0 million t/ha and 1.5 million t/ha (in year 6), respectively, thereafter. The cash flow remains negative up to year 4, and the cumulative cash balance remains negative throughout project life. **(Figure III.1).**



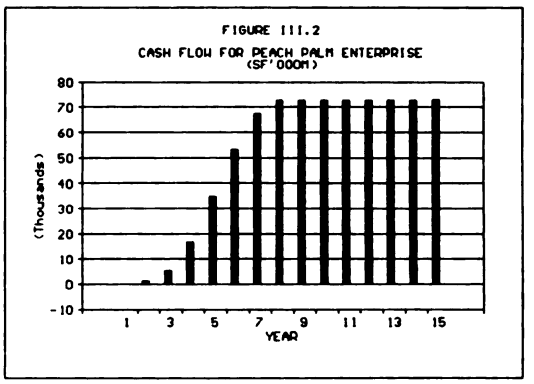

**Peanut:** The production cost for peanut is estimated to be SF 5,429/ha, of which 94% is for material inputs. Both the total labor needs as well as the skill requirements are relatively higher for the peanut enterprise (4.8 md/ha and 65%). Assuming that the capital equipment depreciates at SF 902/ha per year over 10 years, net returns are SF 3,240/ha when productivity is 1.0 mt/ha, and SF 7,920/ha when the yield is 1.5 mt/ha. Gross returns are SF 0.15 million in year 3, SF 0.76 in year 4 and SF 1.9 million from year 5 on. The cash flow is negative for the first 4 years, and decreases in year 7 because of additional investments in equipment. The cumulative balance remains negative until year 5, after which it increases to SF 1.39 million by the end of year 7.

### 3.4.2 Fruit Crops

The estimated costs, returns and cash flow for cultivation of peach palm and passion fruit are shown in **Annex 5.**

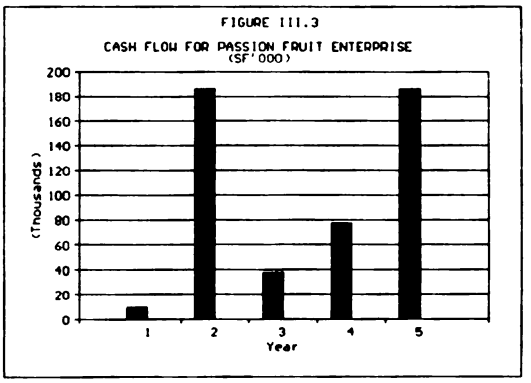
**Peach Palm:** The cost of establishing the peach palm is estimated at SF 29,008 per hectare, of which 78% is for materials and inputs. Maintenance costs are SF 9,849/ha in year 2 and SF 10,080 from year 3 onwards. Based on phasing in the 350 hectares to be cultivated over a four-year period, investment and operating costs are SF 1.5 million in year 1, SF 3.4 million in year 2, SF 4.4 million in year 3, SF 5.4 million in year 4 and SF 3.5 million from year 5 onwards.

Total investment and operating costs are projected for a 15-year period. The cost of establishing the peach palm processing factory ranges between SF 6.0 million and SF 10.0 million. The figure used herein is SF 8.0m or US$400,000. It is assumed that output will begin in year 2, with 1,250 stems produced from the 50 ha established in year 1. It is further assumed that output will increase up to year 4 after cultivation, after which it will stabilize at 12,000 stems per ha, or 4,000 mt/ha, of canned palms. Based on an F.O.B. price of SF 60,000 (or US$3,000/mt of canned palm), the estimated cash flow is negative in the first year and becomes positive from year 2 on **(Figure III.2).**




**Passion Fruit:** The establishment and maintenance costs of passion fruit are estimated to be SF 11,475 and SF 3,726/ha, respectively. The assumption is that 7.5 ha are under cultivation and efforts would be directed to improve current yields in this area. Furthermore, the proposal includes re-establishing this crop on an additional 5.5 ha, which has the necessary infrastructure but was abandoned.

It is assumed that the yield in the first year is 2.0 mt/ha for a newly established plot, and 3.0 mt/ha. for the 7.5 ha currently under cultivation. For already established plots, the yield is expected to increase to 6.0 mt/ha in the second year. Based on a 2.5 year production cycle and an estimated revenue of SF 3.00/kg, total returns are expected to be SF 0.10 million in year 1, SF 0.23m in year 2, SF 0.14m in year 3, then to increase to SF 0.17m in year 4 and SF 0.23m in year 5. The cash flow is positive from year 1 and this accumulates to SF 0.48 million by the end of the fifth year (**Figure III.3**).



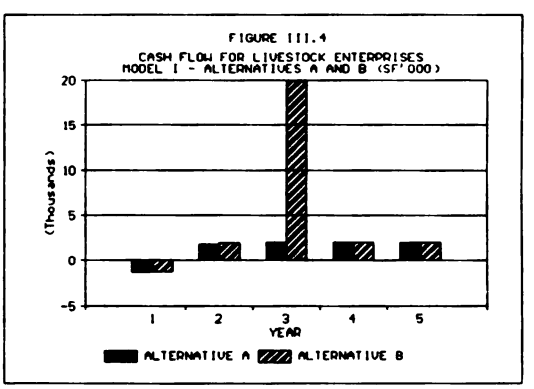

Costs for the experimental plots of the various fruit crops at Phedra and Patamacca were not estimated. It is proposed that these plots be used to test the agronomic and economic feasibility of producing these crops on a commercial scale as possible alternatives to oil palm.

### 3.4.3 Livestock

The estimated costs and returns, including investment and operating costs, output and cash flow for each livestock model, are outlined below and their details are presented in **Annex 6.**

**Model I - Alternative "A":** As indicated before, Alternative "A" is characterized by a low level of technology and a pasture-carrying capacity of 1 AU/ha. Because this model has a short production cycle of 17.6 months, the estimated capital and operating costs are projected for a period of 5 years only. Total investment and operating costs are SF 3.7 million and SF 1.7 million, respectively. Principal investment costs be for purchasing weaned calves, installing fences and establishing pasture facilities in the first year. Capital costs fall to SF 0.8 million in year 2, and thereafter to an average of SF 0.57 million/year. With regard to operating costs, feed inputs and labor are the major cost items. Only 10.5% of total costs are incurred in year 1, with the remainder spread almost evenly over the next 4 years.

Beef is the main output of this model and a total of 52,398 kg of meat would be produced for sale, of which 30% is expected to be sold on the local market and 70% on the export market. Based on meat sold, total revenue for the 5-year period is estimated at SF 11.84 million. The cash flow is positive from year 2 at SF 1.79 million, and increases to an average of SF 2.0m/year thereafter. (**Figure III.4**). The total accumulated cash balance is estimated at SF 6.41 million at the end of the fifth year.




Other benefits can be derived from this operation. If there is an increased

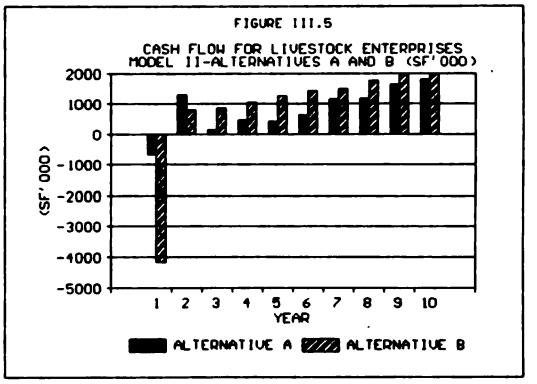
demand for animals to be fattened, beef and dairy farmers could benefit by expanding and improving their own herds. Dairy farmers could also sell weaned animals to be fattened in this system.

**Model I - Alternative "B"**: The parameters used in this model are almost the same as those of Alternative "A". The production cycle is the same and the projected costs and returns are also for five years. Total investment and operating costs are estimated at SF 3.46 million and SF 1.86 million, respectively. However, because of the use of improved technology (to facilitate a pasture carrying capacity of 3.5 AU/ha), the operating cost in year 1 would be twice that of Alternative "A".

This model produces the same amount of meat. A positive cash flow of SF 1.87 million would be realized from Year 2, and this would increase to SF 1.97 million/year thereafter (**Figure III.4**). At the end of year 5, the accumulated cash flow is estimated to be SF 7.52 million, compared to SF 6.41 million in the previous model.

**Model II - Alternative "A"**: The capital and operating costs of this model were estimated for a 10-year period. Total investment cost was estimated at SF 1.89 million for the period, with more than 60% of this amount for purchasing animals and equipment and constructing housing facilities during the first two years of project life. Operating costs total SF 5.45 million, much of which is for the purchase of production inputs, labor and other services.

Both milk and meat are the main products of this model. Output of milk is estimated to be 528 kg/day in year 3 or a total of 192,720 kg/year. This increases to a total of 249,660 kg by year 10. Meat production is expected to be 5,200 kg/year live weight in year 4, and 10,000 kg/year live weight by year 10. It is estimated also that an average of 43 animals/year would be available as of year 4. Revenue will be generated through the sale of milk, meat and animals sold as breeding stock. Income will be generated from year 3 (SF 0.73 million), and reaches a maximum level of SF 2.46 million in year 10 (**Figure III.5**). A negative net cash flow exists up to year 2, and thereafter it is positive up to year 10. However, the accumulated cash balance remains negative up to year 6; a positive total cash balance of SF 5.37 million would be realized by the tenth year.



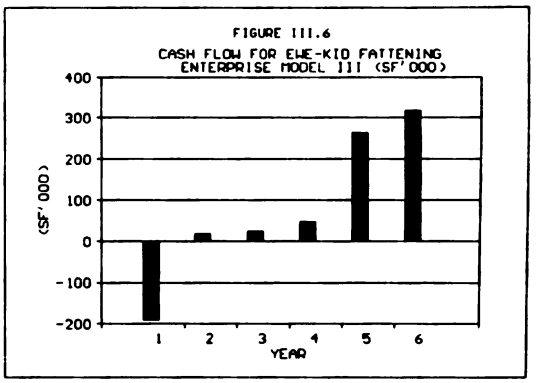

**Model II - Alternative "B"**: A 10-year projection of capital and operating costs was also made for this model. Total investment costs were estimated to be SF 4.75 million, with almost 90% of this being incurred in the first year, mainly for purchasing animals and equipment and for constructing housing facilities. Total operating costs are estimated to be SF 5.95 million; SF 0.38 million is incurred in year 1, increasing to an average value of SF 0.58 for the next three years, and then to an average of SF 0.64 million/year. As in alternative "A" above, production inputs, labor and other services would comprise the main operating costs.

The model's outputs are estimated to be: (i) 686 kg/day of milk, or a total of 144,060 kg in year 1, increasing to 277,400 kg in year 10; (ii) meat production from culled animals for local consumption was estimated at 1,350 kg/year live weight in year 4 and 11,350 kg/year live weight in year 10; and (iii) breeding stock of 43 animals/year as of year 4. In year 1, the expected income from the sale of milk would be SF 0.43 million; thereafter, revenue would also be obtained from the sale of animals.

Revenue is estimated at SF 1.43 million in year 2, SF 1.77 million in year 4, after which it increases to more than SF 2.0 million from year 6. Milk sales account for about 66% of the total revenues. A negative cash flow is expected in year 1, after which it becomes positive and increases steadily up to year 10 (**Figure III.5**). With regard to accumulated balances, a positive cash balance of SF 8.32 million is expected by year 10 in this model.

**Model III - Ewe-Kid Fattening System**: The capital and operating costs for this livestock model were estimated for a 6-year period. These estimates were based on 9 ha of improved pasture that is required with a carrying capacity of 3.5 AU/ha. Investment costs total SF 0.34 million, with much of this to be spent on animal housing and purchases of an initial flock of sheep from Guyana. Total operating costs are SF 0.49 million, with the main cost items being purchases of labor services and feed.

Mutton would be the main output for sale on the local market. It is assumed that each 30 kg live-weight animal yields 21 kg of carcass (70% dressing) and the supply of mutton is estimated at 8,005 kg./year. A negative cash flow of SF 0.19 million and SF 0.02 million would be realized in years 1 and 3, respectively. The accumulated cash balance is negative until year 4; however, by the end of year 6, the accumulated balance is expected to be SF 0.43 million (**Figure III.6**).




## 3.5 Comparative Analysis of Enterprises

Nine crop and livestock enterprises were recommended as the best alternatives for Victoria: soybean, peanut, peach palm, passion fruit, two production alternatives to fatten beef cattle, two dairy production alternatives, and sheep fattening. Eight broad criteria were used to make a comparative analysis of these alternatives. They are:

**Pre-commercial activities**: R & D activities that include the need to experiment and validate production feasibility and technology before proceeding to a phase of large-scale commercial production.

**Expenditure:** The level of investment and operating costs required by each enterprise; also includes foreign exchange needs to finance investment and operating activities. A high value indicates a lower expenditure is required.

**Financial viability:** Indicated by a preliminary estimate of the internal rate of return (IRR).

**Level of technology:** The level and complexity of the technology required.

**Labor needs:** Total labor requirements per enterprise.

**Markets:** The existence of local and external market potential for disposal of the output(s).

**Import substitution:** The extent to which the product is a good import substitute.

**Foreign exchange revenue:** Foreign exchange earnings generated by the sale of the product(s).

The above criteria reflect not only technical and economic considerations, but also factors that are critical to GPOV's activities, especially given the financial and economic constraints of the company. For example, the foreign exchange needed to cover various expenses is considered important because Suriname has a serious foreign exchange shortage, which adversely affects the country's production activities. Therefore, alternatives which have lower foreign exchange requirements, and can earn export revenues would logically fare better in the selection process. Similarly, an enterprise with low labor requirements would be considered favorably.

The enterprises were given a rank value of between 0 and 9 for each criterion considered, except for financial viability (**Table III.6**). The lower the value, the less favorable the criterion. Of the several enterprises suggested, the peach palm has the highest investment,

TABLE III.6
POTENTIAL VIABILITY OF ALTERNATIVE CROPS AND LIVESTOCK ACTIVITIES FOR VICTORIA

| ENTERPRISES | EXPENDITURE | | | | IRR (%) | LEVEL OF TECH. | LABOR NEEDS | MARKETS | | IMPORT SUBSTITUTE | FOREING EXCHANGE REVENUE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRE-COMMERCIAL ACTIVITIES | INVESTMENT | OPERATIONS | FOREIGN EXCHANGE NEEDS | | | | LOCAL | EXPORT | | |
| ANNUAL CROPS: | | | | | | | | | | | |
| SOYABEAN | R | 3 | 6 | 5 | -3.8 | 5 | 3 | 9 | 1 | 9 | 0 |
| PEANUTS | R | 3 | 2 | 6 | 19.2 | 5 | 3 | 9 | 1 | 9 | 0 |
| FRUIT CROPS: | | | | | | | | | | | |
| PEACH PALM | NR | 1 | 1 | 1 | 718.6 | 8 | 7 | 1 | 9 | 0 | 9 |
| PASSION FRUIT | NR | 9 | 9 | 9 | 104.2 | 8 | 3 | 9 | 5 | 4 | 5 |
| LIVESTOCK: | | | | | | | | | | | |
| BEEF I-A | NR | 3 | 3 | 8 | 140.0 | 9 | 9 | 1 | 2 | 1 | 2 |
| BEEF I-B | NR | 4 | 4 | 4 | 156.0 | 6 | 7 | 1 | 2 | 1 | 2 |
| DAIRY II-A | NR | 7 | 5 | 3 | 30.0 | 5 | 6 | 9 | 1 | 9 | 0 |
| DAIRY II-B | NR | 2 | 2 | 2 | 20.0 | 5 | 6 | 9 | 1 | 9 | 0 |
| SHEEP | NR | 8 | 8 | 7 | 30.0 | 8 | 8 | 9 | 2 | 7 | 2 |

NOTES: (1) R - REQUIRED; NR - NOT REQUIRED.
(2) THE OTHER CRITERIA ARE RANKED 0 TO 9. THE LOWER THE VALUE, THE LEAST FAVORABLE IS THE RANKING.

operating cost and foreign exchange needs. While the operating costs for cultivating this crop are low, the processing costs are relatively high because of the fixed investment in factory equipment and high costs for variable inputs. On the other hand, its labor needs are low, its return per hectare and IRR are the highest, and it makes the greatest contribution to foreign exchange earnings. This enterprise also has the advantage of being financed and having its product marketed through a joint venture operation with a foreign investor.

Soybean and peanut are good import substitutes and the enterprises can be integrated easily with livestock and oil palm operations. However, a lower value is given to the investment, foreign exchange and labor criteria because these requirements are high due to capital intensity and production needs. The overall cost of these enterprises is even higher when the costs of the two-year R & D phase are added. The risks and uncertainty associated with these crops are also high because experimental trials are needed and technical feasibility requires prior validation before a commercial operation can be considered. Of the two, peanut has a higher IRR (19.2%). Soybean has an IRR of -3.8%, and its financial viability is further questioned by yield levels below 1.5 mt/hectare. Besides the uncertainty of sustaining productivity above 1.5 mt/ha., the economics of producing soybean in Suriname may not be favorable, if it is compared to other countries in Latin America and North America where average yields are at least 2.0 mt/hectare.

Of the livestock alternatives, beef and sheep fattening enterprises have lower investment, operating cost, foreign exchange and labor requirements. In addition, the level of technology is lower, particularly in alternative "A" and in the sheep fattening activity, because of the use of natural pastures for feed, supplemented with by-products. The beef fattening enterprises also have the highest IRR.

However, there is a critical constraint with regard to meat marketing which accounts for the low rank value assigned to the import substitution and foreign exchange revenue criteria. Local beef requirements are met adequately by current production, but the domestic supply of mutton is insufficient. There is a potential export market in nearby Caribbean countries for both beef and mutton, but Suriname does not currently meet export standards for meat. A new abattoir or substantial rehabilitation of the existing one is required before such standards can be met. Therefore, while beef and sheep fattening activities appear to be financially viable alternatives, disposal of the output on external markets would constitute a problem.

Both dairy production models (alternative "A" and "B") have higher investment needs and operating costs, as well as higher foreign exchange and technology requirements as compared to the other livestock enterprises. Of the two, alternative "B" has the lowest IRR, and it is given a lower value on the expenditure criterion because its foreign exchange requirement is high. However, their outputs are good import-substitutes, for which reason a high value was assigned.

The passion fruit proposal investment alternative to oil palm. It would be a small-scale operation to rehabilitate and improve the productivity level of 13 previously cultivated hectares. The IRR for this enterprise is high (104.2%) and the expanding domestic market for the fruit would make it a viable activity if yields could be increased to between 6 and 8 mt/ha or more. This can be accomplished by improving cultivation and management practices. Furthermore, there is considerable potential to export passion fruit in processed form to Holland, where market

requirements far exceed current production capacity in Suriname.

The above comparison of alternatives is limited in two ways. First, it can be argued that the value assigned to each criterion is arbitrary. While this may be so, it does provide a guide to the extent to which an enterprise is constrained by a given factor. Second, financial viability as indicated by the IRR is only a preliminary estimate. Additional data is required on capital costs repayment and a sensitivity analysis is also needed on costs, yields and prices to make an adequate evaluation of financial viability.

### 3.6 Policy and Institutional Factors

Besides the agroecological, financial and economic factors considered above, there are also important policy and institutional factors that can affect the overall viability of the proposed activities.

**Production Policy**: The GPOV was established to produce and distribute vegetable oils and fats, and the present directorate remains strongly committed to this initial responsibility. This policy objective is evidenced by two expressed propositions. First of all, the company plans to expand oil palm cultivation by 2,000 hectares to a site across the river near Victoria. The hypothesis is that there is little risk of spear rot spreading to this new site, because it would have to move against the wind. Secondly, they view the alternative enterprises being currently tested or proposed as temporary operations that are justified only until a permanent solution can be found to spear rot.

However, considering the policy objectives of the company, there is a limit to the type of alternative the GPOV would be willing to execute. It would be advisable to pursue alternatives with a short production life cycle and minimal foreign exchange and labor requirements, and to avoid those in which capital is "tied up" for longer periods of time, even though they may be more viable from a financial point of view. On the other hand, the choice of alternatives could also be affected by the extent to which the problem of spear rot disease remains unsolved over time.

**Processing**: As indicated before, the pulp of the oil palm fruit deteriorates rapidly after harvest, and this requires that a processing plant be located near cultivated area(s), especially if cultivation is done on a plantation scale. Victoria is no exception to this rule and its current processing operations include palm kernel extraction and refining. However, because output has declined, the factory is operating well below full capacity. If Victoria does not continue to cultivate oil palm and if the proposal to cultivate 2,000 ha across the river is implemented, the processing equipment will probably have to be moved to the new site or to Phedra, to save on transportation costs. In addition, some sections of the plant and other equipment need urgent repair, which has been put off to date by virtue of GPOV's financial situation and the country's general lack of foreign exchange. The company is also contemplating moving its refining operation nearer to Paramaribo, to facilitate exports as well as to refine imported crude oil. Each proposal involves costs that will add to the company's already tight financial situation.

**Markets and Marketing**: When the oil palm plantations were established, the original intent was for Suriname to become self-sufficient in vegetable oil and eventually become a net exporter. This objective has not been achieved. Current production is about 100,000 liters of edible oil per year, which goes to the hotel and catering service sector, falls short by 40,000 liters of their actual needs and is well below the country's annual need of 6 million liters. Therefore, the domestic market is not a constraint as far as disposal of the product is concerned.

However, if and when GPOV increases its output of palm oil beyond domestic market requirements, export markets will have to be sought, possibly in the Caribbean region because of certain constraints in both the North American and European markets. In the first market, consumer acceptance of palm oil is poor because it is perceived as an unhealthy product; in the second, the market requirement is mainly for crude rather than refined palm oil and Suriname is not competitive with other suppliers. With regard to the alternative enterprises being proposed, market potential (local and export) will depend on which activities will be developed. Market access for the quantity planned at remunerative prices is perhaps one of the most important criteria for selection.

**Labor Force**: Although Suriname has high and permanent levels of unemployment, there is a shortage of agricultural labor throughout the country, and especially in the interior. This may be viewed as paradoxical, but this situation is supported by the existence of important ethnic and geographic immobilities of people which may not be apparent. The labor problem is further compounded by the distance of the Victoria plantation from any urban or village center, which makes it necessary to provide certain minimal housing and support facilities to accommodate the laborers and their families. For the most part, the labor is comprised of Guyanese and/or Haitian immigrants, who may not have the necessary farming skills and thus require some training.

GPOV's operations are largely of the plantation type, which requires easy access to a large pool of unskilled labor. Presently, labor needs are adequately met because of the reduced levels of operation at Victoria and the other plantations. However, labor requirements will increase as the situation returns to normalcy and operations increase at Patamacca and Phedra, and Victoria expands into alternative crops and/or new plantings of oil palm. Furthermore, the ready availability of labor from Guyana may cease because the economic conditions in that country are beginning to improve. One alternative, which would further add to GPOV's costs, is to offer higher wages and improved living facilities and amenities to attract and retain an adequate labor pool.

**Financial Situation**: In Chapter II, it was indicated that the GPOV's debt situation has precipitated. However, being a public company, its financial situation is less apparent because: (i) it receives support from the Central Government in the form of subventions and credit; (ii) it has had ready access to date to commercial bank credits through government guarantees; and (iii) more recently, the GOS has provided some relief by converting a substantial part of its outstanding debt into equity. The company's financial constraints have been aggravated by the fact that an additional SF 4.4 million is required to purchase new generators and tractors, and to cover factory maintenance costs and improvements needed during the current year to remain reasonably efficient. The need to expand operations at Phedra and Patamacca and venture into alternative activities at Victoria will further increase its financial burden.

The oil palm activities at Victoria is probably operationally unsustainable. The plan to extend the plantation across the river at an estimated cost of SF 40 million over a six-year period (until harvesting begins) is risky at this stage. The capital required for this venture would probably be sought from the government, which would have to choose between various viable development priorities. Furthermore, the possibility of receiving such financing is not very good,

given the government's tight financial position.

**Managerial and Administrative Capacity:** GPOV currently has two divisional heads and four technical and financial coordinators. This management support structure may be considered adequate at present because of declining oil palm production and a reduced level of operations. However, it would be insufficient to meet the company's needs if both Patamacca and Phedra expand to their full potential and alternative enterprises are developed at Victoria.

**Economic Distortions:** As indicated in Section I, Suriname's economy has deteriorated steadily due to growing distortions in the last decade. The financial and economic viability of GPOV's operations were similarly affected by these distortions, especially those related to price control of the company's principal product (palm oil), overvaluation of the exchange rate, high inflation and the labor market situation. The viability of the company's activities in the future, whether it remains involved in oil palm production and/or ventures into alternative crop and livestock enterprises, will continue to be adversely affected by such factors.

## IV. IMPLEMENTATION STRATEGY

### 4.1 Annual Crops

As indicated earlier, soybean and peanut cultivation would complement livestock activities and be compatible with the GPOV's palm oil production system. It is proposed, therefore, that the production systems be designed as components of an integrated crop-livestock system that includes soybean, peanut, livestock and edible oil production activities. The main elements of this system and their relationships are shown in **Table IV.1.**

TABLE IV.1
PROPOSED INTEGRATION OF SOYBEAN, PEANUT, LIVESTOCK AND EDIBLE OIL ENTERPRISES AT VICTORIA

| ACTIVITIES | PRODUCTS | DESTINATION |
|---|---|---|
| MAIN ELEMENTS | PALM OIL<br>PALM KERNEL<br>SOYBEAN OIL | EDIBLE OIL MARKET<br>KERNEL PLANT<br>EDIBLE OIL MARKET |
| SECONDARY ELEMENTS | PALM KERNEL CAKE<br>SOYBEAN MEAL | FEED MARKET AND.OR BEEF ENTERPRISE |
| SUBSIDIARY ELEMENTS | PASTURE GRASS<br>PEANUTS<br>BEEF | BEEF ENTERPRISE<br>LOCAL MARKET<br>LOCAL.EXPORT MARKET |

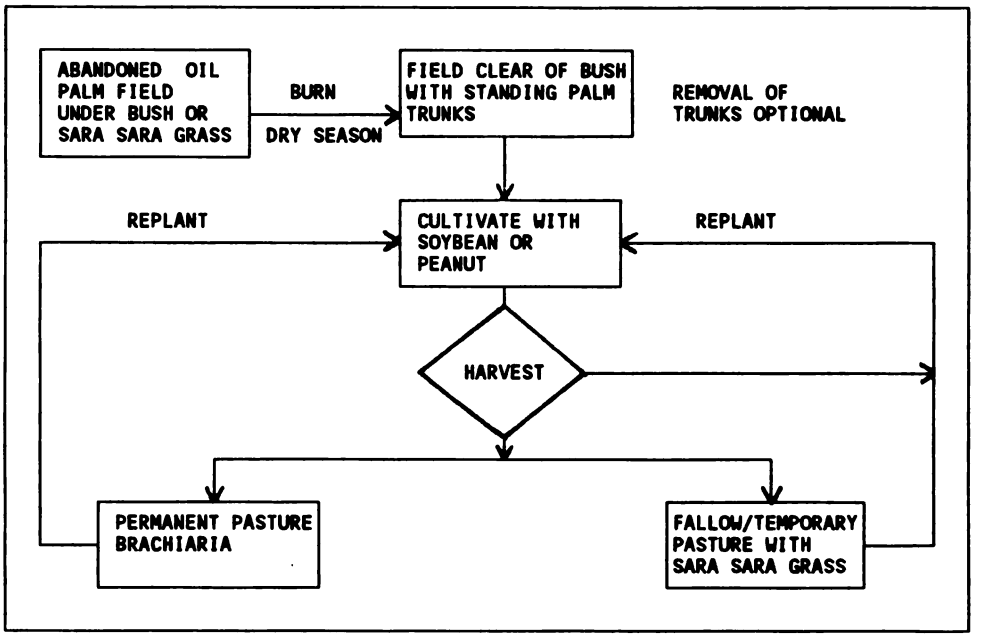
It is further proposed that the integrated production system be as follows: (i) cropping activities on rotation would include soybean, peanut, natural (sara sara grass) and cultivated pasture (Brachiaria spp.) for livestock production; (ii) soybean would be processed into soya oil (to supplement palm oil for the domestic market) and soymeal (to supplement palm kernel cake for use as livestock feed for fattening); and (iii) unprocessed peanut would be sold on the domestic market.

#### 4.1.1 Proposed Production System

Based on agroecological conditions and the scale of operation possible, it is recommended that soybean and peanut be cropped on 350 ha, and that they be restricted to soils selected in the upper and middle terraces[19]. These crops would be rotated with pasture and depending on the schematic plan, the land could be returned to pasture, left fallow or used for grazing in the short- or long-term, as required. The sequence of activities for utilizing land after abandonment of the diseased oil palm field is presented in **Figure IV.1.**

[19] An estimated 800 to 900 ha of these soils are available at Victoria; some could be used for livestock activities and pastures.

FIGURE IV.1
LAND UTILIZATION PLAN FOR SOYBEAN-PEANUT-PASTURE ENTERPRISE




Land would be taken out of oil palm or sara sara grass and cultivated with either soybean or peanut. The common practice of burning the field before cultivation is recommended, to take advantage of the nutrients derived therefrom. After one or more harvest(s), the field can be replanted with either crop, be left fallow for temporary pasture or sara sara grass, or be used as permanent pasture. Rotation will depend mainly on the output response of the recommended crops and the economics of the rotational system.

### 4.1.2 Production Practices

**Planting Material:** Current research in neighboring tropical and sub-tropical countries (i.e., Brazil, Guyana and international research centers such as ITTA and ICRISAT) has identified cultivars of both soybean and peanut that are adaptable to the agroecological conditions of Victoria. These cultivars are tolerant of acidic soils and genetically equipped for near-equator photoperiodic situations, especially in the case of soybean.

Planting material can be obtained from the above countries and/or research centers, but the quantities available would be limited. Some on-site varietal testing would be necessary for selecting the most adaptable material. The project could generate its own planting material from seed plots in the commercial area. Alternatively, the ministry of agriculture or another appropriate agency with the necessary skills and expertise could become involved in seed production.

**Soil and Weed Management Practices:** The physical appearance and texture of the soils on the upper and middle terraces suggest wide versatility in terms of arable cropping and mechanization. The texture is good and both internal drainage and runoff are adequate. The topography is gently to moderately sloping, and some slopes are in excess of 5 percent. While this may not be a problem for oil palm, fruit crops or pasture, any

attempt at row cropping of annuals would cause soil erosion problems.

Appropriate soil and weed management practices will be of critical importance for establishing a successful oilseed-livestock production system. An appropriate soil and weed management program would include: (i) contour farming and strip cropping; (ii) deep placement of lime and phosphate fertilizer; (iii) use of micro nutrients; (iv) use of conservation tillage techniques whenever possible; (v) integrated weed management; and (vi) inoculation of seeds with Rhizobium to encourage nodulation.

**Mechanization:** Soybean and peanut were chosen partly because cultivation and harvesting operations can be mechanized. This is consistent with the need to minimize labor use, not only because of the labor shortage but also because the economic advantages of these crops falls with a greater labor input. The effectiveness, success and reliability of the mechanization program will depend largely on the availability of capable and efficient operators, good equipment maintenance and an adequate spare parts inventory. These factors are directly related to the timeliness of field operations and ultimately, the success of the cropping activity.

**Drying and Processing:** It is assumed that the existing palm oil factory at Victoria can provide the energy required for drying both soybeans and peanuts. Soybean would be processed in situ, and the seeds of both soybean and peanut could be held over from each crop for planting the following crop. Seeds would be specially selected and held in cold storage.

### 4.1.3 Implementation Strategy

To ensure success of the soybean and peanut enterprises, it will be necessary to count on at least a moderate level of field technology and expertise, as well as efficient management and operational logistics. Such expertise does not exist at Victoria now and would be needed to initiate these activities. Fortunately, there exists in the country some limited but valuable experience with these crops, especially as concerns small-scale production and agronomic research. The implementation strategy includes involving several institutions with expertise in these crops. The entities expected to play a pivotal role in the development and transfer of technology are the Ministry of Agriculture, the University's Faculty of Agriculture, the National Soybean Council, the Coordinating Committee on Soybean Research, the Center for Agricultural Research (CELOS) and GPOV.

Given the limited information and on-site experiments with both soybean and peanut at Victoria, it is proposed that cultivation of these crops be carried out in two phases as follows: (i) a pre-commercial research and development phase during the first and second year; and (ii) a full commercial operation from years 3 to 7.

**Pre-Commercial Phase:** This two-year phase is necessary to assemble, adapt and refine the appropriate field technologies that are available for the target crops. Field research would be adaptive in nature and would seek to validate techniques developed and employed in similar agroecological situations. The activities will focus on: (i) testing of selected varieties/cultivars; (ii) soil management studies; (iii) integrated weed management; (iv) mechanization of field operations; and (v) seed production to ensure availability of adequate planting material for the commercial phase.

A multidisciplinary team of research and production technicians would

be required for this task, and it is suggested that the pooled expertise of the participating agencies be utilized. Key specialists could be identified for part-time special assignment or be seconded to the project on a full-time basis, depending on the disciplinary needs, the most vital of which would be in the areas of agronomy, plant protection, agricultural (field mechanization) engineering and soil management.

Development plans for the pre-commercial phase and scheduling of specific activities to be executed are presented in **Annex 7, Tables 7.1 and 7.2.** Prior to the field trials, a 9-month preparatory period would be needed to assemble the technical personnel, plan and procure inputs. Field experiments would be conducted twice a year. Investment costs are expected to be minimal in this phase, as experimental activities would utilize equipment, materials and supplies available at Victoria. The largest investments would consist of farm equipment for small/medium scale mechanized operations and rehabilitation of existing equipment; the principal operating costs would be for fertilizers and pesticides.

It is important to note that the recommendations made herein for both crops are based largely on the agroecological conditions at Victoria and information derived from similar enterprises developed under comparable environmental situations. While much information on the performance of these crops elsewhere exists, it is emphasized that some on-farm (in situ) research and validation will be necessary to derive more accurate parameters to ascertain their feasibility. Furthermore, such research would permit "fine-tuning" of production tech-packs, and garner useful experiences about the crops in the particular locality. Before embarking on the commercial phase, it is recommended that basic preparatory work be carried out through a three-step strategy:

**Step 1:** Set up a working group, comprising of technicians from GPOV, the Ministry of Agriculture, the University's Faculty of Agriculture, CELOS, and Internacional Cooperation agencies, to provide the necessary technical inputs for experimentation and development of cropping activities at Victoria, especially for research and technology transfer. Information on research findings and commercial production of these crops in Suriname would be useful as a starting point. Linkages with the National Soybean Council and Coordinating Committee on Soybean Research, both of which are currently active, would also be useful.

**Step 2:** Develop a work plan for on-farm validation and applicability testing of a composite production tech-pack for both crops. This would include: (i) selected cultivars with acid soil tolerance; (ii) soil amelioration; (iii) weed management; and (iv) soil fertility. This plan would be initiated as soon as possible, and would comprise simple but well constructed trials of a scale large enough to phase into a pilot commercial operation. On-farm applicability testing of the vital elements of an assembled tech-pack should be initiated as soon as possible, under the guidance and direction of the "working group" recommended above.

**Step 3:** Conduct economic analyses on the experiments and derive a technically and economically sound model for application in the commercial operation.

**Commercial Phase:** It is recommended that this phase commence at least after two full years of field testing and validation, for conversion to full operational status over a 5-year period. This would facilitate adjustment and/or refining of the field technology in the shift from the experimental/pilot stage to the

commercial operation. Furthermore, multi-institutional participation in this exercise should continue at least in the initial stages to ensure smooth transition from the experimental phase to commercial cultivation.

The project's proposal is to rotate these crops with pasture and livestock activities (**Table IV.2**). In the first year of commercial production (year 3 of the project), 160 ha would be transferred out of existing pasture (120 ha) and oil palm (40 ha) to be cropped with soybean and peanut. In the second year, 100 ha of this area would be rotated among the crops, plus 50 ha each to be transferred out of sara sara grass and oil palm respectively for crop cultivation. By year 3, the 160 ha cropped in the first year would be reverted back to pasture. A strategy recommended for the combined cropping and pasture activities is as follows:

- Land would be rotated out of soybean/peanut into pasture, either to rest or to phase it out, if the cropping activity is uneconomic.
- Improved pasture developed after a crop cycle may be reverted back to cropping, but perhaps only after 5 to 7 years of grazing.
- Repeated cropping, although theoretically undesirable, could be practiced for 3 to 4 seasons, to take advantage of soil ameliorants and soil rhizobium buildup.
- At the end of year 5, it is envisaged that 450 ha would be cropped with soybean and peanut. In addition, 310 ha would have been transferred to improved pasture and 150 to temporary grazing land under Sara Sara grass.

Pasture land that has become compacted after several years of grazing or that may have become uncontrollably weed-infested can be ploughed under and put into row crops for 2 to 3 years. If necessary, soils could be re-limed at this opportunity.

TABLE IV.2
LAND UTILIZATION IN SOYBEAN, PEANUT AND PASTURE

| FROM | TO | HA OF LAND IN UPPER/MIDDLE TERRACES | | | | |
|---|---|---|---|---|---|---|
| | | YEAR | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| SARA SARA GRASS | CROP | 120 | 50 | 100 | 100 | 50 |
| OIL PALM | CROP | 40 | 50 | 100 | 50 | 50 |
| CROP | CROP | --- | 100 | 100 | 200 | 350 |
| CROP | SARA SARA GRASS | --- | --- | --- | 50 | 100 |
| CROP | IMPROVED PASTURE | --- | 60 | 100 | 100 | 50 |

A schedule for phasing the field activities for soybean and peanut is presented in **Figure IV.2** below and the strategies for developing the respective enterprises are presented in **Annex 7, Tables 7.3 and 7.4.**, respectively. Two crops per year are recommended, the first for the long rainy season (LRS) (April to August), and the second, a smaller crop, in the short rainy season (SRS) (September to March). It is proposed that the second crop be used to provide seed for the larger crop that follows. By year 3, it is estimated that production would be stabilized on 300 ha of soybean and 150 ha of peanut per year.

In the first year of commercial operation, productivity of soybeans and peanuts is estimated at 1.0 mt/ha and 0.8 mt/ha respectively, with yields being generally lower for both crops in the short

FIG. IV.2
SCHEDULING FIELD ACTIVITIES FOR SOYBEAN AND PEANUT ENTERPRISES

| | LONG RAINY SEASON | | | | | SHORT RAINY SEASON | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR |
| LAND PREP | -------- | | | | | ------ | | | | | | |
| PLANT | | ---------- | | | | | | ------- | | | | |
| CROP CARE | | | ---------- | | | | | | | ---------- | | |
| HARVEST | | | | | --------- | | | | | | | ------- |
| DRY/STORE | | | | | | ---- | | | | | | ---- |

NOTES: (1) THERE ARE 2 CROPPING CYCLES PER YEAR ON A SEASONAL BASIS.
(2) THE PEAK PERIODS OF FIELD ACTIVITY ARE MAY/JUNE AND NOV/DEC.

rainy season. In the second year (year 4 of the project), the yield is expected to increase to 1.5 mt/ha and 1.2 mt/ha in the long and short rainy seasons, respectively, for soybean. By year 5, soybean yields are expected to stabilize at 2.0 mt/ha and 1.2 mt/ha, respectively, in both seasons, and increase to 1.5 mt/ha in the short rainy season by year 6. With regard to peanut, the yield would be expected to increase to 1.2 mt and 1.0 mt, respectively, for the two seasons by year 4, and to stabilize at 1.5 mt and 1.0 mt, respectively, by year 5.

## 4.2 Fruit Crops

### 4.2.1 Production System

#### A. Peach Palm

It is proposed that an integrated system of peach palm production, processing and export be developed. Under this project, 350 ha would be established over a four-year period, which is considered adequate for the scale of operations necessary at the processing level. Selected seed would be imported from Costa Rica and a nursery would be established at Victoria. Young plants must be from 4 to 6 months old before they can be transplanted. The following production system is recommended:

**Land preparation:** Avoid over-compacting the soil to economize on this operation. An alternative and less costly method for the removal of the oil palm trees is recommended, with the following done during the dry season: (i) kill oil palm trees by internal injection of herbicide; (ii) slash and burn all the vegetation between the rows; and (iii) pile all debris between the rows and burn again.

**Planting method:** Plants should be established in a triple row system where single rows are separated by 2 m. and plants within the row by 1 m. A 3 m. wide aisle will be left between every four rows to facilitate harvesting and other operations within the orchard, including transportation of the stems out of the field. This will prevent soil compacting either by animals or light vehicles. All holes will be manually prepared to avoid soil compaction and plants will be set in a triangular pattern. Plots will be established over a 4-year period as follows: 50 ha the first year, followed by another 100 ha per year until a total of 350 ha have been planted.

**Plant population:** A density of 4,000 plants per ha can be realized with the planting method recommended above. Each plant would be allowed to produce 4 stems (at different stages of development), giving a total of 16,000 stems/ha at any time.

**Cultural practices:** The main cultural practices for this crop are weed

control and fertilizer applications. Manual weed control is only significant during the first year, since the canopy of the different suckers will subsequently provide sufficient cover to inhibit weed development. However, occasional labor may be needed to eliminate bushes and weeds inside and around the plots. Chemical weed control will be applied mainly in the aisles and on the passages along the roads. Fertilizer applications will consist primarily of high-nitrogen formulas because a continuous and rapid growth of the tender stem is desired.

**Harvesting:** This operation starts at the end of the second year after planting and peaks by the fifth year. Cabbages within a plot are harvested once every month. The harvester cleans the spines from the shoot, eliminates the leaves and cuts the whole sucker, but saves only the terminal part (about 60 cm long). The pieces of stems are collected in bundles and can be transported out of the field by mules, and then to the factory by trucks.

**Yield:** Each "mother" plant produces an average of 3 good stems per year at full production (by the fifth year), yielding an average of 12,000 good stems/ha/year. The expected yield of stems per hectare over time is presented in **Table IV.3** below.

TABLE IV.3: PEACH PALM YIELD PER HECTARE

| YEAR | NOS. OF STEMS FOR PROCESSING |
|---|---|
| 1 | 0 |
| 2 | 1,250 |
| 3 | 3,750 |
| 4 | 9,000 |
| 5 | 12,000 |

**Processing:** A factory would be established at Victoria to process the peach palm. Processing is a simple operation, and much of it can be automated to improve efficiency and avoid the labor problem. The stems are received in an unloading area, washed and cleaned of dirt, peeled and then cut to a length of 50 cm. External fibrous layers are removed to conserve only the very central soft cylinder, 2 to 3 cm in diameter. These cylinders are cut again to the dimensions of the cans, and they are canned in a brine solution. Immediately thereafter, the cans are sterilized and sealed, and can then be shipped by non-refrigerated sea containers.

**Yield:** The heart of palm is the internal central cylinder of the terminal end of the peach palm trunk, and each cylinder measures about 50 cm in length and 2-3 cm in diameter. The average weight for canning varies from 300 to 500 g/can of palm heart. About 1.5 stems are needed to produce a 500 g can. At full production, each hectare will produce approximately 8,000 cans (of 500 g size), or an estimated of 2.8 millions cans total from the 350 ha cultivated.

**Markets:** The domestic peach palm market is undeveloped because it is a relatively new product in Suriname. However, both the European and the U.S. markets for this product are large and current demand exceeds supply. The current world consumption is estimated at 20,000 tons, and is increasing steadily as consumers become aware of the product. Marketing the product, particularly in Europe will not be a serious problem, as the company willing to enter a joint venture operation has already penetrated this market.

**Production schedule:** The schedule for annual cultivation and development of the 350 ha enterprise, are presented in **Annex 7, Tables 7.5 and 7.6,** respectively.

### B. Rehabilitation of Passion Fruit

The proposal is to rehabilitate and maintain 13 ha of yellow passion fruit at

least for the next three years, and modify the production system to remove the constraints that reduce yields. Recommended cultivation practices are:

(i) To increase the presence and activity of natural pollinators by planting a hedge of common hibiscus on the boundaries of the plots. The hibiscus should be pruned during the natural flowering periods of the passion fruit and be allowed to flower only during the off-period flowering of the passion fruit plant. The objective is to prevent migration of natural pollinators such as bumble and carpenter bees, which normally occur during the off-period flowering of the passion fruit. In the event that these insects are insufficient to provide adequate pollination, they should be brought in from other production areas of the country. Alternatively, they can be produced at Victoria, as both the entomology units at the University and at LVV have the technical capability.

(ii) Hand pollination will be expanded and improved. Previous experiences at Victoria indicate that one person can pollinate more than 1 ha in 2 to 3 hours, resulting in at least a 50% yield increase. However, due to other management constraints, flower production is still considered to be low. Assuming that the plants increase their production of flowers, output can be increased four to five times just by improving management practices and assigning labor to do hand pollination to all flowers in the field.

(iii) Fertilization should be adapted more to the crop demand cycle and adjusted to existing needs. This will increase flower production and yields. The problem of conducting soil analyses can be avoided by utilizing the experiences of other growers in similar areas or by purchasing a small "soil tester".

(iv) Apply a nematicide-insecticide (such as Carbofuran) to the plant hole just before planting, to control insects presently affecting plants at Victoria.

(v) Increase the pH of the soil to at least the level of 5. This can be achieved by applying shells as needed to an area of approximately 1 meter in diameter around each plant site.

(vi) Ensure that plants are set in mounds, to raise the level of the root system and avoid the problems associated with the high water table.

(vii) Avoid mulching the plant during the wet season.

(viii) The chief technician can improve his/her technical and crop management skills by getting additional exposure to other production plots in Suriname where yields are about two to three times higher than in Victoria. National and international technical assistance organizations can also help to improve the production system and train technical personnel.

### C. Establishment of Experimental Plots with Fruit Crops

Although some spear rot-resistant oil palms have been developed, these have yet to be tested and evaluated under conditions in Suriname. The disease has

already appeared in both the Phedra and Patamaca plantations and it is only a matter of time before palms at these farms are destroyed. In view of this likelihood, the GPOV should experiment with alternative fruit crops for these plantations. Some trials with potential crops should begin as soon as possible to improve the knowledge and collect field experiences. The phenological and economic data collected would determine the commercial potential of these crops. This activity could be executed either in total or in part at Phedra and Patamacca, in collaboration with LVV and other agencies working with fruit crops. It is recommended that an experimental 11-ha plot be established with various fruit crops **(Table IV.4)**.

TABLE IV.4
CROPS AND CULTIVARS RECOMMENDED FOR EXPERIMENTAL PLOTS AT PHEDRA AND PATAMACA PLANTATIONS

| CROP | CULTIVARS | PLOT SIZE | PLANTS |
|---|---|---|---|
| BRAZIL NUT | | 1 HA | 100 |
| CARAMBOLA | ARKIN, B-2, LOCAL SELECTIONS | 1 HA | 277 |
| GRAPEFRUIT | RUBY RED, MARSH SEEDLESS, T.PINK | 1 HA | 156 |
| GUAVA | CENTENO PROLIFIC LOCAL SELECTIONS. | 1 HA | 277 |
| LIME | TAHITI | 1 HA | 277 |
| PAPAYA | SUNRISE, KAPOHO | | |
| | TAINUNG 1 | 1 HA | 2000 |
| PASSION FRUIT | SELECTIONS FROM BRAZIL, GUYANA | 1 HA | 1000 |
| PINEAPPLE | SMOOTH CAYENNE RED SPANISH LOCAL TYPES | 1 HA | 60000 |
| RAMBUTAN | SUMATJAN, SUKONTO | 1 HA | 204 |
| SOURSOP | BURIS, LOCAL | 1 HA | 416 |
| WI.CHERRIES | ALOCAL SELECT. | 1 HA | 555 |

## 4.3 Livestock Enterprises

### 4.3.1 Production Models

#### A. Model I: Fattening Cattle

**Alternative "A"**: The objective of this fattening system is to utilize as much land as possible for fattening cattle and also to prevent a re-growth of trees and shrubs. On the basis of land availability and scale of operations, an area of 277 ha is needed requiring only a low level of technology. This system will be used to gain experience for development of the other livestock enterprises.

The feeding system would be based on the available sara sara grass. Although field trials and analysis of this grass have not been done, field observations indicate that its production of dry matter is low, possibly due to slow regrowth. Furthermore, this grass cannot withstand droughts because of its superficial rooting system. Based on these observations, one animal unit per hectare (AU/ha) is recommended for this system. The animals would also be fed with a supplementary feed of 2 kg kernel cake/AU/day, and salt minerals would be supplied in the amount of 19 kg/AU during the fattening period.

**Alternative "B"**: This model builds on the production system of Alternative "A" by increasing the level of the technology. Under this system, the low productive sara sara grass will be replaced by a cultivated variety such as Brachiria spp. This will allow the stocking rate to be raised from 1 AU/ha. to 3.5 AU/ha., and land can be released for the proposed dairy model.

Nitrogen will be applied twice a year at the rate of 50 kg/ha/application to maintain a good pasture. With the improved pasture, the system's capacity will rise to 3.5 AU/ha, reducing the area required from 277 ha to only 80 ha. Supplementary feed and the supply of minerals and salt are the same as in Alternative "A".

A total of 277 animals will be needed for this herd and the fattening process can be completed in the second year. To maintain the herd, animals

(weaned calves) should be bought yearly from the large beef farms in the country. The animals would require an average of 528 days to reach a live weight of 400 kg (to yield a carcass weight of 213 kg), based on a dressing of 53.2%. An estimated 30.3% of the carcass weight would be suitable for export; the remainder would be sold on the local market.

The infrastructure required includes construction of a corral with a squeezing shute for handling the animals, as well as perimetral and internal fences for pasture division. Natural boundaries such as swamps and creeks will also be utilized as natural fences. Equipment needed includes a weighing scale to monitor animal growth.

### B. Model II: Dairy Breeding Stock and Milk Production

**Alternative "A":** Fifth-two hectares of land are required in this model. A herd of 93 AU will be developed into 183 AU over a five-year period. In the first year, 125 one-year old heifers will be bought locally and 3 jersey bulls will be imported. The final herd in year 10 would consist of 100 mature cows. Bull calves would be raised to an age of 20 months, pregnant heifers would be sold as breeding stock, while culled bulls and cows would be the system's by-products.

Grass pasture is the main feed source, to be supplemented by kernel cake. Pastures will be fertilized with 100 kg of urea/ha./year in order to maintain a stocking rate of 3.5 AU/ha. Required infrastructure includes a pen measuring approximately 220 $m^2$, with facilities for milking parlor, storage and cooling rooms and pens for calves and bulls. A perimetral barbed-wire fence and an internal solar fence measuring approximately 15,600 meters will be installed to manage pastures and animals. A milking machine, water pump, solar fencer, cooling machine, milk cans and a 2-ton pick-up truck will also be required.

**Alternative "B":** Breeding stock animals and milk would be produced in this model, which will use pure-bred breeding stock. Pure-bred animals such as Siboney, Yersey or Jamaica Hope breed would be imported, as they tend to perform well under tropical conditions. The offspring (F1) of these animals could be utilized to improve dairy herds in Suriname and thus improve milk production.

Fifty-two hectares of land would also be required for this model, and a 123 AU herd will be developed into 183 AU over a period of 6 years. In the first year, 100 four-month pregnant Yersey or Siboney heifers and three 15-month old breeding bulls would be imported. The final herd would consist of 100 mature cows. Bull calves would be raised to an age of 20 months and sold as breeding stock. Surplus four-month pregnant heifers would also be sold as breeding stock. Culled bulls and cows would be the system's by-products.

Grass pasture would be the main source of feed, supplemented by oil palm by-products. Pastures would be fertilized with 100 kg urea/ha/year in order to maintain a stocking rate of 3.5 AU/ha. The required infrastructure would be the same as for Alternative "A".

### C. Model III: Ewe-Kid Fattening System

Mutton will be the principal output of this system, and will be sold on the local market. About 9 ha of land with a high-input level of technology will be required, mainly in the form of improved pastures. Target herd size is 100 ewes and 10 rams, to be reached in the fifth year. Ewes and rams will be imported from

Guyana, and they are expected to have about 75% to 100% Barbadian blackbelly blood. The animals will be ready for slaughter (with a dressing of 70%) when they reach a live weight of 30 kg, which can be achieved in 12 to 14 months.

A rotational grazing system will be used for the improved pastures (Brachiaria decumbens and humidicola). Animals will be penned during the night and provided with supplementary feed, salt, minerals and water. Supplementary feed will be given at a rate of 0.2 kg for pregnant ewes, and 0.4 kg/day for a period of 8 months for animals being fattened.

A sheep shed of 10 x 35 meters and 14 pens for lambing of 1 x 1 meter will be required. Perimetral fences will be installed with 4 rows of barbed wire and two galvanized wires on solar energy. Internal fences would be established at 2 rows of galvanized wires on solar energy. Natural boundaries such as swamps and creeks will also be utilized as fences. Equipment required includes a 2" water pump, a solar fencer, a tool set, 2 wheel barrows and two knapsack sprayers.

### 4.3.2 Development Strategy

The following are the main elements of the strategy for developing the recommended production systems:

- Utilization of livestock production systems that can easily transform, at least cost, the existing 900 ha of Sara Sara grass into outputs for which potential local and external markets exist.

- Utilization of ruminants that adapt well to the environment at Victoria, and which have a production system that is sustainable and can prevent land from reverting to trees and shrubs.

- Development of a production system that can contribute to boosting foreign exchange earnings for both GPOV and Suriname.

Based on the above, a four-phased implementation strategy is recommended:

**Phase I:** The following activities are recommended for the pre-development phase: (i) analyze the agronomic and nutritional potential of the Sara Sara grass and its response to cutting, fertilization and grazing; (ii) investigate animal response to the sara sara grass regime; (iii) assign a person to work full-time on livestock production, to conduct grass evaluation trials and receive in-service training; (iv) analyze information available on water buffalos and on their possible use as a livestock production system in swampy areas at Victoria; and (v) evaluate an integrated agriculture-forestry-livestock production system as another alternative for oil palm.

**Phase II:** In this phase, production models that require low technology (no fertilization and a low carrying capacity of 1 AU/ha) as well as a low level of capital and operational inputs, would be implemented first. Model I, Alternative "A" is the production system recommended. In a period of 3 years, three replications of this model could be developed; approximately 300 ha would be utilized and 83% of the animals supplied would be fattened. This phase would enable GPOV to improve its skill level and improve its livestock production expertise.

**Phase III:** Models requiring a higher level of technology should be implemented in this phase. Activities would include establishment and fertilization of improved pastures, and rotational grazing with a higher carrying capacity of 3.5 AU/ha. It is estimated that

300 ha would be used with this technology to develop 2 replications of Model I Alternative "A" and "B", one Model II dairy breeding stock Alternative "A" and "B", and one Model III sheep ewe-kid fattening.

**Phase IV:** It is recommended that this phase concentrate on continuously intensifying land use with the incorporation of improved technologies into the production systems.

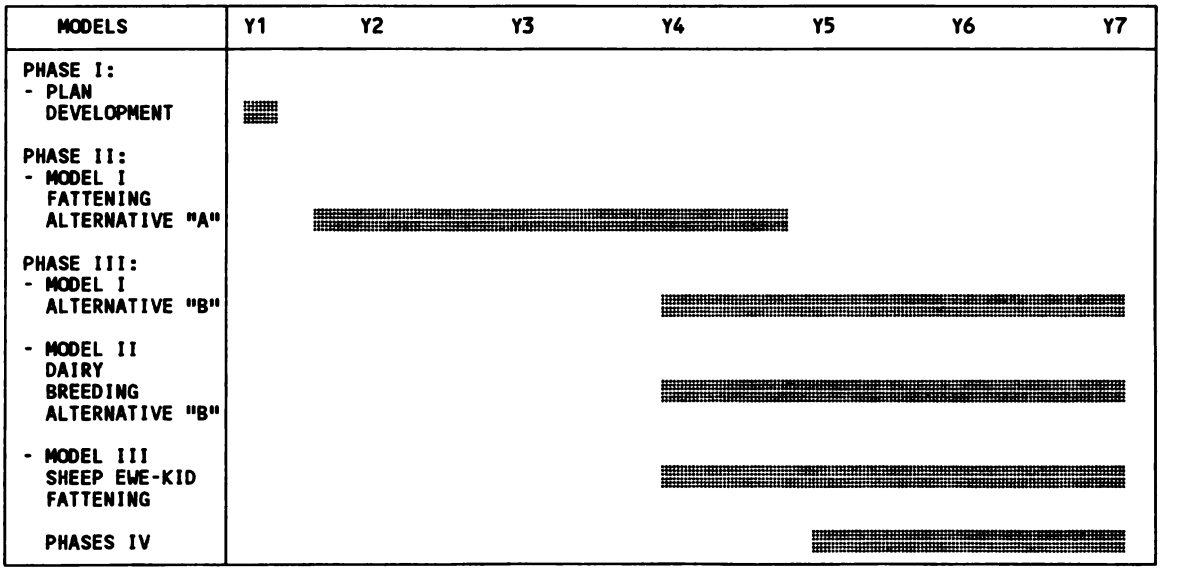
The implementation schedule for the models recommended is shown in **Figure IV.3** below. Development of the work plan, generation of relevant information and assembling of the technical team would be done in the first year. It is proposed that Model I Alternative "A" be implemented in phase two, during the next three years, to be followed by development of Model I Alternative "B", Model II Alternative "B" and Model III in phase three. The final phase would begin in year 5, after all the models have been established.

Phases II, III and IV can be considered as the development stage of the recommended production systems. Other recommendations for this stage include: (i) improving the skill level of personnel by providing formal and in-service training in pasture production and management, animal feeding, herd management and record keeping; and (ii) establishing a technical team comprising at least an animal production specialist and a veterinarian for development of the recommended models.

## V. SUMMARY AND CONCLUSIONS

The Suriname economy has declined in the last decade, mainly because of reduced bauxite production, suspension of the Dutch development aid, poor economic and sectoral policies and the rebel insurgence. The policies have distorted resource allocation, and have provided disincentives to production and exports. As a result, real total output has declined, the inflation rate has been high, the currency has become severely

FIG. IV.3
IMPLEMENTATION SCHEDULE FOR LIVESTOCK MODELS



overvalued, the supporting infrastructure has deteriorated and smuggling of goods to neighboring countries has increased. The role of agriculture in the economy has remained strong and its share in GDP has been relatively stable, but the sector's growth rate has also declined due to lower output from the major subsectors, including rice, bananas, palm oil, sugar and citrus.

The oil palm subsector in Suriname is one of the main activities developed by the government to diversify the agricultural sector, enhance import substitution and contribute to export earnings. It has been declining since 1985, with total fruit output from the three government-owned plantations (Victoria, Phedra and Patamacca) dramatically falling and production coming to a halt in 1991 on the 300 hectare small-holder scheme. One of the main causes for this decline has been the spread of spear rot disease, aggravated by the rebel insurgence between 1986 and 1990, which prevented maintenance of the oil palm fields and adequate control of the disease. Although spear rot has been found on all three plantations, it has affected Victoria the most, where around 80% of the area cultivated has been abandoned and fruit production has declined by some 90%.

Spear rot has remained a major problem in Suriname and efforts to eradicate it have been unsuccessful. Research has shown that the Victoria plantation should not be immediately replanted with oil palm, because of the possible quick reappearance of the disease. An alternative is to cultivate hybrids that are disease resistant; however, their productivity is lower than that of the variety currently cropped in Suriname. Due to investments in land improvement, equipment, buildings and other infrastructure, the oil palm company, GPOV, would like to make use of these resources in developing alternative agricultural activities until a long-term solution to spear rot is found. The need to explore such alternatives is also based on the fact that the disease has already been identified in the Phedra and Patamacca plantations, and it is only a matter of time before fruit production is seriously affected.

Several crop and livestock activities were considered, and a number of criteria were used to select those that have the best potential for Victoria. A two-step process was used to select the activities, and each was ranked against the various criteria. In the first, a number of crops and livestock activities were pre-selected according to their suitability to agroecological conditions. Those were: 9 annual crops (maize, sorghum, cowpea, soybean, peanut, pumpkin, melon, tannia and other vegetables), 13 fruit crops (brazil nuts, cocoa, carambola, grapefruit, guava, Tahiti lime, papaya, passion fruit, peach palm, pineapple, rambutan, soursop and West Indian cherry), and two livestock production systems (four cattle-based systems and a sheep fattening system).

In the second step, a number of technical and economic criteria were considered to select the most promising alternatives from among the pre-selected. Other factors also considered in this step were: the compatibility of alternatives with current GPOV activities; financial and other resource constraints of the company; research and experience with other crops and livestock activities at Victoria and in Suriname. The following were selected as the most suitable alternatives for Victoria: two annual crops (soybean and peanut), two fruit crops (peach palm and passion fruit), and five livestock production enterprises (two cattle-fattening models, two dairy breeding stock and milk production models and one sheep-fattening system). It was also recommended that experiments with a number of fruit crops be conducted at

Phedra and Patamacca to examine their production and economic feasibility, should alternatives be required for those plantations too.

Other factors that could constrain development of the alternatives recommended were also considered, including: (i) the technical, financial, managerial and administrative capacity of GPOV to venture into alternative production activities; (ii) the changing labor market situation in Suriname; and (iii) the country's overall economic policy environment.

The costs, returns and cash flow were estimated for each alternative. Soybean and peanut were considered as good import substitutes, and they can be easily integrated with oil palm and livestock activities, but their financial and economic viability are low (particularly soybean). They are risky enterprises requiring prior research, technology validation and assessment of production feasibility. In the case of soybean, the risks are higher at yield levels below 1.5 mt/hectare. With regard to fruit crops, peach palm has the highest investment needs, operating costs and foreign exchange requirements compared to all the other alternatives. However its labor needs are low, it has the highest returns per hectare and financial viability, and can contribute the most to generating foreign exchange earnings. It also has an advantage over the other alternatives: a foreign investor has already indicated interest in developing this crop and marketing its product abroad. Given the local market situation, passion fruit is also financially, if yields can be increased to at least 6 mt/hectare.

Of the livestock activities, cattle and sheep fattening have good potential. A low-cost natural pasture already exists to fatten cattle and sheep, and the proposed production systems have low investment needs and operating costs, as well as reduced foreign exchange and labor requirements. There is a good local market for mutton, but exporting meat is constrained by the fact that Suriname does not have adequate processing facilities to meet export market standards. The financial feasibility of the dairy production models is lower, because of the high costs of investment and operations, the need to employ a higher level of technology and high foreign exchange requirements.

An implementation strategy was also proposed for the alternatives recommended. For annual crops, it was suggested that the cropping activities be developed over a 7-year period, of which the first two years would concentrate on research and development. Commercial production would begin in year 3, with two crops per year. These crops would be rotated with oil palm, natural pasture and cultivated pastures. By year 5, the area cultivated is expected to stabilize at 300 ha under soybean and 150 ha under peanut. It is also proposed that in both phases, these crops be developed through a multi-institutional effort to include the GPOV, LVV, the University and the National Soybean Council.

With regard to fruit crops, the strategy recommended for peach palm is to develop 350 ha over a 4-year period, using imported seed started in nurseries at Victoria. The peach palm would be processed in a factory to be established at Victoria, and canned hearts of palm would be produced for export. The proposal for passion fruit includes rehabilitating the 13 ha already cultivated with this crop, modifying the production system to increase yields, and disposing of the output on the local market.

The livestock production alternatives would be developed in four phases. The first would concentrate on planning, generating information and

identifying resource needs. Two cattle-fattening models to produce meat for export were recommended. The first would be developed in phase two (years 2 to 5). It would utilize 277 ha of land already under Sara Sara grass for a 5-year period, and have a carrying capacity of 1 AU/hectare. The second model proposes utilizing 80 ha of pasture only, and increasing the level of technology and the stocking rate to 3.5 AU/hectare. Supplementary feed would be used in both models, and additional infrastructure would be required in the second model only.

In both dairy production models, it is recommended that 52 hectares be utilized. Alternative "A" proposes to develop 93 AU into 183 AU over five years, while Alternative "B" would develop 123 AU into 183 AU over a 6-year period. Both production systems would use grass pasture as the main feed source, supplemented with kernel cake and other feed inputs. Pens, equipment and other infrastructure would be required, and milk would be the main output for sale on the domestic market. In the sheep fattening system, mutton would be produced for sale in both the local and export markets. Its main input requirements would be 9 ha of land with improved pastures, supplementary feed and infrastructure for pasture maintenance and herd management.

In addition to the above, the following is noted:

- Peach palm offers the best potential for Victoria. It satisfies several requirements as a good alternative to oil palm, the most important of which are: it places the lightest financial burden on GPOV because external financing can be secured and the product exported through partnership with a foreign investor, its labor requirements are low, and it makes the highest contribution to foreign exchange earnings.

- Fattening cattle and sheep are good alternatives too, but whether meat can be exported will depend on the establishment of a new meat processing facility, or rehabilitation of the existing one to meet export standards. Given the potential local market for mutton, this enterprise can represent a high priority for development, though on a smaller scale.

- GPOV should continue to cultivate passion fruit but with improved production and management techniques. The experience gained from this enterprise can be valuable if alternatives should also be needed for Phedra and Patamacca. The company should also experiment with other fruit crops on those plantations in case replacements for oil palm prove to be required.

- The risks with soybean and peanut are high because they require prior research and validation at Victoria, yields are uncertain and their financial viability is low. Therefore, a cautious approach should be adopted to pursue these alternatives.

- It is assumed that the problems affecting oil palm production will continue for some time, and that the availability of managerial, technical and financial resources to embark on alternative enterprises is limited. The company should consider the possibility of leasing part or all of its production operations and\or of collaborating with domestic or foreign private enterprises in the new initiatives.

The need to attract investment capital and technology, exploit market potential and adopt improved management techniques are some compelling reasons to do so.

- If GPOV intends to be actively involved in the alternative enterprises, a separate division should be established within the company (or preferably a separate company be formed), and provided with independent management, administrative and technical staff, as well as its own labor force and finances to embark on alternative cropping and/or livestock activities. The only transfers from Victoria would be land, access roads, and if available, some office and residential accommodations.

- The separate entity should manage the agricultural enterprise(s) on a commercial basis. Initially, it should devote substantial land areas to those products for which the technology and production techniques have been validated and tested, satisfactory yields are envisaged and markets assured. This will require investments in additional facilities for technical and support personnel, as well as processing and/or packaging facilities, which still have to be estimated. In addition, the company should have a commercial testing unit to validate the potential of other crops suitable to the agroecological conditions existing at and around the oil palm plantations, and develop a dynamic marketing division with offices in Paramaribo to promote its products on the local and export markets.

- There is a need to improve the operational efficiency of GPOV if it is to venture into new enterprises and attract financing. There is a limit to government transfers in the short and medium term given the public sector's deteriorating financial situation and the possibility that Suriname may soon implement a structural adjustment program.

- Rational product pricing and an effective market strategy must be pursued if the oil palm sub-sector is to survive. Price controls should be removed, so that it could be determined by the market.

- With regard to markets, both the domestic and export markets should be carefully evaluated to determine their size and the extent to which Suriname can meet their needs. Production should be planned to meet domestic market needs, and output efficiency should be improved if the country is to be competitive on the export market.

- In view of GPOV's long-term commitment to oil palm, it is critical that research efforts be intensified in Suriname and closer collaboration be developed with international research centers to address the spear rot problem. A research program is needed for both the medium and long term. Medium term efforts could be oriented to identifying the causes of the disease and to determining control measures, while long-term research could involve plant breeding to find high-yielding, spear rot-resistant varieties. Although the quality of currently available hybrids is high, a breeding program to improve yields while maintaining such quality would be important.

- Reform of macroeconomic and sectoral policies is necessary if distortions and disincentives to production activities and trade are to be removed. This is also important for GPOV, if oil palm production and investments in alternative agricultural activities are to be economically viable.

- The purpose of the current exercise was to identify potential alternatives to oil palm. The data available and the criteria used in the evaluation were limited. As a result, a comprehensive comparative analysis of the alternatives, was not made because it was not possible to consider the full range of factors likely to affect financial and economic viability. A more detailed feasibility study will be needed to determine these. Issues such as risk factors, sensitivity analysis and those related to market potential can be addressed more adequately in such a study.

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# ANNEX 1

# STATISTICS ON THE ECONOMY AND THE OIL PALM SECTOR

Table 1.1

Annual Real Growth Rate of GDP at Factor Cost by Economic Activity (1980 prices)

| Sectors | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture, Animal Husbandry, Forestry and Fishing | 1.8 | 13.2 | -3.1 | -8.8 | 3.8 | 1.5 | -2.6 | 5.5 | -0.5 | -2.4 | 0.3 |
| Mining and Quarrying | -28.0 | 6.0 | -21.4 | -25.1 | 28.1 | 18.5 | 13.5 | -17.7 | 43.8 | 6.6 | -1.7 |
| Manufacturing | -10.5 | 2.8 | -16.4 | -9.5 | -3.2 | 6.5 | 2.7 | -21.9 | 14.8 | 1.6 | -9.6 |
| Gas, Water & Electricity | 1.3 | -10.4 | -18.8 | 1.1 | -0.2 | 6.0 | 20.8 | -6.9 | 34.0 | 7.6 | 11.3 |
| Construction | -15.5 | 20.0 | -1.7 | -9.7 | 3.9 | -11.3 | 7.3 | -17.3 | -1.7 | -10.3 | -6.3 |
| Trade, Restaurants & Hotels | -10.9 | -3.5 | 2.2 | -5.4 | -15.8 | -11.0 | -10.1 | -28.9 | 13.3 | 32.1 | -6.7 |
| Transport, Storage & Communication | -17.8 | -5.1 | 2.0 | -0.1 | -1.3 | 3.7 | 0.8 | 13.5 | -0.2 | -4.8 | -3.0 |
| Finacial Institutions & Insurance | 7.8 | 36.2 | -14.7 | -19.7 | -6.3 | 22.5 | -2.9 | 21.6 | 6.1 | 10.7 | -2.0 |
| Housing, Other Real Estate & Business Services | 1.1 | 3.4 | 2.1 | 1.8 | 1.4 | 5.0 | 3.5 | 1.9 | 3.9 | 0.6 | 1.6 |
| Public Administration & Defence | 1.9 | 22.2 | 8.1 | 8.0 | 0.0 | 3.3 | 2.8 | 8.5 | -0.2 | 1.3 | 1.8 |
| Personal, Social & Other Community Services | 0.8 | -1.2 | -3.1 | 5.8 | -7.8 | 5.6 | -8.8 | -4.1 | 9.5 | -7.9 | -3.7 |
| Less: Imputed Bank Service Charges | 19.4 | 26.4 | -16.1 | -25.6 | -6.5 | 18.7 | 21.4 | 22.1 | 12.2 | 9.7 | 1.3 |
| GDP Growth Rate | -8.7 | 7.1 | -4.2 | -3.9 | -1.9 | 2.0 | 0.8 | -6.2 | 8.2 | 4.2 | -1.7 |

Source: Central Statistical Office

Table 1.2

Total Area Cultivated, Area Harvested and Oil Palm Fruit Production, 1974-91

| Description | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Area Cultivated (Hectares)** | | | | | | | | | | | | | | | | | | |
| - Victoria Plantation | 1,212 | 1,424 | 1,649 | 1,649 | 1,649 | 1,649 | 1,649 | 1,649 | 1,649 | 1,649 | 1,649 | 1,704 | 1,704 | 1,704 | 1,704 | 1,704 | 1,704 | 1,704 |
| - Phedra Plantation* | | | | | | 53 | 416 | 593 | 844 | 844 | 844 | 844 | 844 | 844 | 844 | 844 | 844 | 844 |
| - Patamacca Plantation* | | | | | | | | | 549 | 1,501 | 2,549 | 3,048 | 3,295 | 3,295 | 3,295 | 3,295 | 3,295 | 3,295 |
| - Small Farmers | | | | | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 307 |
| Total Cultivated Area | 1,212 | 1,424 | 1,649 | 1,649 | 1,956 | 2,009 | 2,372 | 2,549 | 3,349 | 4,301 | 5,349 | 5,903 | 6,150 | 6,150 | 6,150 | 6,150 | 6,150 | 6,150 |
| **Area Harvested (Hectares)** | | | | | | | | | | | | | | | | | | |
| - Victoria Plantation | 280 | 586 | 782 | 1198 | 1456 | 1607 | 1624 | 1635.5 | 1649.1 | 1649.1 | 1649.1 | 1649.1 | 1649.1 | 1674.1 | 1526 | 1250 | 923 | 650 |
| - Phedra Plantation | | | | | | | | 53.2 | 416.3 | 593.2 | 843.2 | 876.8 | 876.8 | 876.8 | 876.8 | 876.8 | 843.2 | 763.6 |
| - Patamacca Plantation | | | | | | | | | | | 98.2 | 692.6 | 1500.4 | | | | | |
| - Small Farmers | | | | | 25 | 75 | 134 | 307 | 307 | 307 | 307 | 307 | 307 | 307 | 245 | 230 | 115 | 90 |
| Total Harvested Area | 280 | 586 | 782 | 1,196 | 1,481 | 1,682 | 1,758 | 1,996 | 2,372 | 2,549 | 2,898 | 3,526 | 4,333 | 2,858 | 2,648 | 2,357 | 1,881 | 1,504 |
| **Fruit Production (MT of FFB)*** | | | | | | | | | | | | | | | | | | |
| - Victoria Plantation | 768 | 3,275 | 7,296 | 10,083 | 14,838 | 24,703 | 20,670 | 23,243 | 22,594 | 22,625 | 23,211 | 23,671 | 16,893 | 1,713 | 9,228 | 6,848 | 2,944 | 2,656 |
| - Phedra Plantation | | | | | | | | 237 | 2,509 | 5,749 | 7,270 | 10,363 | 10,006 | 87 | 1,299 | 5,973 | 4,353 | 4,188 |
| - Patamacca Plantation | | | | | | | | | | | 290 | 1,309 | 3,436 | | | | | |
| - Small Farmers | | | | | 13 | 56 | 356 | 1,173 | 3,085 | 2,861 | 3,123 | 2,894 | 1,425 | 190 | 1,083 | 1,134 | 397 | 97 |
| Total Production | 768 | 3,275 | 7,296 | 10,083 | 14,851 | 24,759 | 21,026 | 24,653 | 28,188 | 31,235 | 33,894 | 38,237 | 31,760 | 1,990 | 11,610 | 13,955 | 7,694 | 6,941 |
| **Productivity per HA** | | | | | | | | | | | | | | | | | | |
| - Victoria Plantation | 2.74 | 5.59 | 9.33 | 8.42 | 10.19 | 15.37 | 12.73 | 14.21 | 13.70 | 13.72 | 14.07 | 14.35 | 10.24 | 1.02 | 6.05 | 5.48 | 3.19 | 4.09 |
| - Phedra Plantation | | | | | | | | 4.45 | 6.03 | 9.69 | 8.62 | 11.82 | 11.41 | 0.10 | 1.48 | 6.81 | 5.16 | 5.48 |
| - Patamacca Plantation | | | | | | | | | | | 2.95 | 1.89 | 2.29 | | | | | |
| - Small Farmers | | | | | 0.52 | 0.75 | 2.66 | 3.82 | 10.05 | 9.32 | 10.17 | 9.43 | 4.64 | 0.62 | 4.42 | 4.93 | 3.45 | 1.08 |
| Total Production | 2.74 | 5.59 | 9.33 | 8.42 | 10.03 | 14.72 | 11.96 | 12.35 | 11.88 | 12.25 | 11.70 | 10.85 | 7.33 | 0.70 | 4.38 | 5.92 | 4.09 | 4.62 |

FFB - Fresh fruit bunch

* Harvesting of fruits was affected by the rebel insurgence from 1986. As a result, no fruits were harvested at Patamacca and there was reduced production at both Victora and Phedra. Data for 1986 and 1987 are for 10 months and 4 months respectively.

Source: GPOV

Table 1.3

Production, Local Sales and Exports of Palm Oil anb By-Products by Victoria Company Ltd., 1974-91 (Mt)*

| Activity | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total fruit delivered to Victoria | 788 | 3,275 | 7,296 | 10,083 | 14,851 | 24,759 | 21,026 | 24,653 | 28,188 | 31,235 | 33,895 | 38,211 | 30,297 | 1,990 | 11,610 | 13,955 | 7,694 | 6,941 |
| Crude Oil | | | | | | | | | | | | | | | | | | |
| Production | 131.2 | 632.8 | 1336.5 | 1841.5 | 2806.4 | 4674.1 | 4090.9 | 4721.6 | 5691.0 | 6558.0 | 7139.7 | 7958.3 | 6024.3 | 370.9 | 2226.8 | 2950.7 | 1573.7 | 1503.6 |
| Extraction rate (%) | 17.1 | 19.3 | 18.3 | 18.3 | 18.9 | 19.7 | 19.5 | 19.2 | 20.2 | 21.0 | 21.0 | 20.8 | 19.9 | 18.7 | 19.5 | 21.1 | 20.8 | 22.0 |
| Delivery to refinery | - | - | - | 664.4 | 2309.1 | 2581.6 | 3647.2 | 4804.0 | 5044.0 | 6153.9 | 6872.8 | 6947.7 | 4703.4 | 1094.5 | 1855.0 | 3400.6 | 1795.1 | 1698.3 |
| Local sales | 13.2 | 68.6 | 27.9 | 0.2 | - | - | - | - | - | - | - | - | 685.2 | - | - | - | - | 124.1 |
| Palm Kernel | | | | | | | | | | | | | | | | | | |
| Production | - | - | 58.8 | 368.9 | 734.5 | 993.9 | 844.0 | 880.4 | 1133.3 | 1179.9 | 1531.0 | 1967.0 | 1609.3 | 78.0 | 560.4 | 640.0 | 363.2 | 279.8 |
| Extraction rate (%) | - | - | 0.8 | 3.7 | 4.9 | 4.0 | 4.0 | 3.6 | 4.0 | 3.8 | 4.5 | 5.2 | 5.3 | 3.9 | 4.9 | 4.6 | 4.2 | 4.1 |
| Delivery to kernel extraction factory | - | - | - | - | - | - | - | - | - | 1723.7 | 2243.0 | 1951.0 | 1590.6 | 57.9 | 558.7 | 653.3 | 364.1 | 281.4 |
| Exports | - | - | 49.3 | 355.8 | 690.0 | 1000.9 | 725.9 | 935.3 | - | - | - | - | - | - | - | - | - | - |
| Kernel Processing | | | | | | | | | | | | | | | | | | |
| Kernel received | - | - | - | - | - | - | - | - | - | 1723.7 | 2243.0 | 1951.0 | 1590.6 | 57.9 | 558.7 | 653.3 | 364.1 | 281.4 |
| Crude oil produced | - | - | - | - | - | - | - | - | - | 549.8 | 671.0 | 660.0 | 515.2 | 17.9 | 180.0 | 230.4 | 125.0 | 99.4 |
| Extraction rate (%) | - | - | - | - | - | - | - | - | - | 31.9 | 29.9 | 33.8 | 32.4 | 30.9 | 32.2 | 35.3 | 34.3 | 33.8 |
| Local sales | - | - | - | - | - | - | - | - | - | 3.5 | 19.0 | 53.0 | 22.0 | 7.6 | 6.2 | 22.5 | 7.5 | 40.7 |
| Delivery to refinery | - | - | - | - | - | - | - | - | - | 446.8 | 466.0 | 304.6 | 711.9 | 83.6 | 306.9 | 216.7 | 87.7 | 39.8 |
| Kernel Cake | | | | | | | | | | | | | | | | | | |
| Production | - | - | - | - | - | - | - | - | - | 669.0 | 1180.0 | 866.0 | 788.0 | 26.9 | 256.6 | 308.7 | 165.2 | 155.4 |
| Extraction rate (%) | - | - | - | - | - | - | - | - | - | 38.8 | 52.6 | 44.4 | 49.5 | 46.5 | 45.9 | 47.2 | 46.8 | 55.2 |
| Local sales | - | - | - | - | - | - | - | - | - | 599.9 | 1134.0 | 905.0 | 855.0 | 20.6 | 221.9 | 285.7 | 183.7 | 122.8 |
| Refinery (Oil Delivere | | | | | | | | | | | | | | | | | | |
| Crude palm oil | - | - | - | 630.6 | 2323.3 | 2561.2 | 3647.2 | 4804.0 | 5044.0 | 6153.9 | 6872.8 | 6947.7 | 4703.4 | 1094.5 | 1906.4 | 3400.6 | 1795.1 | 1698.3 |
| Crude kernel oil | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 446.8 | 466.0 | 304.6 | 711.9 | 83.6 | 306.9 | 216.7 | 87.7 | 39.8 |
| Total crude palm & kernel oil | - | - | - | 630.6 | 2323.3 | 2581.2 | 3647.2 | 4804.0 | 5044.0 | 6600.7 | 7338.8 | 7252.3 | 5415.3 | 1178.1 | 2215.3 | 3617.3 | 1882.8 | 1738.2 |

Table 1.3 Cont'd

| Activity | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edible Oil | | | | | | | | | | | | | | | | | | |
| Production | - | - | - | 301.9 | 1613.4 | 1691.5 | 2375.9 | 3009.2 | 3152.1 | 4002.6 | 4191.0 | 3073.4 | 1534.2 | 533.4 | 559.4 | 1252.4 | - | - |
| Extraction rate (%) | - | - | - | 47.9 | 69.4 | 65.5 | 65.1 | 62.6 | 62.5 | 60.6 | 57.1 | 42.3 | 28.3 | 45.3 | 25.3 | 34.6 | - | - |
| Local sales | - | - | - | 271.5 | 1624.1 | 1697.3 | 2382.1 | 3004.1 | 3151.4 | 3981.9 | 4151.4 | 3090.1 | 1598.2 | 477.8 | 607.3 | 1068.0 | - | - |
| Mixed Edible Oil | | | | | | | | | | | | | | | | | | |
| Production | - | - | - | - | - | - | - | - | - | 43.1 | 118.0 | 571.2 | 1938.3 | 127.4 | 910.9 | 1379.4 | 1254.5 | 939.2 |
| Extraction rate (%) | - | - | - | - | - | - | - | - | - | 0.7 | 1.6 | 7.9 | 35.8 | 10.8 | 41.1 | 38.1 | 66.6 | 54.0 |
| Local sales | - | - | - | - | - | - | - | - | - | 20.8 | 134.4 | 568.4 | 1920.3 | 104.7 | 932.2 | 1427.4 | 1352.3 | 970.7 |
| Refined Palm Oil | | | | | | | | | | | | | | | | | | |
| Production | 0.0 | 0.0 | 0.0 | 0.5 | 8.3 | 138.3 | 143.9 | 88.0 | 4.6 | 30.4 | 434.0 | 669.6 | 595.5 | 3.5 | 75.9 | 69.2 | 5.9 | 2.9 |
| Extraction rate (%) | - | - | - | 0.1 | 0.4 | 5.4 | 3.9 | 1.8 | 0.1 | 0.5 | 5.9 | 9.2 | 11.0 | 0.3 | 3.4 | 1.9 | 0.3 | 0.2 |
| Local sales | 0.0 | 0.0 | 0.0 | 0.5 | 8.3 | 138.3 | 143.9 | 88.0 | 4.6 | 30.4 | 433.3 | 669.5 | 571.8 | 0.2 | 84.5 | 61.7 | 5.9 | 2.9 |
| Refined Kernel Oil | | | | | | | | | | | | | | | | | | |
| Production | - | - | - | - | - | - | - | - | - | 1.1 | 94.0 | 108.2 | 133.8 | 40.1 | 32.3 | 27.5 | 6.7 | 4.1 |
| Extraction rate (%) | - | - | - | - | - | - | - | - | - | 0.2 | 1.3 | 1.5 | 2.5 | 3.4 | 1.5 | 0.8 | 0.4 | 0.2 |
| Local sales | - | - | - | - | - | - | - | - | - | 1.1 | 90.8 | 108.5 | 133.0 | 28.6 | 31.7 | 33.7 | 6.7 | 4.1 |
| Fatty Acid: | | | | | | | | | | | | | | | | | | |
| Production (kg) | - | - | - | 29.3 | 105.4 | 120.3 | 177.2 | 213.7 | 316.6 | 397.0 | 400.0 | 375.5 | 244.6 | 180.2 | 152.5 | 184.1 | 115.0 | 111.9 |
| Extraction rate (%) | - | - | - | 4.7 | 4.5 | 4.7 | 4.9 | 4.4 | 6.3 | 6.0 | 5.5 | 5.2 | 4.5 | 5.3 | 6.9 | 5.1 | 6.1 | 6.4 |
| Local sales (kg) | - | - | - | 4.1 | 4.2 | 4.9 | 8.0 | 7.0 | 8.0 | 2.0 | 19.4 | 21.0 | 54.6 | 79.8 | 153.5 | 12.7 | 29.5 | 11.1 |
| Exports (kg) | - | - | - | - | 100.1 | 98.6 | 116.2 | 237.4 | 313.7 | 356.9 | 358.5 | 313.3 | - | 356.9 | - | - | - | - |
| Condensed Oil: | | | | | | | | | | | | | | | | | | |
| Production (kg) | - | - | - | 219.8 | 663.6 | 591.1 | 943.7 | 1357.8 | 1573.8 | 2127.1 | 1969.0 | 2333.5 | - | 6.4 | 82.9 | 24.3 | 98.2 | 508.2 |
| Extraction rate (%) | - | - | - | 34.9 | 28.6 | 22.9 | 25.9 | 28.3 | 31.2 | 32.2 | 26.8 | 32.2 | - | 0.6 | 3.7 | 0.7 | 5.2 | 29.2 |
| Local sales (kg) | - | - | - | 10.0 | 26.8 | 12.1 | 18.9 | 26.5 | 27.9 | 52.1 | 160.4 | 175.6 | 103.7 | 4.7 | 45.4 | 60.1 | 55.1 | 97.0 |
| Exports (kg packed) | - | - | - | 115.0 | 519.9 | 608.0 | 811.2 | 559.7 | 5.0 | - | - | - | - | - | - | - | - | - |
| Exports (kg bulk) | - | - | - | - | - | - | - | 653.5 | 1573.9 | 1823.6 | 1797.9 | 2602.9 | - | - | - | - | - | - |

* Production data for 1986 and 1987 are for 10 months and 4 months respectively.

Source: GPOV

Table 1.4

Real Wholesale and Retail Prices of Palm Oil and Fatty Acid (SF per MT) *

| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oleine: | | | | | | | | | | | | | |
| Wholesale (packed) | 2433.1 | 2492.3 | 2292.7 | 2136.9 | 2184.1 | 2106.3 | 1899.5 | 1600.4 | 1621.0 | 1510.4 | 1499.1 | 1231.3 | |
| Retail (packed) | 2610.9 | 2747.5 | 2527.4 | 2355.7 | 2417.8 | 2331.7 | 2102.8 | 1771.6 | 1732.6 | 1614.4 | 1602.4 | 1316.1 | |
| Blend (Culina): | | | | | | | | | | | | | |
| Wholesale (packed) | | | | | 2409.8 | 2323.9 | 2095.8 | 1765.7 | 1817.3 | 1693.4 | 1680.7 | 1380.5 | 1176.7 |
| Retail (packed) | | | | | 2635.4 | 2541.5 | 2292.0 | 1931.1 | 1925.1 | 1793.8 | 1780.4 | 1462.4 | 1246.5 |
| Refined Palm Oil | 1450.0 | 1280.6 | 1178.1 | 1098.0 | 1450.8 | 1294.2 | 1159.0 | 983.9 | 693.1 | 1025.3 | 1055.7 | 1743.8 | 1729.6 |
| Fatty Acid | 815.0 | 706.6 | 650.0 | 605.8 | 580.3 | 559.7 | 504.7 | 261.0 | 298.7 | 286.4 | 439.4 | 323.8 | 274.0 |

* Deflated by Consumer Price Index

Source: GPOV

# ANNEX 2

# AGROECOLOGIAL SUMMARY OF VICTORIA

# AGROECOLOGICAL SUMMARY OF VICTORIA

## Climate

The climate in Suriname is characterized by four seasons, namely two rainy and two dry seasons as follows:

(i) A long rainy season from April to August.
(ii) A long dry season from August to December.
(iii) A short rainy season from December to February.
(iv) A short dry season from February to April.

The demarcations between the seasons are not clearly pronounced and the annual variations could be rather high. In some years the short rainy season or the short dry season may be non-existent, but both the long rainy and dry seasons are always fairly defined. The differences in rainfall between the seasons is caused by the changing position of the so-called Inter Tropical Conference Zone (ITCZ).

Victoria lies approximately 50° N Lat. and 55° W Long, about 125 km inland to the south of Paramaribo. The average total annual rainfall is 2500 mm and this is distributed accordingly with the seasonal pattern described above. During the long dry season there is a significant water deficit and the average total annual sunshine averaging about 2000 hours. The average annual temperature is about 27°C with a seasonal variation of 5 to 7°, and a wider variation of almost 10°C between the cooler months earlier in the year and the hotter months during mid-year.

## Geophysical Characteristics

Victoria is characterized by flat to gently rolling forested landscape comprising the following features.

(i) **The recent river floodplains** at a height of 4m to 7m above sea level. These consist of very sandy levees and heavy clay basin soils and creek valleys.

(ii) **Low terraces** at a height of 7m to 11m above sea level. They are very flat and consist of sandy loam to sandy clay. The total area is very small.

(iii) **Medium terraces** at a height of 11m to 17m above sea level. There are slightly undulating and consist of clay to very heavy clay soils. There is also sandy loam and sandy clay.

(iv) **High terraces** at a height of 17m to 25m above sea level. They are slightly undulating and consist mainly of coarse sand in the western area. Close to the river or the creek, they consist of clay to heavy clay soils.

(v) **The Compagnie landscape** at a height of 11m to 17m above sea level. This landscape is slightly undulating. The soils are residual soils developed on the stones from the Rosebel Series and consist of bleached sand to sandy loam.

(vi) **The Tempati landscape** which attains a height of 30m above sea level. This landscape is hilly and a steeply dissected low land with steepest slopes from 16% to 30% or more. The soils are residual, developed on parent material from the Paramakka series and consist mainly of red brown clay.

The most important soil groups are:

(i) The recent river floodplains.
(ii) The medium terraces.
(iii) The high terraces.

The landscape of the several terraces and the river floodplain are just like a staircase, where the age of the various levels increases with the height. High and medium terraces are of Pleistocene age; low terraces and the recent river floodplains are of Holocene age. After the stow at Afobakka was constructed the inundation of the recent river floodplains stopped.

On the landscapes several soils were developed. For agricultural purposes the following soil series are important:[1]

**(i) Soils**

(1) Asigron series. These are well-drained comprising brown to yellow brown sands situated on the levees.

(2) Assipoya series. These are well-drained yellow-brown clay and silty-clay soils.

(3) Devis series. These are poor to moderately well-drained clay and silty clay soils.

**(ii) Blow terraces**

(4) Rementcourt series. These soils are well-drained sandy loams to sandy clay loams.

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[1] Based on "Soils and Soil Suitability of the Land of Victoria" from M. W. H. de Boer, January 1976.

(5) Berg en Dal series. These soils are well-drained clay to sandy clay soils.

**(iii) Medium terraces**

(6) Maserikori series. These soils are well-drained sandy clay loams.

(7) Moroe series. These soils are well-drained sandy clay soils.

(8) Victoria series. These soils are moderately well-drained clay to heavy clay soils.

(9) Inini series. These soils are imperfectly drained sandy clays and clays.

**(iv) High terraces**

(10) Koerawa series. These soils are well-drained sandy loams.

(11) Nason series. These soils are moderately well-drained clay soils with gravel.

(12) Toemtoe series. These soils are well to moderately well-drained clay soils.

# ANNEX 3

# SUMMARY OF FRUIT CROPS ASSESSMENT AT VICTORIA

## Summary of Fruit Crops Assessment at Victoria

### 1. First Planting

Evaluation of the performance of different fruit crop species at Victoria farm started in 1974. Unfortunately, the results from these were not well documented. Following are the most important results, as reported by species:

(a) **Cashew**: Phenological observations on the performance of this crop showed a low yield as a result of a poor fruit setting, even though the report does not elaborate the possible causes.

(b) **Citrus:** The development of all plants within the different species tested was only moderate. Unfortunately, details could not be found regarding performance of individual species (e.g., yield, quality, etc.).

(c) **Guava**: Two cultivars were tested ('Centeno prolific' and 'Indian white'). Pests such as lice and fruit flies were found to affect both the plants and fruits, but this problem was overcome with the application of insecticides. Although the flowering was irregular, the fruit yield was fairly good.

(d) **Papaya:** The yield was generally poor as a result of a low fruit setting. Soils on which the plants were established were characterized by poor drainage and a low pH content. The need to supplement with calcium-rich fertilizers was recommended.

(e) **Passion fruit (markoesa):** Production was low due to sub-optimal physical soil conditions (compactation, poor drainage and low pH) and unknown diseases. Use of the 'I' trellis system with only one wire was reported as the most convenient. A better selection of planting material such as more compatible clones was recommended to increase yield.

(f) **Pineapple**: The plants developed well even on the low fertility soils. Use of specific herbicides and flowering hormones was recommended to reduce weeding costs and rationalize the cultural practices and increase yield.

(g) **Soursop**: Bagging the fruits was necessary because of a high damage of the fruits by fruit wasps and moths (fruit and seed borrowers). However, this practice was costly as it was labor intensive. The use of suitable rootstocks was recommended to deal with soil problems.

(h) **West Indian cherry**: Plant development was moderate and flowering irregular. Details about yield or other parameters to evaluate the performance of this crop are unavailable.

Trials were conducted also on other crops such as **sapodilla** (Achras sapota), **tomato tree** (Cyphomandra betacea) and **kasjoena** (Annona reticulata). Unfortunately, not enough information was reported to derive any conclusions on these.

## 2. Second Planting Evaluation

After the rebel disturbance in 1987, a large part of the northern area of Victoria that was planted with oil palm was abandoned, due to the spear rot disease and high costs for cleaning and maintenance. About 30 ha. in this area were cleared for trial in passion fruit and pineapple cultivation. The first plots of passion fruit and pineapple were experimented in 1988 and 1990 respectively, taking advantage of planting material (for pineapple) that was available locally. Some results from these plots are:

(a) **Passion fruit**: During the period 1988-89, small experimental plots of passion fruit were established on 5.5 ha., using 3 mixed clones. The yield from the first two hectares was low and this may have been related to poor activity of the main pollinators. This was clearly demonstrated by trials using hand pollination, which resulted in at least a 50 percent increase in yield. This area was then replaced by a second plot of 3 ha. in 1991, using seeds from the first experiment. Plants in the new plot showed nutrient deficiencies, drop of flowers, thick stem feet and low yields, despite the use of hand pollination. In general weed control was and continues to be a costly practice, due to scarcity and high cost of labor and chemicals. Although yields have been low compared with other plots in the country, returns have been close to production costs.

(b) **Pineapple**: The experiment started in 1991 with 5,000 plants from diverse origins (and unknown varieties). Plant distances were wide and weed control were very expensive without the use of herbicides. This project was abandoned after one year, despite this, the plant continued to grow and produce, indicating its adaptability to the environmental conditions at Victoria.

Both experiments suggest that the experiences with fruit crops in the 1970's were not utilized to improve cultivation in the second trials. The main reason is the limiting factors that affected cultivation and production were identified in the first experiments but they were not corrected in the second attempt.

## 3. Assessment of Alternative Crops

Based on the agroecological conditions at Victoria, 13 fruit crops were considered to have good potential regarding their adaptability.

(a) **Brazil Nuts**: Two species, the true Brazil nut (Bertholletia excelsa) and the Paradise nut (Lecythis zabucajo) native to the Amazonian basin were considered. The environment at Victoria is quite favorable for both species, and they could adapt well

to the soils on the recent river plain and on the lower terrace. The Paradise nut could also do well in a location having a high water table and/or if occasional flooding occurs. Although aspects of adaptability and market potential would make this crop a good candidate, its propagation on a large scale is cumbersome and difficult. Furthermore, a long time period would be required before commercial production is possible.

(b) **Cocoa** (Theobroma cacao): This crop requires a tropical climate with a well distributed rainfall of no less than 1,500 mm and a high relative humidity (85%) for best performance. Soils must have good water retention as well as good drainage. It is suited for the lower and middle terraces at Victoria, except in some areas where there is poor drainage. Low pH is not a problem, since the plant can tolerate a pH as low as 3.9, although this would not be an ideal situation. Despite its easy adaptability, constraints such as diseases which caused abandonment of cocoa cultivation in Suriname in the past, and low and unstable export prices could affect its future development. Competition in the external market is strong and penetrating foreign markets would require a high quality product.

(c) **Carambola** (Averrhoa carambola): This crop is already common in Suriname. It could adapt to various soil conditions and would perform well in the lower and middle terraces at Victoria. One major constraint is that the fruit is easily infected by the carambola fruit fly (Bactrocera sp.), a pest which is already of quarantine importance in the country. Some efforts have been initiated to eradicate the fly but it may be some time before this can be achieved. Bagging the fruits is an alternative that is being done in Southeast Asia, but given the current labor situation in Suriname, this could be uneconomical. Furthermore, although the market potential is good for both fresh and processed products and favorable prices exist in the external markets, the fruits require sophisticated handling for export because they bruise easily.

(d) **Grapefruit** (Citrus paradisis): Grapefruits do well in tropical areas where average temperatures vary from 22 to 26°C and rainfall fluctuates between 1,800 and 2,000 mm. Conditions at Victoria are suitable for grapefruit cultivation, either on the lower and middle terraces or on the high terraces. The exception are some areas on the low terraces which are subjected to waterlogging during the rainy season. One constraint is the presence of the tristeza citrus virus, which may require a careful selection of rootstock, given the type of soil, pH and humidity of the area. With regard to the product market, both the fresh fruit and juice markets abroad are currently strong, but it is difficult for "new" exporters to penetrate these, unless product quality and competitive prices can be accepted.

(e) **Guava** (Psidium guayaba): This crop is adaptable to wider environmental conditions. It can perform well even under prolonged waterlogging conditions. The crop could perform well in most, if not all the areas at Victoria. However, it is susceptible to the

fruit fly, which could be an important constraint for cultivation on a commercial scale. The scarcity and high cost of chemicals in Suriname to control these pests could also affect its economic viability. Nevertheless, although the traditional demand for guava is in a processed form, there is a growing market for table and processed guavas.

(f) **Lime 'Tahiti'** (Citrus latifolia, Tan.): This is a green seedless lime that is bigger than the popular West Indian lime (10-12 fruits per kg.); its production in Latin America and the Caribbean is mainly oriented to the fresh fruit export market. This crop could produce good results on the well-drained lower and middle terraces at Victoria, providing the correct rootstock is chosen and the scion material is free of viruses (e.g., exocortis, xyloporosis and psorosis). Prospects in the external market are not favorable because the "Tahiti" lime represents only 0.01% of the total lemons and limes exported to the world market and several Latin American countries are already strong competitors.

(g) **Papaya** (Carica papaya): This is an attractive early bearing fruit crop, that is well adapted to the semi-humid tropical areas, with average temperatures between 24° and 26°C, and rainfall from 1,500 to 2,000 mm evenly distributed during the year. For good performance, papaya requires adequate drainage as waterlogging facilitates destruction of the root system by phytophthora. Under the conditions at Victoria, papaya would be suited to the well-drained lower and middle terraces. Low pH clay soils and low content of organic matter could be limiting factors due to blockage of some important micro-nutrients. Although some major pests and diseases of papaya have not been reported in Suriname (e.g., the papaya fruit fly Toxotrypana curvicauda and the bacterial decline Erwinia sp.), others such as fruit flies and "Bunchy top" may be a threat to large scale commercial production.

Both the fresh fruit and processed export markets for papaya have grown steadily and this trend is expected to continue. Even though, demand is strong, it is mainly for consistently-supplied and high-quality fruits. Likewise, the internal market for fruit processing seems to be good.

(h) **Passion Fruit** (Passiflora edulis f. flavicarpa). The yellow passion fruit or "markoesa" as popularly known in Suriname, requires a tropical climate with average temperatures ranging from 21 to 24°C and rainfall from 1,500 to 3,000 mm. For best performance, soils should be well drained and have a high content of organic matter; heavy soils with poor drainage should be avoided. Under low pH conditions, fertilization should be closely monitored because blockages of macro and micro-elements frequently occur.

Passion fruit has been cultivated on the high terraces (sandy soils) at Victoria for the last 3 to 4 years. The plants grow well but productivity has been low (about 2.0 tons per ha.), compared to between 6 and 8 tons/ha. achieved by other plots in the

country. This is due mainly to pest damages, nutrient deficiencies and insufficient natural pollination. Despite the possible ease of adaptability, it is a labor intensive crop, a factor which would seriously limit its large scale cultivation. A low labor input could affect the traditional cultural practices and reduce the possibility of increasing yields via hand pollination.

The internal market for passion fruit juice is good and is expected to continue to expand steadily. Likewise, there is an increasing external demand for the yellow variety as a fresh fruit. However, the concentrated juice market abroad is currently competitive and prices have followed a declining trend in the last 5 years.

(i) **Peach Palm** (Giulielma gasipaes): This palm tree requires an average rainfall of 2,500 mm, and performs well on a wide variety of soils, including those with heavy clays and those that have a high water table and are subjected to occasional flooding. The tree is used for the production of both fruits and cabbage (heart of palm). Fruits are usually marketed locally in most producing countries, but there is a high demand for "canned" hearts of palm (palmito) in export markets where prices are high.

This crop should grow well under the conditions in Suriname. At Victoria it would be suited to the soils of the river plain to the lower terraces and even in those with poor drainage. With regard to pests and diseases, no major ones seems to be present, as peach palm plantations in neighboring countries have not been affected yet by any. Furthermore, compared to most other fruit crops, this crop requires a low labor input.

(j) **Pineapple** (Ananas comosus): Pineapple requires a humid tropical climate, though some varieties are well adapted to dry tropical conditions. The ideal average temperature for this crop is 21° to 25°C, and evenly distributed rainfall (from 1,500 to 2,000 mm). Regarding soils, pineapple grows well on a permeable light soil with an acid pH ranging from 4 to 5.5. The fruit can be marketed fresh or processed (juice, pulp and canned slices).

The results of the initial trials at Victoria were not conclusive enough to suggest that this crop was unsuccessful, because the plants continued to grow healthy even with the lack of care. It is indicative that the crop is suited for this type of environment, but if large scale cultivation is attempted, some pest problems (such as Thecla basilides which is endemic in South America) could be an important constraint. Moreover, it is expected that nematodes and scales would present additional problems. Before any large scale planting is attempted, experimentation should be done to select the best varieties and clones that are adapted to local conditions. The lack of a large amount of planting material could also limit production on a commercial scale. Despite these factors, a significant advantage of this crop is that most of its cultural practices can be mechanized.

Product demand in the export market has been good for a long time and the supply sources have been dominated by large multinational companies. Any large scale operation intended for the export market (particularly for Europe and North America), could be economically risky if some linkages with these companies are not established.

(k) **Rambutan** (Nephelium lappaceum): Rambutan, a relative to the litchi, is well adapted to the humid tropics, with rainfall not less than 2,000 mm a year. Some scattered trees can be found in Suriname. Although there is not much experience with its cultivation in South America, the ecological conditions at Victoria seem to be suitable for its development. Reactions to low soil pH is difficult to predict. Furthermore, establish a commercial-size orchard could be a problem because high quality vegetative planting material is not easily accessible. The external market prospects for both fresh and canned fruits are good.

(l) **Soursop** (Annona muricata): This specie requires a humid tropical climate. The crop is not so exigent with regard to soil type and it adapts to a wide range of soils, provided that prolonged waterlogging is absent. Soursop performs well on soils that have a pH between 5.5 and 6.5. However, it may adapt to a lower pH soil, if supplemented by an adequate nutritional program to avoid deficiencies. There is an increasing market for Puree which is used to make drinks, ice creams, yogurt and flavorings. Competition in the puree market is still fairly low as excess demand for the product persists.

This crop is already popular in Suriname and is expected to perform well at Victoria, particularly on the well drained lower and middle terraces. A low pH and occasional waterlogging could be overcome by using local tolerant rootstocks such as A. glabra and A. montana. One main constraint is the attack on its fruit pulp and seed by the soursop wasp, **Bephrata maculicollis** and the soursop moth **Cerconota anonella.** Fruits attacked by these pests are susceptible to severe diseases such as anthracnose (**Colletotrichum sp.**). Bagging the fruits at an early stage of their development is an alternative but this is a costly operation.

(m) **West Indian Cherry** (Malpighia glabra): This shrub adapts well to the humid tropics, and performs well under a wide range of soils including heavy clays. At present, fruit demand by local processors is good and the external market has been growing steadily, but it is based mainly on fruits supplied with a high vitamin C content. The fruit is also used as a natural red colorant for cakes and in the mixture of fruit cocktails.

West Indian cherries are already cultivated commercially in Suriname for the juice processing industry. A good varietal selection which gives high yields has been released by LVV. Even though some problems still persist at the vegetative propagation stage, these can be resolved easily by training of staff and constructing

a mist propagation unit. Fruits are also susceptible to fruit flies and an important constraint is the high perishability of the fruit. Cherries must be processed and/or frozen within one or two days of harvest, because of the relatively small domestic market and the possibility of a glut situation being easily developed.

# ANNEX 4

# COSTS AND RETURNS FOR SOYBEAN AND PEANUT

**Table 4.1**

**Estimated Incremental Costs for Machinery and Equipment in the Pre-Commercial R & D Phase (SF'000)**

| Type of Equipment | Qty | Value* | Remarks |
|---|---|---|---|
| Tractor | 1 | 40.0 | already on location |
| Plough | 1 | 10.0 | already on location |
| Harrow | 1 | 100.0 | |
| Mist Blower | 3 | 40.0 | |
| Knapsack Sprayer | 4 | 20.0 | |
| 2 row planter | 2 | 120.0 | |
| Peanut thresher | 1 | 30.0 | |
| Bean thresher | 1 | 40.0 | |
| Bin drier (small) | 1 | 100.0 | |
| Misc equipment | - | 120.0 | |
| **Total** | | 620.0 | |

Notes:

(1) Tractor and plough are already on location. Costs are for major repairs and maintenance of these equipment.

(2) Costs of imported inputs are based on a currency conversion rate of US$1.00 = SF 20.00

**Table 4.2**

**Estimated Costs for Soybean and Peanut Development in the R & D Phase (SF'000)**

| Item | Yr1 | Yr2 | Total |
|---|---|---|---|
| Mach & Equip | 620 | 40 | 660 |
| Misc. Tools | 15 | 10 | 25 |
| Inputs (biocides) | 82 | 90 | 172 |
| Manpower | 75 | 80 | 155 |
| Total | 792 | 220 | 912 |

Notes:

(1) Costs for technical expertise to be obtained from GPOV, Ministry of Agriculture, CELOS, etc., are not included.

(2) Machinery and equipment procured in the first year will carry into the commercial phase.

(3) The costs of machinery, equipment and inputs procured abroad are based on a currency conversion rate of US$1.00 = SF 20.00

Table 4.3

**Estimated Investment Costs for Machinery and Equipment for Soybean and Peanut Production Modules (SF'000)**

| TYPE OF EQUIPMENT | YEAR 1 | | YEAR 2 | | YEAR 3 | | YEAR 4 | | YEAR 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | QTY | VALUE | QTY | VALUE | QTY | VALUE | QTY | VALUE | QTY | VALUE |
| Tractor | 1 | 400 | 1 | 400 | -- | --- | -- | --- | -- | --- |
| Plogh | 1 | 60 | 2 | 160 | -- | --- | -- | --- | -- | --- |
| Harrow | 1 | 100 | 1 | 100 | -- | --- | -- | --- | -- | --- |
| | | | | | -- | --- | -- | --- | | |
| T.M Spayer | 1 | 160 | | | -- | --- | -- | --- | -- | --- |
| Cultivator | 1 | 60 | 1 | 60 | -- | --- | -- | --- | -- | --- |
| Slasher | 1 | 100 | | | -- | --- | -- | --- | -- | --- |
| Planter | 1 | 160 | 1 | 160 | -- | --- | -- | --- | -- | --- |
| | | | | | -- | --- | -- | --- | -- | |
| Soya Combine | 1 | 900 | | | -- | --- | -- | --- | -- | --- |
| Peanut Digger | 1 | 120 | 1 | 120 | -- | --- | -- | --- | -- | --- |
| Peanut Combine | 1 | 600 | | | -- | --- | -- | --- | -- | --- |
| Trailer | 1 | 100 | 1 | 100 | -- | --- | -- | --- | -- | --- |
| Bin Drier | 1 | 240 | - | | -- | --- | -- | --- | -- | --- |
| Misc. Equipment | - | 400 | - | 200 | -- | 80 | -- | 120 | -- | 160 |
| Total Value | - | 3,400 | - | 1,300 | -- | 80 | -- | 120 | -- | 160 |

Notes:

(1) Most of the equipment is common to both operations except the peanut digger and combine (for peanut) and Soya combine (for soybean).

(2) Actual equipment utilization on the enterprises are as follows: for soybean enterprise it is 54% of total value; for peanut enterprise it is 32% of total value and 14% for other farm activites.

(3) Imported inputs are costed at a foreign exchange rate of US$1.00 = SF 20.00

**Table 4.4**

**Estimated Production Cost for Soyabean (SF/Ha.)**

| Activity | Labour/Costs Unit | Cost | Qty/Ha. | Cost/Ha. | Material Cost/Ha. | Total Cost | Remarks |
|---|---|---|---|---|---|---|---|
| Land Clearing | MD | 57.8 | 0.5 | 28.9 | ---- | 28.9 | |
| Lime/Shell Opp . | MD | 65.0 | 0.4 | 26.0 | 80 L | 340.0 | repr.25% of total |
| Plough | HA | 72.0 | 0.2 | 14.4 | 20 | 34.4 | mech* |
| Harrows | HA | 72.0 | 0.2 | 14.4 | 15 | 29.9 | mech |
| Weed Control | HA | 72.0 | 0.2 | 14.4 | 10 | 24.4 | mech |
| Seed Prep. | TON | 57.8 | 0.2 | 11.6 | 140 | 151.6 | |
| Plant + Fertilize | HA | 65.0 | 0.4 | 26.0 | 2500 | 2526.0 | mech |
| Field Surv. | MD | 72.0 | 0.2 | 14.4 | 10 | 24.4 | |
| Weed Control (Mech) | HA | 65.0 | 0.2 | 13.0 | 10 | 23.0 | mech |
| Plant Protec. (Mech) | HA | 72.0 | 0.3 | 21.6 | 1250 | 1271.6 | mech |
| Fertilizer Side Dress (M) | HA | 65.0 | 0.2 | 13.0 | 1550 | 1563.0 | mech |
| Combine Harv. | HA | 72.0 | 0.5 | 36.0 | 40 | 76.0 | mech |
| Dry and Store | TON | 57.8 | 0.5 | 28.9 | ---- | 28.9 | Use factory drier |
| Total | | | 4.0 | 262.6 | 5625 | 5887.6 | |

Notes:

(1) Mech - fully or partially mechanized operation

(2) Labour costs estimates are: Gen. worker - SF 57.8/day
Tractor Operator - SF 65.0/day
Skiller equip. operator - SF 72.0/day

(3) Material costs include fertilizer, biocides, fuels and oil. All material costs procured with foreign exchange at a conversion rate of US$1.00 = SF 20.00.

(4) Summary:

- Total md/ha - 4.0: skilled 60% unskilled 40%
- Manpower cost/ha.: SF 262.6 or 4.5% of total op. costs.
- Materials cost/ha.: SF 5625.0 or 95.5%
- Total Cost of Production = SF 5887.6/ha.

Table 4.5

**Estimated Returns for Soyabean at Different Yield Levels (SF)**

| | 1 | 2 |
|---|---|---|
| Capital Costs (SF) | 794.0 | 794.0 |
| Operational Costs (SF) | 5887.6 | 5887.6 |
| Total Production Cost(SF) | 6681.6 | 6681.6 |
| Yield t/ha. | 1.5 | 2.0 |
| Gross Return (SF) | 7560.0 | 10080.0 |
| Average Net Return/ha.(SF) | 878.4 | 3398.4 |

Notes:

(1) Seed is valued at SF 5040/tonne.

(2) Capital equipment is depreciated over 10 years at an average enterprise value of SF 794/ha.

(3) Opt. 1 gives a project yield of 1.5 t/ha.
Opt. 2 gives a project yield of 2.0 t/ha.

**Table 4.8**

**Estimated Returns for Peanut Different Yield Levels (SF)**

| | 1 | 2 |
|---|---|---|
| Capital Costs (SF) | 902.0 | 902.0 |
| Operational Costs (SF): | 5428.0 | 5428.0 |
| Total Production Cost(SF) | 6330.0 | 6330.0 |
| Yield t/ha. | 1.0 | 1.5 |
| Gross Return (SF) | 9500.0 | 14250.0 |
| Average Net Return/ha.(SF) | 3240.0 | 7920.0 |

Notes:

(1) Crop value is based on an average local price of SF 9500/tonne.

(2) Capital equipment is depreciated over 10 years at an average enterprise cost of SF 902/ha.

(3) 32% of the total capital equipment capacity is utilized in the peanut enterprise.

Table 4.9

Estimated Cash Flow for Peanut Production Module (SF'000)

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|---|---|---|---|---|---|---|---|
| Capital Investment (equip) | 229.4 | 14.8 | 1289.6 | 497.6 | 25.6 | 38.4 | 51.2 |
| Operational Costs: | | | | | | | |
| -Local Currency Costs (manpower) | 40.5 | 43.2 | 6.2 | 21.7 | 46.4 | 46.4 | 46.4 |
| -Offshore Costs (mat. supplies) | 30.1 | 30.7 | 102.4 | 358.3 | 767.9 | 767.9 | 767.9 |
| Total Costs | 300.0 | 88.7 | 1398.2 | 877.6 | 839.9 | 852.7 | 865.5 |
| Returns | - | - | 152.0 | 760.0 | 1900.0 | 1900.0 | 1900.0 |
| Cash Flow | -300.0 | -88.7 | -1246.2 | -117.6 | +1060.1 | +1047.3 | +1034.5 |
| Cumulative Balance | -300.0 | -388.7 | -1546.2 | -1663.8 | -692.4 | +354.9 | +1389.4 |

Notes:

(1) Capital Investment: 32% of the value of machinery and equipment applied to peanut enterprise.

(2) All values in Suriname Guilders (SF) converted at the rate of US$ 1 to SF 20 where applicable.

# ANNEX 5

# COSTS AND RETURNS FOR PEACH PALM AND PASSION FRUIT

Table 5.1

Estimated Costs for Establishing 1 Hectare of Peach Palm
at Victoria in Year 1 (SF)

| Activity | Unit | Quantity | Costs |
|---|---|---|---|
| Land Clearing: | | | |
| Kill old palm trees | md | 4 | 231.20 |
| Weed control | md | 4 | 231.20 |
| Herbicide application | md | 3.5 | 202.30 |
| Burning | md | 0.5 | 28.90 |
| Discharrow | md | 0.5 | 28.90 |
| Drainage | md | 6 | 346.80 |
| Lining | md | 12 | 693.60 |
| Digging holes & fertilizing | md | 52 | 3005.60 |
| Planting | md | 25 | 1445.00 |
| Disease control | md | 3 | 115.60 |
| Replanting | md | 2 | 115.60 |
| sub-total | | 112.5 | 6444.70 |
| Materials/Inputs: | | | |
| Seeds | nos. | 6000 | 13200.00 |
| Sticks | nos. | 6000 | 1304.40 |
| Fungicides | liter | 10 | 347.80 |
| Herbicides | liter | 15 | 2100.00 |
| Fertilizers | liter | 750 | 3750.00 |
| Sticker | kg. | 2 | 200.00 |
| Implements (hoes, etc.) | | | 217.80 |
| Transport | mat. | | 1304.40 |
| Tractor hours | | | 139.20 |
| sub-total | | | 22563.60 |
| Total | | | 29008.30 |

Table 5.2

Estimated Costs for Maintenance of Peach Palm in Year 2 (SF/HA.)

| Activities | Unit | Quantity | Costs |
|---|---|---|---|
| Labour use: | | | |
| Herbicide application | md | 4 | 231.20 |
| Drainage maintenance | md | 4 | 231.20 |
| Replanting | md | 2 | 115.60 |
| Fertilizing | md | 6 | 346.80 |
| Disease control | md | 2 | 115.60 |
| Weed control | md | 15 | 867.00 |
| Harvesting | md | 10 | 578.00 |
| Transport | md | 4 | 231.20 |
| sub-total | | 47.00 | 2716.60 |
| Material/Inputs: | | | |
| Fungicides | liter | 10 | 347.80 |
| Herbicides | liter | 10 | 1400.00 |
| Fertilizers | kg. | 950 | 4750.00 |
| Sticker | liter | 2 | 200.00 |
| Transport | mat. | | 434.80 |
| Sub-total | | | 7132.60 |
| Total | | | 9849.20 |

Table 5.3

Estimated Costs for Maintenance of Peach Palm in Year 3 & Onwards (SF/HA.)

| Activities | Unit | Qty/ha | Costs |
|---|---|---|---|
| Labour use: | | | |
| Herbicide application | md. | 4 | 231.20 |
| Drainage maintenance | md. | 2 | 115.60 |
| Fertilizing | md. | 6 | 346.80 |
| Disease control | md. | 3 | 173.40 |
| Weed control | md. | 13 | 751.40 |
| Harvesting | md. | 15 | 867.00 |
| Transport | md. | 4 | 462.40 |
| sub-total | | 47.00 | 2947.80 |
| Material/Inputs: | | | |
| Fungicides | liter | 10 | 347.80 |
| Herbicides | liter | 10 | 1400.00 |
| Fertilizers | kg. | 950 | 4750.00 |
| Sticker | liter | 2 | 200.00 |
| Transport | mat. | | 434.8 |
| sub-total | | | 7132.60 |
| Total | | | 10080.40 |

Table 5.4

Estimated Investment and Operational Costs for Establishing 350 Hectares of Peach Palm (SFM)

| Cost Items | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cultivation: | | | | | | | | | | | | | | | |
| Area (ha.) | 50.00 | 100.00 | 100.00 | 100.00 | | | | | | | | | | | |
| Land clearing | 0.32 | 0.64 | 0.64 | 0.64 | | | | | | | | | | | |
| Materials & inputs | 1.13 | 2.26 | 2.26 | 2.26 | | | | | | | | | | | |
| Maintenance | | 0.49 | 1.49 | 2.50 | 3.51 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 |
| sub-total | 1.45 | 3.40 | 4.39 | 5.40 | 3.51 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 | 3.53 |
| Processing: | | | | | | | | | | | | | | | |
| Factory equip. | | 8.00 | | | | 25.00 | 25.00 | 25.00 | 25.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 0.00 |
| Operations | | 0.02 | 0.06 | 0.19 | 0.40 | 0.61 | 0.78 | 0.84 | 0.88 | 0.92 | 0.97 | 1.02 | 1.07 | 1.12 | 1.18 |
| Repairs & Maintenance | | | | | 0.06 | 0.06 | 0.56 | 0.56 | 0.56 | 0.56 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 |
| Cans & Cartons | | 166.67 | 833.33 | 2533.33 | 5333.33 | 8200.00 | 10400.00 | 11200.00 | 11200.00 | 11200.00 | 11200.00 | 11200.00 | 11200.00 | 11200.00 | 11200.00 |
| sub-total | | 174.68 | 833.40 | 2533.53 | 5333.80 | 8225.67 | 10426.34 | 11226.40 | 11226.44 | 11251.48 | 11252.03 | 11252.08 | 11252.13 | 11252.18 | 11202.24 |
| Total | 1.5 | 178.1 | 837.8 | 2538.9 | 5337.3 | 8229.2 | 10429.9 | 11229.9 | 11230.0 | 11255.0 | 11255.6 | 11255.6 | 11255.7 | 11255.7 | 11205.8 |

Table 5.5

Estimated Costs, Returns and Cash Flow for 350 Hectares of Peach Palm (SFM)

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Returns | | 1250.0 | 6250.0 | 19000.0 | 40000.0 | 61500.0 | 78000.0 | 84000.0 | 84000.0 | 84000.0 | 84000.0 | 84000.0 | 84000.0 | 84000.0 | 84000.0 |
| Total Cost | 1.5 | 178.1 | 837.8 | 2538.9 | 5337.3 | 8229.2 | 10429.9 | 11229.9 | 11230.0 | 11255.0 | 11255.6 | 11255.6 | 11255.7 | 11255.7 | 11205.8 |
| Cash Flow | -1.5 | 1071.9 | 5412.2 | 16461.1 | 34662.7 | 53270.8 | 67570.1 | 72770.1 | 72770.0 | 72745.0 | 72744.4 | 72744.4 | 72744.3 | 72744.3 | 72794.2 |

Table 5.6

Estimated Cost for Establishing 1 Hectare of Passion Fruit (SF)

| Activities | Unit | Quantity | Cost |
|---|---|---|---|
| Land clearing | TH | 4 | 2050.00 |
| Materials: | | | |
| Poles | Unit | 400 | 1600.00 |
| Plants | Unit | 756 | 1890.00 |
| Herbicides | liter | | 230.00 |
| Fungicides | liter | | 440.00 |
| Implements | | | 1200.00 |
| Cultivation & Maintenance: | | | |
| Lining | MD. | 18 | 1040.40 |
| Dig holes | MD. | 11 | 635.80 |
| Planting | MD. | 6 | 346.80 |
| Planting poles | MD. | 8 | 462.40 |
| Trellising | MD. | 5 | 289.00 |
| Planting | MD. | 3 | 174.00 |
| Manual weeding | MD. | 10 | 578.00 |
| Chem. weeding | MD. | 5 | 289.00 |
| Transport | | | 250.00 |
| Total | | | 11475.40 |

Table 5.7

Estimated Cost for Maintenance of Passion Fruit (SF/HA.)

| Activities | Unit | Quantity | Cost |
|---|---|---|---|
| Inputs: | | | |
| Herbicides | liter | | 250.00 |
| Fungicides | liter | | 432.00 |
| Fertiliser | kg. | | 490.00 |
| Manual weeding | MD. | 8 | 462.40 |
| Chemical weeding | MD. | 3 | 173.40 |
| Pruning | MD. | 5 | 289.00 |
| Spraying | MD. | 3 | 173.40 |
| Repair trellis | MD. | 4 | 231.20 |
| Fertilizing | MD. | 2 | 115.60 |
| Surveillance | MD. | 12 | 693.60 |
| Harvesting | MD. | 2 | 115.60 |
| Transport | | | 300.00 |
| Total | | | 3726.20 |

Table 5.8

Estimated Output, Costs, Returns and Cash Flow for 13 Hectares of Passion Fruit (SF)

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Area cultivated (ha.): | | | | | |
| Establishment | 5.5 | | 7.5 | 5.5 | |
| Maintenance | 7.5 | 13.0 | 5.5 | 7.5 | 13.0 |
| Output (kg.) | 33,500 | 78,000 | 48,000 | 56,000 | 78,000 |
| Returns | 100500.0 | 234000.0 | 144000.0 | 168000.0 | 234000.0 |
| Total Costs | 91061.2 | 48440.6 | 106559.6 | 91061.2 | 48440.6 |
| Cash Flow | 9438.8 | 185559.4 | 37440.4 | 76938.8 | 185559.4 |

Notes:

(1) It is assumed that 7.5 ha. is already under cultivation and only maintenance costs would be incurred for this area. An additional 5.5 ha. would need to be established.

(2) A 2.5-year production cycle is assumed.

(3) Yield is estimated at 2.0 mt/ha. for a newly established plot and 3.0 mt/ha. for the for the 7.5 ha. in the first year. From year 2 onwards, the yield is estimated at 6.0 mt/ha. for plots already under production.

(4) Output is priced at SF 3.00/kg. and costs are assumed to increase 5% per year.

# ANNEX 6

# COSTS AND RETURNS FOR LIVESTOCK PRODUCTION ALTERNATIVES

Table 6.1

Estimated Capital Costs for Fattening Cattle Model I - Alternative "A" (SF'000)

| Costs | Years | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y1 * | Y1 ** | Y2 * | Y2 ** | Y3 * | Y3 ** | Y4 * | Y4 ** | Y5 * | Y5 ** | |
| 1. Infrastructure | | | | | | | | | | | |
| Coral | 80.0 | | | | | | | | | | 80.0 |
| Weighing Scale | 37.9 | | | | | | | | | | 37.9 |
| Feeding houses for minerals (5) and water supply | 80.0 | | | | | | | | | | 80.0 |
| Feeding houglas supply feed (10) | | | | | | | | | | | |
| 2. Fencing | | | | | | | | | | | |
| Barbed wire | 59.0 | 88.6 | 109.8 | | | | | | | | 257.4 |
| Fence posts | 23.4 | 35.1 | 46.7 | | | | | | | | 105.2 |
| Nails | 3.3 | 5.0 | 6.6 | | | | | | | | 14.9 |
| Labour | 18.5 | 27.7 | 36.9 | | | | | | | | 83.1 |
| Sub-total | 104.2 | 156.4 | 208.4 | | | | | | | | 468.9 |
| 3. Purchase of Animals | | | | | | | | | | | |
| Weaned calves (125) | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 2500.0 |
| Horses (4) | 40.0 | 40.0 | | | | | | | | | 80.0 |
| Farm Tools and Equipment | | | | | | | | | | | |
| 2 Saddles | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 17.0 | | 0.0 | | 47.0 |
| Tools | 20.0 | 0.0 | 15.0 | 0.0 | 15.0 | | 15.0 | | 15.0 | | 80.0 |
| Sub-total (6 months) | 642.1 | 446.4 | 473.4 | 250.0 | 265.0 | 250.0 | 282.0 | 250.0 | 265.0 | 250.0 | 3373.8 |
| Sub-total/ year | | 1088.5 | | 723.4 | | 515.0 | | 532.0 | | 515.0 | 3373.8 |
| Contingencies (10%) | | 108.8 | | 72.3 | | 51.5 | | 53.2 | | 51.5 | 337.4 |
| Total | | 1197.3 | | 795.7 | | 566.5 | | 585.2 | | 566.5 | 3711.2 |

* First 6 months of the year

** Second 6 months of the year

Table 6.2

Estimated Operational Costs for Fattening Cattle Model I-Alternative "A" (SF'000)

| Activities | Years | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y1 * | Y1 ** | Y2 * | Y2 ** | Y3 * | Y3 ** | Y4 * | Y4 ** | Y5 * | Y5 ** | |
| Manager | | 39.0 | | 39.0 | | 39.0 | | 39.0 | 0.0 | 39.0 | 195.0 |
| | | | | | | | | | | | 0.0 |
| Labour (2) | | 31.8 | | 31.8 | | 31.8 | | 31.8 | 0.0 | 31.8 | 159.2 |
| Infrastructure Mantenance | | | | | | | | | | | |
| Corral Feeding Houses and Trhoughs 5% | | | 8.0 | 0.0 | 8.0 | 0.0 | 8.0 | | 8.0 | | 32.0 |
| Fence 5% | | | 5.2 | 7.8 | 15.6 | 7.8 | 23.5 | | 23.5 | | 83.4 |
| Complementary Feed Cattle | 17.7 | 44.3 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 699.8 |
| Horses | 0.9 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 16.3 |
| Mineral/Salt | | 22.1 | | 66.4 | | 66.4 | | 66.4 | | 66.4 | 287.9 |
| Drugs | | 6.9 | | 20.8 | | 20.8 | | 20.8 | | 20.8 | 90.0 |
| Sub Total 6 mths | 18.6 | 145.9 | 94.7 | 247.3 | 105.1 | 247.3 | 112.9 | 239.5 | 112.9 | 239.5 | 1563.6 |
| Sub total/ year | | 164.5 | | 342.0 | | 352.4 | | 352.4 | | 352.4 | 1563.6 |
| Contengensies 10% | | 16.5 | | 34.2 | | 35.2 | | 35.2 | | 35.2 | 156.4 |
| Total | | 181.0 | | 376.2 | | 387.6 | | 387.6 | | 387.6 | 1720.0 |

* First 6 months of the year

** Second 6 months of the year

Table 6.3

Herd Projection for Fattening Cattle Model I

| Animal Category | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y1 1 | Y1 2 | Y2 1 | Y2 2 | Y3 1 | Y3 2 | Y4 1 | Y4 2 | Y5 1 | Y5 2 |
| | | | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| Fattening Hehed | | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| Weaned Calves Perchased | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| Mortality 2% | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Transfer | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| Animals Sold | | | 123 | 123 | 123 | 123 | 123 | 123 | 123 | 123 |

Notes:

(i) Weaned calves 6-12
(ii) Mortality 2%
(iii) Fattening period 528 days

Table 6.4

Estimated Cash Flow for Fattening Cattle Model I - Alternative "A" (SF'000)

| Activities | Years | | | | | TOTAL |
|---|---|---|---|---|---|---|
| | Yr. 1 | Yr. 2 | Yr. 3 | Yr. 4 | Yr. 5 | |
| Income from Sales of cows: | | | | | | |
| Export | - | 2517.1 | 2517.1 | 2517.1 | 2517.1 | 10068.3 |
| Local | - | 442.8 | 442.8 | 442.8 | 442.8 | 1771.2 |
| Total | | 2959.9 | 2959.9 | 2959.9 | 2959.9 | 11839.5 |
| Expenditure: | | | | | | |
| Capital | 1197.3 | 795.7 | 566.5 | 585.2 | 566.5 | 3711.2 |
| Operations | 181.0 | 376.2 | 387.6 | 387.6 | 387.6 | 1720.0 |
| Total | 1378.3 | 1171.9 | 954.1 | 972.8 | 954.1 | 5431.2 |
| Cash flow | -1378.3 | 1788.0 | 2005.8 | 1987.1 | 2005.8 | 6408.32 |
| Accumulated Balanace | | 409.8 | 2415.5 | 4402.6 | 6408.3 | |

Notes:

(i) Beef production from cattle having a 400 kg. live weight. Assuming a dressing of 53.2%, a yield of 213 kg. fresh meat and 10 kg. of saleable offal is realized.

(ii) Assumes 64.49 kg. of meat is exported @ SF158.6/kg.

(iii) Assumes 212.8 kg. beef @ SF12.6/kg. and 10 kg. of offals sold in the local market.

Table 6.5

Estimated Investment Costs for Fattening Cattle Model I - Alternative "B" (SF'000)

| Expenditure | Years | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y1 * | Y1 ** | Y2 * | Y2 ** | Y3 * | Y3 ** | Y4 * | Y4 ** | Y5 * | Y5 ** | |
| 1. Infrastructure | | | | | | | | | | | |
| Coral | 80.0 | | | | | | | | | | 80.0 |
| Weighing Scale | 37.9 | | | | | | | | | | 37.9 |
| Feeding houses for minerals (5) and water supply | 80.0 | | | | | | | | | | 80.0 |
| Feeding throughs supply feed (10) | 0.4 | | | | | | | | | | 0.4 |
| 2. Pastures | | | | | | | | | | | |
| Establishment | 23.2 | 34.7 | 46.3 | | | | | | | | 104.3 |
| 3. Fencing | | | | | | | | | | | |
| Barbed wire | 16.9 | 25.2 | 33.7 | | | | | | | | 75.8 |
| Fence posts | 6.7 | 10.0 | 13.3 | | | | | | | | 30.0 |
| Nails | 1.0 | 0.0 | 1.9 | | | | | | | | 2.8 |
| Labour | 5.3 | 7.9 | 10.5 | | | | | | | | 23.7 |
| Sub total | 29.8 | 44.6 | 59.5 | | | | | | | | 133.8 |
| 4. Purchase of Animals | | | | | | | | | | | |
| Weaned calves (125) | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 250.0 | 2500.0 |
| Horses (4) | 40.0 | 40.0 | | | | | | | | | 80.0 |
| 5. Farm Tools and Equipment | | | | | | | | | | | |
| 2 Saddles | 30.0 | | | | | | 17.0 | 0.0 | 0.0 | 0.0 | 47.0 |
| Tools | 20.0 | | 15.0 | | 15.0 | 0.0 | 15.0 | 0.0 | 15.0 | 0.0 | 80.0 |
| Sub total/6 mths | 590.9 | 369.3 | 370.8 | 250.0 | 265.0 | 250.0 | 282.0 | 250.0 | 265.0 | 250.0 | 3143.0 |
| Sub total/ year | | 960.2 | | 620.8 | | 515.0 | | 532.0 | | 515.0 | 3143.0 |
| Contingencies 10% | | 96.0 | | 62.1 | | 51.5 | | 53.2 | | 51.5 | 314.3 |
| Total | | 1056.2 | | 682.9 | | 566.5 | | 585.2 | | 566.5 | 3457.3 |

* First 6 months of the year

** Second 6 months of the year

Table 6.6

Estimated Operational Costs for Fattening Cattle Model I - Alternative "B" (SF'000)

| Expenditure | Years | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y1 * | Y1 ** | Y2 * | Y2 ** | Y3 * | Y3 ** | Y4 * | Y4 ** | Y5 * | Y5 ** | |
| Manager | | 39.0 | | 39.0 | | 39.0 | | 39.0 | | 39.0 | 195.0 |
| Labor | | 31.8 | | 31.8 | | 31.8 | | 31.8 | | 31.8 | 159.2 |
| Infrastructure Mantenance | | | | | | | | | | | |
| Corral Feeding Houses Water and Feeding Throughs | | | 8.0 | | 8.0 | | 8.0 | | 8.0 | | 32.0 |
| Fence 5% | | | 1.5 | 2.3 | 4.5 | 2.3 | 6.8 | | 6.8 | | 24.0 |
| Suplementary Feed | | | | | | | | | | | |
| Cattle | 17.7 | 44.3 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 79.7 | 699.8 |
| Horses | 0.9 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 16.3 |
| Mineral/Salt | | 22.1 | | 66.4 | | 66.4 | | 66.4 | | 66.4 | 287.9 |
| Drugs | | 6.9 | | 20.8 | | 20.8 | | 20.8 | | 20.8 | 90.0 |
| Fertilizer | 9.2 | 13.7 | 27.4 | 13.7 | 41.1 | | 41.1 | | 41.1 | | 187.1 |
| Sub Total 6 mths | 27.7 | 159.6 | 118.3 | 255.4 | 135.0 | 241.8 | 137.3 | 239.5 | 137.3 | 239.5 | 1691.4 |
| Sub Total/Year | | 187.3 | | 373.8 | | 376.7 | | 376.8 | | 376.8 | 1691.4 |
| Contingensies 10% | | 18.7 | | 37.4 | | 37.7 | | 37.7 | | 37.7 | 169.1 |
| Total | | 206.1 | | 411.2 | | 414.4 | | 414.4 | | 414.4 | 1860.5 |

* First 6 months of the year
** Second 6 months of the year

Table 6.7

Estimated Cash Flow for Fattening Cattle Model I - Alternative "B" (SF'000)

| Source | Years | | | | | TOTAL |
|---|---|---|---|---|---|---|
| | Y1 | Y2 | Y3 | Y4 | Y5 | |
| Income: | | | | | | |
| Exports | | 2517.1 | 2517.1 | 2517.1 | 2517.1 | 10068.3 |
| Local sales | | 442.8 | 442.8 | 442.8 | 442.8 | 1771.2 |
| Total | | 2959.9 | 2959.9 | 2959.9 | 2959.9 | 11839.5 |
| Expenditure: | | | | | | |
| Capital | 1056.2 | 682.9 | 566.5 | 585.2 | 566.5 | 3457.3 |
| Operational | 206.1 | 411.2 | 414.4 | 414.4 | 414.4 | 1860.6 |
| Total | 1262.3 | 1094.1 | 980.9 | 999.6 | 980.9 | 5317.9 |
| Cash flow | -1262.3 | 1865.8 | 1978.9 | 1960.2 | 1978.9 | 7784.0 |
| Accumulative Balance | | 603.5 | 2582.5 | 4542.7 | 7521.7 | |

Notes:

(i) Production of Sara Sara grass is replaced by Brachiaria spp. Costs per ha. will be SF1,200 for seed, SF80 for CHLM weeding and SF40 for labor.

(ii) The stocking rate can be increased to 3.5 AU/ha. and area required is 79 ha.

(iii) Fencing cost is SF133,820. Fertilizer cost is SF260 per 50 kg. at total cost of SF41,080 for 79 ha.

Table 6.8

Estimated Investment and Operational Costs for Dairy Farm Model II - Alternative "A" (SF'000)

| Expenditure | Years 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Investments: | | | | | | | | | | | | |
| Pastures | | 43.7 | 13.0 | 16.2 | 11.3 | | | | | | | 84.2 |
| Fencing | | 51.3 | 15.2 | 19.0 | 13.3 | | | | | | | 98.8 |
| Housing Facility | | | 380.0 | | | | | | | | | 380.0 |
| Drainage, Water & Electricity | | | 20.0 | | | | | | | | | 20.0 |
| Equipment | | | 620.2 | | 2.8 | 2.7 | 22.8 | | 5.5 | | 2.8 | 656.8 |
| Animals | | 369.5 | | | | 139.5 | | | 139.5 | | | 648.5 |
| Total | | 464.5 | 1048.4 | 35.2 | 27.4 | 142.2 | 22.8 | | 145.0 | | 2.8 | 1888.3 |
| Operations: | | | | | | | | | | | | |
| Manpower | | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 867.6 |
| Prod. inputs | | 59.2 | 78.4 | 178.0 | 181.3 | 207.6 | 211.4 | 224.3 | 234.7 | 245.1 | 255.4 | 1875.5 |
| Pasture Maintenance | | 31.9 | 41.3 | 53.1 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 555.8 |
| Equipment Maintenance | | | | 62.0 | 62.0 | 62.3 | 62.6 | 64.9 | 64.9 | 65.4 | 65.4 | 509.5 |
| Building Maintenance | | | | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 152.0 |
| Fence Maintenance | | | 5.1 | 6.6 | 8.5 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 79.6 |
| Services | | 18.0 | 18.0 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 910.1 |
| Sub-total | | 195.9 | 229.5 | 514.8 | 528.3 | 556.2 | 560.3 | 575.5 | 585.8 | 596.8 | 607.1 | 4950.1 |
| Contingency 10 | | 19.6 | 23.0 | 51.5 | 52.8 | 55.6 | 56.0 | 57.5 | 58.6 | 59.7 | 60.7 | 495.0 |
| Total Operational Costs | | 215.4 | 252.5 | 566.3 | 581.1 | 611.8 | 616.3 | 633.0 | 644.4 | 656.4 | 667.8 | 5445.1 |

Table 6.9

Technical Coefficients for Dairy Farm Model II - Alternative "A"

| | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Coefficients | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Calving rate % | | | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Calfmortality % | | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Heifer mortality 9-24 mths % | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Heifer mortality 2-3 years % | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Steer mortality 9-24 mths % | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Steer mortality 2-3 years % | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Adult mortality % | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Culling cows % | | | | | | 32 | 26 | 26 | 26 | 26 |
| Culling bulls % | | | | | 100 | | | 100 | | |
| Culling heifers % (2-3 yrs) | | | | | | 20 | 20 | 20 | 20 | 20 |
| Lactation lenght (days) | | | 290 | 290 | 290 | 290 | 290 | 290 | 290 | 290 |
| Average milkprod./cow (kg.) | | | 6.0 | 6 | 7. | 7. | 8. | 8.0 | 9.0 | 9.0 |
| Average prod./lackt (kg.) | | | 1,450 | 1,450 | 2,030 | 2,030 | 2,320 | 2,320 | 2,610 | 2,610 |
| Average prod. on farm/year | | | 192,720 | 166,440 | 194,180 | 189,070 | 221,920 | 221,920 | 249,660 | 249,660 |
| Average prod./ha./year | | | | | | | | | | |
| Milk to calves/day for 80 dys | | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Stocking rate (a.u./ha.) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Meat prod. (kg) live weight | | | | 5,200 | 1,350 | | 10,800 | 1,350 | 10,000 | 10,000 |
| Price/kg. live weight (SF) | | | | 11.4 | 12 | 12.6 | 13.2 | 13.8 | 14.4 | 15.2 |
| Breed. stock (kg) live weight | | | | 11,700 | 9,900 | 12,300 | 11,700 | 12,000 | 11,400 | 12,000 |
| Value/kg live weight | | | | 0.87 | 0.91 | 0.96 | 1.01 | 1.06 | 1.11 | 1.17 |

Table 6.10

Herd Projection for Dairy Farm Model II - Alternative "A"

| Animal Categories | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Bulls: | | | | | | | | | | |
| Opening stock | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Purchases | | | | | 3 | | | 3 | | |
| Culls (salos) | | | | | 3 | | | 3 | | |
| Closing stock | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Cows: | | | | | | | | | | |
| Opeiningstock | | | | 117 | 102 | 100 | 98 | 100 | 100 | 100 |
| Purchses | | | | | | | | | | |
| Heifers transfer | | | 119 | | | | 31 | 26 | 26 | 26 |
| Deaths | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Culls (sales) | | | | 13 | | | 27 | 25 | 25 | 25 |
| Closing stock | | | 117 | 102 | 100 | 98 | 100 | 100 | 100 | 100 |
| Calves (0-9 mths.): | | | | | | | | | | |
| Opening stock male | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Opening stock female | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Male births | | | 44 | 38 | 38 | 37 | 38 | 38 | 38 | 38 |
| Female births | | | 44 | 38 | 38 | 37 | 38 | 38 | 38 | 38 |
| Male deaths | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Female deaths | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Transfer to heifers (9-24 mths) | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Transfer to steers/bulls | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Closing stock | | | 84 | 72 | 72 | 70 | 72 | 72 | 72 | 72 |
| Heifers (9-24 mths.): | | | | | | | | | | |
| Opening stock | 125 | | | | 39 | 35 | 35 | 34 | 35 | 35 |
| Transfer from calves | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Deaths | 6 | | | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Transfer to (2-3 yrs) | 119 | | | | 38 | 34 | 34 | 33 | 34 | 34 |
| Closing stock | | | | 39 | 35 | 35 | 34 | 35 | 35 | 35 |
| | | | | | | | | | 72 | |
| Steers/Bulls (9-24 mths): | | | | | | | | | | |
| Transfer from calves | | | | 40 | 36 | 36 | 35 | 36 | 36 | 36 |
| Sales | | | | 39 | 35 | 35 | 34 | 35 | 35 | 35 |
| Heifers (2-3 yrs.): | | | | | | | | | | |
| Opening stock | | 119 | | | | 38 | 34 | 34 | 33 | 34 |
| Transfer from H (9-24 mths) | 119 | | | | 38 | 34 | 34 | 33 | 34 | 34 |
| Culls (sales) | | | | | | 7 | 7 | 7 | 6 | 7 |
| Transfer to cows | | 119 | | | | 31 | 27 | 27 | 27 | 27 |
| Surplus heifers | | | | | | | | | | |
| Closing stock | 119 | | | | 38 | 34 | 34 | 33 | 34 | 34 |
| Total | 122 | 122 | 204 | 255 | 283 | 275 | 277 | 278 | 279 | 279 |
| Animal Units (AU) | 92.9 | 122.6 | 140.6 | 160.0 | 185.1 | 182.0 | 182.0 | 183.0 | 183.0 | 183.0 |

Table 6.11

Estimated Cash Flow for Model II Dairy Farm - Alternative "A" (SF'000)

| Source | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Income: | | | | | | | | | | |
| Milk Soid | | | 732.3 | 699.1 | 893.2 | 945.4 | 1242.8 | 1375.9 | 1697.7 | 1847.5 |
| Animal Sold | | | | 370.5 | 282.1 | 314.2 | 534.2 | 574.9 | 579.4 | 609.3 |
| Total | | | 732.3 | 1069.5 | 1175.3 | 1259.6 | 1777.0 | 1950.9 | 2277.1 | 2456.8 |
| Expenditure: | | | | | | | | | | |
| Capital investment | 464.5 | 1048.4 | 35.2 | 27.4 | 142.2 | 22.8 | 0.0 | 145.0 | 0.0 | 2.8 |
| Operative cost | 215.4 | 252.5 | 566.3 | 581.1 | 611.8 | 616.3 | 633.0 | 644.4 | 656.4 | 667.8 |
| Total | 680.0 | 1300.9 | 601.5 | 608.5 | 754.0 | 639.1 | 633.0 | 789.4 | 656.4 | 670.6 |
| Net Cash flow | -680.0 | -1300.9 | 130.9 | 461.0 | 421.4 | 620.5 | 1144.0 | 1161.5 | 1620.7 | 1786.2 |
| Accumulated cash balance | -680.0 | -1980.8 | -1849.9 | -1388.9 | -967.6 | -347.1 | 796.9 | 1958.4 | 3579.1 | 5365.2 |

Table 6.12

Estimated Capital and Operational Costs for Dairy Breeding Stock and Milk Farm Model II - Alternative "B" (SF'000)

| Item | Years | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| Investments: | | | | | | | | | | | | |
| Pasture | | 56.7 | 27.5 | | | | | | | | | 84.2 |
| Fencing | | 66.5 | 32.3 | | | | | | | | | 98.8 |
| Housing Facilities | | 380.0 | | | | | | | | | | 380.0 |
| Dr.,W + E | | 20.0 | | | | | | | | | | 20.0 |
| Equipment | | 620.2 | | 2.8 | 2.7 | 22.8 | | 5.5 | | 2.8 | 2.7 | 659.5 |
| Animals | | 3085.5 | | | 139.5 | | | 139.5 | | | 139.5 | 3504.1 |
| Total | | 4228.9 | 59.8 | 2.8 | 142.2 | 22.8 | | 145.0 | | 2.8 | 142.2 | 4746.6 |
| Operations: | | | | | | | | | | | | |
| Labor | | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 86.8 | 867.6 |
| Production Inputs | | 153.9 | 173.4 | 188.3 | 184.9 | 203.9 | 212.1 | 224.3 | 234.7 | 245.1 | 255.4 | 2076.1 |
| Pasture Maintenance | | 41.3 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 61.4 | 593.5 |
| Equipment Maintenance | | | 62.0 | 62.0 | 62.3 | 62.6 | 64.9 | 64.9 | 65.4 | 65.4 | 65.7 | 575.2 |
| Building Maintenance | | | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 19.0 | 171.0 |
| Fence Maintenance | | | 6.6 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 9.9 | 85.7 |
| Services | | 60.0 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 109.3 | 1043.3 |
| Sub-total | | 342.0 | 518.5 | 536.6 | 533.5 | 552.7 | 563.2 | 575.5 | 586.4 | 596.8 | 607.4 | 5412.4 |
| Contigencies (10 | | 34.2 | 51.8 | 53.7 | 53.4 | 55.3 | 56.3 | 57.5 | 58.6 | 59.7 | 60.7 | 541.2 |
| Total Operational Costs | | 376.2 | 570.3 | 590.2 | 586.9 | 608.0 | 619.5 | 633.0 | 645.0 | 656.4 | 668.1 | 5953.7 |

Table 6.13

Technical Coefficients for Dairy Farm Model II - Alternative "B"

| Coefficent | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Calving rate % | | | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Calf mortality % | 10 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Heifer mortality % | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Steer mortality % | | | | | | | | | | |
| Adult mortality % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Culling cows % | | | | | 25 | 25 | 25 | 25 | 25 | 25 |
| Culling bulls % | | | | 100 | | | 100 | | | 100 |
| Culling heifers (2-3 yr) % | | | | | | | | | | |
| Lactation lenght (days) | 210 | 290 | 290 | 290 | 290 | 290 | 290 | 290 | 290 | 290 |
| Average milkprod./cow (kg.) | 7.0 | 8.0 | 9.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Average prod./lackt (kg.) | | | | | | | | | | |
| Average prod. on farm/year | 144,060 | 216,060 | 236,520 | 255,500 | 277,400 | 277,400 | 277,400 | 277,400 | 277,400 | 277,400 |
| Average prod./ha./year | | | | | | | | | | |
| Milk to calves/day for 80 dys | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Stocking rate (a.u./ha.) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Breed. stock (kg) live weight | | 45 (-) | 35 (-) | 34 (18) | 33 (6) | 36 (5) | 36 (4) | 36 (7) | 36 (7) | 36 (7) |
| Meat production (kg) | | | | 1,350 | 9,200 | 10,000 | 11,350 | 10,000 | 10,000 | 11,350 |

* 210 lactation days because heifers will be imported at 4 months pregnancy.
In the first year cows will lactate 7 mths.

Table 6.14

Herd Projection for Dairy Farm and Breeding Stock Model II - Alternative "B"

| Animal Categories | Years | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| Bulls | | | | | | | | | | | |
| Opening stock | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 27 |
| Purchases | 3 | | | 3 | | | 3 | | | 3 | 12 |
| Culls (sales) | | | | 3 | | | 3 | | | 3 | 9 |
| Closing stock | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 30 |
| Cows | | | | | | | | | | | |
| Openingstock | | 98 | 96 | 94 | 92 | 100 | 100 | 100 | 100 | 100 | 880 |
| Purchases | 100 | | | | | | | | | | 100 |
| Heifers transfer | | | | | 25 | 27 | 27 | 27 | 27 | 27 | 160 |
| Deaths | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 20 |
| Culls (sales) | | | | | 23 | 25 | 25 | 25 | 25 | 25 | 148 |
| Closing stock | 98 | 96 | 94 | 92 | 100 | 100 | 100 | 100 | 100 | 100 | 980 |
| Calves (0-9 Mths) | | | | | | | | | | | |
| Opening stock male | | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 327 |
| Opening stock female | | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 327 |
| Male births | 50 | 37 | 36 | 35 | 38 | 38 | 38 | 38 | 38 | 38 | 386 |
| Female births | 50 | 37 | 36 | 35 | 38 | 38 | 38 | 38 | 38 | 38 | 386 |
| Male deaths | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 23 |
| Female deaths | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 23 |
| T/fers to heifers (9-24 mths) | | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 327 |
| Transfer to steers/bulls | | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 327 |
| Closing stock | 90 | 70 | 68 | 66 | 72 | 72 | 72 | 72 | 72 | 72 | 726 |
| Heifers (9-24 Mths) | | | | | | | | | | | |
| Opening stock | | | 44 | 34 | 33 | 32 | 35 | 35 | 35 | 35 | 283 |
| Transfer from calves | | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 327 |
| Deaths | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 17 |
| Transfer to Heifers(2-3 yrs) | | | 43 | 33 | 32 | 31 | 34 | 34 | 34 | 34 | 275 |
| Closing stock | | 44 | 34 | 33 | 32 | 35 | 35 | 35 | 35 | 35 | 318 |
| Steer / Bulls (9-24 Mths) | | | | | | | | | | | |
| Transfer from calves | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 36 | 363 |
| Sales | 45 | 35 | 34 | 33 | 36 | 36 | 36 | 36 | 36 | 36 | 363 |
| Heifers (2-3 Yrs) | | | | | | | | | | | |
| Opening stock | | | | 43 | 33 | 32 | 31 | 34 | 34 | 34 | 241 |
| Transfer form H (9-24 mths) | | | 43 | 33 | 32 | 31 | 34 | 34 | 34 | 34 | 275 |
| Culls (sales) | | | | 18 | 6 | 5 | 4 | 7 | 7 | 7 | 54 |
| Transfer to cows | | | | 25 | 27 | 27 | 27 | 27 | 27 | 27 | 187 |
| Closing stock | | | 43 | 33 | 32 | 31 | 34 | 34 | 34 | 34 | 275 |
| Total | 191 | 258 | 277 | 261 | 272 | 277 | 280 | 280 | 280 | 280 | 2656 |
| Animal Units (AU) | 122.8 | 160 | 182 | 170 | 178 | 180 | 183 | 183 | 183 | 183 | 1724.8 |

Table 6.15

Estimated Cash Flow for Dairy Farm Model - Alternative "B" (SF'000)

| SOURCE | Years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Income: | | | | | | | | | | |
| Milk sold | 432.2 | 734.7 | 898.8 | 1073.1 | 1276.0 | 1387.0 | 1553.4 | 1719.9 | 1886.3 | 2052.8 |
| Animal sold | | 697.5 | 542.5 | 701.8 | 620.4 | 657.1 | 702.8 | 676.7 | 676.7 | 732.2 |
| Total | 432.2 | 1432.2 | 1441.3 | 1774.9 | 1896.5 | 2044.1 | 2256.2 | 2396.6 | 2563.1 | 2785.0 |
| Costs: | | | | | | | | | | |
| Capital | 4228.9 | 59.8 | 2.8 | 142.2 | 22.8 | 0.0 | 145.0 | 0.0 | 2.8 | 142.2 |
| Operations | 376.2 | 570.3 | 590.2 | 586.9 | 608.0 | 619.5 | 633.0 | 645.0 | 655.4 | 668.1 |
| Total | 4605.1 | 630.1 | 593.0 | 729.1 | 630.8 | 619.5 | 778.0 | 645.0 | 658.2 | 810.4 |
| Cash flow | -4172.9 | 802.0 | 848.2 | 1045.8 | 1265.7 | 1424.6 | 1478.2 | 1751.6 | 1904.8 | 1974.6 |
| Accumulated Cash Balance | -4172.9 | -3370.9 | -2522.6 | -1476.8 | -211.2 | 1213.4 | 2691.6 | 4443.2 | 6348.0 | 8322.7 |

Table 6.16

Estimated Investment Costs and Operational for Ewe-Kid Fattening Enterprise Model III (SF'000)

| Costs | Years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Investment: | | | | | | | | |
| Pastures: | | | | | | | | |
| - legumes | | 10.0 | | | | | | 10.0 |
| - pasture | | 2.8 | 2.8 | 5.7 | | | | 11.4 |
| Fencing | | 6.0 | 6.0 | 12.0 | | | 0.0 | 24.1 |
| Housing Facility | | 80.0 | 40.0 | | | | 0.0 | 120.0 |
| Drainage, Water and Electricity | | 5.0 | | | | | | 5.0 |
| Equipment | | 20.0 | | 2.3 | | | | 22.3 |
| Animals | | 86.0 | | 32.0 | | 32.0 | | 150.0 |
| TOTAL | | 209.9 | 48.9 | 52.0 | | 32.0 | | 342.7 |
| Operations: | | | | | | | | |
| Labor | | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 215.0 |
| Prod. Inputs | | | | | | | | |
| - animal feed | | 14.9 | 22.1 | 15.2 | 18.5 | 43.6 | 44.2 | 158.4 |
| - drugs | | 1.5 | 1.6 | 1.1 | 1.4 | 2.8 | 3.0 | 11.5 |
| Pasture Maintenance | | | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 22.4 |
| Equipment Maintenance | | | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 5.6 |
| Building Maintenance | | | 4.0 | 6.0 | 6.0 | 6.0 | 6.0 | 28.0 |
| Fence Maintenance | | | 0.3 | 0.6 | 1.2 | 1.2 | 1.2 | 4.5 |
| Sub-total | | 52.2 | 69.5 | 64.3 | 68.5 | 95.0 | 95.8 | 445.4 |
| Contingencies (10 | | 5.2 | 7.0 | 6.4 | 6.9 | 9.5 | 9.6 | 44.5 |
| Total Operational Costs | | 57.4 | 76.5 | 70.8 | 75.4 | 104.5 | 105.4 | 490.0 |

Table 6.17

Technical Coefficients for Ewe-Kid Fattening Enterprise

| | | | | | | |
|---|---|---|---|---|---|---|
| Breeding ewes | | > 1 year old | | | | |
| Gestation | | 146 days - 5 months | | | | |
| Weaning | | 4 months | | | | |
| Lambing frequency | | 3 lambing/2 year period | | | | |
| Lambing % | | 80% | | | | |
| Lambing size X | | 1.5 | | | | |
| Mortality % | | | | | | |
| | | | | | | |
| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| Mature | | 5 | 3 | 3 | 3 | |
| Young 0-5 months | | 8 | 8 | 8 | 8 | 8 |
| Young 5-12 months | | 2 | 2 | 2 | 2 | 2 |
| Culls % | | 10 | | | | |

Table 8.16

Estimated Flock Projection for Ewe-Kid Fattening Model III

| Herd | Months | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 Month | 5 Months | 13 Months | 21 Months | 29 Months | 37 Months | 45 Months | 53 Months | 61 Months | 69 Months | 77 Months |
| Breeding Ewes: | | | | | | | | | | | |
| Opening stock | 100.0 | 100.0 | 95.0 | 80.0 | 110.0 | 129.0 | 159.0 | 193.0 | 200.0 | 200.0 | 200.0 |
| lambs transferred | | | | 46.0 | 38.0 | 53.0 | 63.0 | 77.0 | 93.0 | 96.0 | 96.0 |
| subtotal | 100.0 | 100.0 | 95.0 | 126.0 | 148.0 | 182.0 | 222.0 | 270.0 | 293.0 | 296.0 | 296.0 |
| deaths | | 5.0 | 5.0 | 4.0 | 4.0 | 5.0 | 7.0 | 8.0 | 9.0 | 9.0 | 9.0 |
| Culls (sales) | | | 10.0 | 12.0 | 15.0 | 18.0 | 22.0 | 62.0 | 84.0 | 87.0 | 87.0 |
| Closing stock | 3.0 | 3.0 | 80.0 | 110.0 | 129.0 | 159.0 | 193.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Lambs (0 - 5 months): | | | | | | | | | | | |
| births M&F | | 57(57) | 46(46) | 66(66) | 77(77) | 95(95) | 116(116) | 120(120) | 120(120) | 120(120) | 120(120) |
| Deaths | | 5(5) | 4(4) | 6(6) | 6(6) | 6(6) | 9(9) | 10(10) | 10(10) | 10(10) | 10(10) |
| Culls (sales) | | 5(5) | 5(5) | 6(6) | 7(7) | 9(9) | 12(12) | 12(12) | 12(12) | 12(12) | 12(12) |
| Closing stock | | 47(47) | 39(39) | 54(54) | 64(64) | 78(78) | 95(95) | 98(98) | 98(98) | 98(98) | 98(98) |
| Lambs (5 - 12 months): | | | | | | | | | | | |
| Transferred M&F | | | 47(47) | 39(39) | 54(54) | 64(64) | 78(78) | 95(95) | 98(98) | 98(98) | 98(98) |
| Deaths F&M | | | 1(1) | 1(1) | 1(1) | 1(1) | 1(1) | 2(2) | 2(2) | 2(2) | 2(2) |
| Closing stock | | | 46(46) | 38(38) | 53(53) | 63(63) | 77(77) | 93(93) | 96(96) | 96(96) | 96(96) |
| Breeding Rams: | | | | | | | | | | | |
| Opening stock | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 20.0 | 20.0 | 20.0 |
| Transfer from (5-12) | | | 46.0 | 38.0 | 53.0 | 63.0 | 77.0 | 93.0 | 96.0 | 96.0 | 96.0 |
| Deaths | | | | | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Purchases | | | | | 10.0 | | | 10.0 | 10.0 | | |
| Culls | | | 46.0 | 38.0 | 52.0 | 61.0 | 75.0 | 91.0 | 104.0 | 94.0 | 94.0 |
| Closing stock | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| End of Year Herd | 110.0 | 199.0 | 260.0 | 304.0 | 373.0 | 451.0 | 547.0 | 602.0 | 606.0 | 606.0 | 606.0 |
| End of Year (AU) | 6.9 | 9.3 | 12.5 | 14.5 | 17.6 | 231.5 | 26.0 | 29.0 | 29.9 | 29.9 | 29.9 |
| Pasture Requirement (ha.) | 2.0 | 2.7 | 3.6 | 4.1 | 5.1 | 6.1 | 7.4 | 8.3 | 8.4 | 8.4 | 8.4 |
| | | | | 39.0 | 35.0 | 35.0 | 34.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Sales: | | | | | | | | | | | |
| Culled ewes | 25 17.5kg | | 10.0 | 10.0 | 14.0 | 18.0 | 22.0 | 62.0 | 84.0 | 87.0 | 87.0 |
| Culled rams | 25 17.5kg | | 46.0 | 38.0 | 52.0 | 61.0 | 75.0 | 91.0 | 104.0 | 94.0 | 94.0 |
| Culled lambs female | | 5.0 | 5.0 | 6.0 | 7.0 | 9.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Culled lambs male | | 5.0 | 5.0 | 6.0 | 7.0 | 9.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Total Live Weight | | | | | | | | | | | |
| Total Carcase Weight | | | | | | | | | | | |

Table 6.19

Estimated Cash Flow for Ewe-Kid Fattening Enterprise Model III (SF'000)

| SOURCE | Years | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Income | | | | | | | |
| Milk sold | | | | | | | |
| Animal sold | 76.3 | 142.5 | 98.7 | 122.9 | 400.1 | 422.1 | 1262.5 |
| Loan | | | | | | | |
| Total | 76.3 | 142.5 | 98.7 | 122.9 | 400.1 | 422.1 | 1262.5 |
| OUTCOME | | | | | | | |
| Capital | | | | | | | |
| Investment | 209.9 | 48.9 | 52.0 | | 32.0 | | 342.7 |
| Operation | 57.5 | 76.5 | 70.5 | 75.4 | 104.5 | | 384.4 |
| Loan Repayment | | | | | | | |
| Interest | | | | | | | |
| Principle | | | | | | | |
| Total | 267.3 | 125.3 | 122.6 | 75.4 | 136.5 | 105.4 | 727.1 |
| Cash flow | -191.0 | 17.1 | -23.8 | 47.5 | 263.5 | 316.7 | |
| Accumulated Cash Balance | | -173.9 | -197.7 | -150.2 | 113.3 | 430.0 | |

Table 6.20

Summary of Input Requirements and Outputs of the Livestock Models Recommended

| Models | Land Needed Ha. | Animals Required | | Imported Inputs/Ha. (SF'000) | Capital Costs Per Ha. (SF'000) | Operational Costs/Ha. (SF'000) | Generated Net Income Ha.(SF'000) | Product | Market | Priority for Development |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Local | Imported | | | | | Local | External | |
| Cattle | | | | | | | | | | |
| Model I | | | | | | | | | | |
| Alternative "A" | 277.0 | 277.0 | | 102.9 | 13.4 | 1.3 | 6.0 | | X | 1 |
| Alternative "B" | 80.0 | 277.0 | | 197.7 | 43.2 | 4.6 | 18.8 | | X | 2 |
| Model II | | | | | | | | | | |
| Dairy | | | | | | | | | | |
| Alternative "A" | 52.0 | 125.0 | 9.0 | 948.7 | 26.8 | 10.5 | 10.3 | X | | 3 |
| Alternative "B" | 52.0 | | 103.0 | 3894.1 | 91.3 | 11.4 | 16.0 | X | | 5 |
| Model III | | | | | | | | | | |
| Sheep | | | | | | | | | | |
| Ewe-Kid Fatenning | 9.0 | | 110.0 | 161.7 | 38.1 | 8.7 | 6.2 | X | X | 4 |

Table 6.21

Summary of Outputs of the Livestock Models

| Production/Year | | | | |
|---|---|---|---|---|
| Models | Milk Kg. | Breeding Stock Num. | Kg. of Meat (Live Weight) | Herd Value In Year 10 |
| Model I | | | | |
| Alternative "A" | | | 98,400.0 | |
| Alternative "B" | | | 98,400.0 | |
| Model II | | | | |
| Alternative "A" | 221,920.00 | 42 | 10,000.00 | 78,261.00 |
| Alternative "B" | 277,400.00 | 42 | 10,000.00 | 85,000.00 |
| Model III | | | | |
| Sheep | | | 12,300.00 | 17,520.00 |

# ANNEX 7

# IMPLEMENTATION SCHEDULE FOR CROP ALTERNATIVES

Table 7.1
Research and Development Phase: Land Allocation Plan
for Cultivation of Soybean and Peanuts (Ha.)

| Activity | Soybean | | | | Peanut | | | |
|---|---|---|---|---|---|---|---|---|
| | Year 1 | | Year 2 | | Year 1 | | Year 2 | |
| | LRS | SRS | LRS | SRS | LRS | SRS | LRS | SRS |
| Agronomic Validation Trials | 5 | 2 | 10 | 5 | 2 | 2 | 5 | 5 |
| Pilot Production | 15 | 5 | 30 | 10 | 5 | 5 | 10 | 10 |
| Totals | 20 | 7 | 40 | 15 | 7 | 7 | 15 | 15 |

Notes: LRS - Long Rainy Season
SRS - Short Rainy Season

Table 7.2
Phasing of Activities in the Pre-Commercial Phase of the Oilseed Enterprise

| Activity | Short Rainy Season | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Form Working Group | -9 | -6 | -3 | 0 | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 |
| Develop Workplans | ---- | | | | | | | | | | | |
| Procure Equipment | | -------- | | | | | | | | | | |
| Procure Inputs | | ------- | | | | | | | | | | |
| Design Field Trials | | | -------- | | ----- | | | ----- | | ----- | | |
| Implement Trials | | | | ---------- | | | | | | | | |
| Analyse and Recommended | | | | | ----- | | | ----- | | ----- | | ----- |

Notes:

(1) Months -9 to 0 represents a 9 month preparatory period prior to initiating trials and demonstrations.

(2) Field trials to be run on the basis of two seasons per year.

Table 7.5

Proposed Schedule for Cultivation of Peach Palm

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Agu | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Clearing | | | | | | | | XXXXXXXX | XXXXXXXX | XXX | | |
| Setting Nursery | | | | | XXX | | | | | | | |
| Planting | | | | | | | | | | | | XXX |
| Weeding/Manual | | | XXXXXXXX | XXX | | | | | | | | |
| Weeding/Mechan. | XXX | | | | | | | XXX | | | XXX | |
| Fertilizer Apl. | | | | | | | | | | | | |
| Harvesting | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXXXXXXX | XXX |

Table 7.6

Purposed Schedule for Established of 350 Ha. of Peach Palm

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Clearing (ha.) | 50 | 100 | 100 | 100 | | | | | | | | |
| Planting (ha.) | 50 | 100 | 100 | 100 | | | | | | | | |
| First Crop (ha.) | | 50 | 100 | 100 | 100 | | | | | | | |
| Full Production (ha.) | | | | | 50 | 100 | 100 | 100 | | | | |
| Factory Building | | XXX | | | | | | | | | | |
| Acquisition of Equipment | | | XX | XX | XX | | | XX | XX | XX | | |


FECHA DE DEVOLUCION
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