3899

REVISED DRAFT GREEN

FILE COPY

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

June 3, 1983

Eastern Africa Projects Department Northern Agriculture Division

CURRENCY EQUIVALENTS

| Annual ^e Average | 1 Rupee = US\$ | 1 US\$ = Rupees |
|--------------------------------|----------------|--------------------|
| 1975 | 0.1659 | 6.0268 |
| 1976 | 0.1497 | 6.6824 |
| 1977 | 0.1515 | 0.5996 |
| 1978 | 0.1628 | 6.1410 |
| 1979 | 0.1562 | 6.4017 |
| 1980 | 0.1300 | 7.6896 |
| 1981 | 0.1100 | 9.0911 |
| 1982 | 0.0916 | 10.8992 |

FISCAL YEAR

July 1 - June 30

WEIGHTS AND MEASURES

| 1 kilom | eter | = | 0.62 mile |
|---------|-------------|---|-----------------|
| 1 squar | e kilometer | = | 0.3861 miles |
| 1 hecta | re | = | 2.47 acres |
| 1 arpen | | = | 1.043 acres |
| 1 metri | c ton | | 1.102 short ton |
| 1 metri | c ton | = | 0.984 long ton |
| l kilog | ram | = | 2.205 pounds |

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

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This report is based on the findings of a mission that visited Mauritius in August 1982 consisting of: D. Lister (Mission Leader), J. Ball (Agricultural Economist), U. Kuffner (Water Resources Engineer), H. Marples (Livestock Specialist) and G. Bacs (Consultant/Agriculturalist).

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MAP - IBRD 15920

OFFICE MEMORANDUM

FILE COPY

TO: Those Listed Below

DATE: June 3, 1983

FROM: R.L.P. Harris, Acting Chief, EAPNA

SUBJECT: MAURITIUS - Agriculture Sector Memorandum

Attached please find the revised draft green cover version of the Agriculture Sector Memorandum for Mauritius which takes into account the comments received on the draft green cover circulated last December. The present version also incorporates the findings of a mission to Mauritius in May 1983, and agreements reached with Government in the course of negotiating the SAL II and Technical Assistance loans. A meeting to review the attached report is scheduled for Friday, June 10, at 2:30 p.m. in Mr. Christoffersen's office (A-1042) and you are invited to attend. Alternatively, please send written comments to Mr. Douglas Lister (F-1006) by c.o.b. that day. One of the issues which we plan to raise at the meeting is how to handle the future processing of the report after the final green cover is issued and sent to Government.

DLister:ejm

Attachment

cc: Messrs. Wapenhans, Wyss, Christoffersen, Gue, Gulhati, Gusten, Armstrong, Payson, Nekby o/r, Schott (2), RMEA (2), Parsons, Chenery, Hughes, Rajagopalan, T. Jones, Abbai, Marshall, Hopcraft, Van Holst Pellekaan, Sutherland, Collins, Erkmen, Ball, Kuffner, Marples

I. INTRODUCTION

- Agriculture in Mauritius is dominated by sugar. Over 90 percent of all cultivated land is used to produce sugarcane. Sugar accounts for about 75 percent of agricultural GDP (including sugar milling). Sugar and molasses represent about 95 percent of agricultural export earnings. Sugar accounts for about 90 percent of employment in the sector. Agriculture is also important in the national economy, accounting for about 20 percent, 70 percent and 25 percent, respectively, of total GDP, exports and employment. Agricultural products also represent about 25 percent of imports. Although the share of agriculture in GDP has been declining in recent years with the rise of other sectors such as manufacturing and tourism, the sector remains critical for export earnings and employment. Largely because of the predominance of sugarcane in land utilization, production of other crops amounts to a relatively minor activity in Mauritius. Tea for export accounts for 4 percent of the cropped area, foodcrops for domestic consumption for 4 percent and tobacco, also for domestic consumption, for 1 percent. Livestock and fish are also produced, mainly for domestic consumption.
- Twenty-one miller planters (sugar estates) own 60 percent of the land under sugarcane, the remainder being owned by about 32,500 planters. Roughly half of these own less than 5 arpents each (1 arpent = 1.043 acres = 0.42 ha), often subdivided into smaller plots located in different parts of the island. Both the miller planters and planters produce foodcrops and livestock products to varying degrees. Due to increasing urbanization, the area under sugarcane has declined in recent years (from about 205,000 arpents in the early 1970s to around 203,000 arpents in the early 1980s) but because yields have increased, production has remained relatively-Sugar production in 1981 was adversely affected by drought and in 1980 by cyclones, so that the last "normal" year was 1979 when production reached 688,000 tons. Despite low sucrose content caused by too much late rain, Mauritius had another "normal" year in 1982 with production of 690,000 tons. Tea production has increased by 13 percent over the last 10 years. Output of foodcrops and tobacco has also increased mainly due to higher yields.

II. PRODUCTION STRATEGY

A. Objectives

3. Based on recent Government documents and discussions with Government officials, Mauritius has basically three objectives for its agricultural sector: (a) that it will be a source of GDP growth, (b) that it will contribute to export earnings and to budget revenue, and (c) that it will create employment to absorb increases in the labor force, estimated to number 13-14,000 per year for the next 15 years. 1/. To some extent,

^{1/} Mauritius Population Sector Review (Report No. 4486-MAS, dated April 8, 1983), p. 8.

these objectives are conflicting, since the pursuit of any one of them to extremes would almost certainly mean less of the others. The Government has thus faced the difficult task of ranking them, and has decided that GDP growth should be the first objective of Mauritian agriculture, since without an expanding agricultural sector, it is difficult to see how the other two objectives could be met. Next in order of priority come export earnings and budget revenue to provide the foreign and local resources necessary to finance the development effort. More jobs come third in what will hopefully be an expanding economic pie as a result of the successful pursuit of the first two objectives. Since the sugar industry is already saturated with labor, increased employment opportunities will probably have to be created mainly in non-sugar agriculture or in other sectors such as industry.

B. Potential

- Being an island, the land available for agriculture in Mauritius is inherently limited. There are only 460,800 arpents (690 sq mi)on the main island, and of these only about 60 percent or 262,500 arpents are suitable for agriculture, the remainder being occupied by forests and other vegetation, ponds, rocks, roads or buildings. Of the other islands in the group, only Rodrigues with an area of 24,500 arpents (40 sq mi) and a population of some 30,000 is of any agricultural significance. Topographically, the main island rises to a central plateau (elevation 425-500 m) from coastal plains (under 100 m) through sloping plains of intermediate altitude interpersed with areas of steep relief. The coastal plains are located in the north and west coasts. The sloping plains surround the central plateau and extend to the sea along the south and east coast.
- 5. Mauritius enjoys a subtropical maritime climate with a warmer, wetter summer from November to April and a cooler, drier winter from May to October. Averaging about 2,000 mm per year, rainfall is plentiful, but because of the island's topography and its location, precipitation varies widely from one part of the island to another. The exposure of the island to southeasterly winds leads to much higher rainfall on the southern and eastern slopes, reaching peaks of 5,000 mm annually, while the eastern and northern coastal lowlands (e.g. the Northern Plains) receive only about 1,000 mm per year. The wettest months are January through April (peak March), while the driest are September and October, but individual monthly rainfall varies widely, causing droughts and floods. Because of the heavy nature of the rain, the steep slopes, the porous nature of the volcanic soils and the short distance to the sea, run-off into the ocean or the ground is considerable. Average annual temperatures vary from 25°C on the west coast to 15°C on the central plateau, as do hours of sunshine (3,000 on the west coast; 2,000 on the central plateau) and relative humidity (75 and 90 percent, respectively). Locally three climatic zones are distinguished. These tend to follow the topography and are described as superhumid (central plateau), humid (sloping plains) and subhumid (coastal plains).
- 6. These natural factors volcanic soils, sloping plains, plentiful rainfall, bright sunshine and warm temperatures constitute almost ideal growing conditions for sugarcane. According to the 1975 FAO Land Resources

Survey, 44 percent of the total amount of agricultural land in Mauritius is classified as highly or moderately suitable for sugarcane. However, this land is not contiguous, and the specific areas have not been identified. Because of the diversity of microclimates, soils and topography, land use potential can really only be assessed on an area-specific basis. In addition to inland ponds and the coastal lagoon, Mauritius has fishing rights in various parts of the Indian Ocean including certain banks and the waters around Diego Garcia which have been studied by the FAO among others. If it is economically viable to develop them, these areas might represent a significant untapped resource for Mauritius.

C. Constraints

- The potential of Mauritius to grow sugarcane and other crops is 7. also constrained by a number of other natural factors: (a) Cyclones. From December to May, the island is subject to winds exceeding 50 km per hour, and damage to crops is extensive. Between 1957 and 1980, cyclones accounted for major agricultural disasters in 1960, 1975 and 1979; significant losses occurred in five other years. (b) Rocks. The presence of often large stones, boulders and flat rock is another major constraint. The rocks can be removed but only by machine at considerable cost. (c) Need for Irrigation. Despite the overall plentiful water supply, irrigation is highly desirable in the subhumid belt for sugarcane and essential for most foodcrops. In the humid area, supplementary irrigation systems have been installed to bridge dry spells. (d) Land Available for Foodcrops. With 90 percent of all cultivated land under sugarcane. the scope for foodcrop production is limited to land not occupied by sugarcane, the period between the sugarcane harvests or the space between the sugarcane rows before the canopy closes or the roots of the cane crop have invaded the interrow areas. Intercropping almost always involves some kind of trade off - changes in row spacing, variations from optimal fertilizer applications - which affect cane/intercrop yields or quality and need to be carefully evaluated before reaching production decisions. Expansion of foodcrop production beyond these limited areas would imply a reduction in sugar production, unless sugar yields could be increased. An assessment of the scope for productivity increases in the sugar industry is therefore fundamental to any plans to expand foodcrop production. Until now, only some 10,000 arpents have been devoted to foodcrop production with only about 5,000 arpents of this in pure stand. (e) Distance from World Markets. The geographic isolation of Mauritius from the major trading centers of the world gives rise to a significant difference between the export and import parity prices of commodities. As a result, the net foreign exchange savings from the production of an imported commodity is much greater than can be realized from the production of the same commodity for export. Agriculture in Mauritius is also limited by a number of external and internal man-made factors:
- 8. World Sugar Market. Barring crop failure in a major producing country, a technological breakthrough with artificial sweeteners (e.g. high fructose corn syrup, HFCS) or some other shock, sugar prices on the world market can be expected to follow the sugar cycle. Because current prices are low (under US 10 cents per 1b), producers can be expected to cut back production, but as soon as stocks decline prices are likely to rise,

possibly reaching some US 12 cents per 1b (in 1981 constant terms) in 1983. Producers can then be expected to overrespond, driving prices down two to four years later. Any move toward substituting HFCS in the US is likely to dampen peaks in the sugar cycle while leaving the troughs relatively unaffected. Over 50 percent of the sugar entering world trade, however, is sold under bilaterial or multilateral agreements. As a party to the Lome Convention, Mauritius is entitled to sell about 500,000 tons of sugar annually on the EC market at higher than world prices. The price is tied to the strength of the European sugar beet lobby. Similar though less favorable arrangements exist between the USSR and Cuba, Japan and Australia and Japan and Brazil. Their main feature is that they create two distinct world sugar markets in which the amount of sugar that can be sold at preferential prices is strictly limited, and any that must be sold beyond such markets face highly volatile prices that are frequently very low and at times below the average cost of production.

Sugar Industry Finances. Partly because of the instability of world market prices, but also because of the vagaries of weather, gross returns in the sugar industry tend to be volatile. A bumper crop at a time when world market prices are high, can mean a bonanza for producers, while a bad crop as a result of poor weather can spell heavy losses. Costs of production tend to be more stable, but they can also change. In developing countries, labor is usually the largest cost item, and it can be pushed up by union demands and/or Government wage policy. Government tax policy is another major determinant of industry costs, especially in countries which rely heavily on the sugar industry for revenue in the form of import and export duties, company profits tax, etc. Because of the factors governing industry costs and returns, net returns are usually subject to wide year-to-year fluctuations. This, in turn, means that the industry must set aside sufficient reserves in good years to cover its costs in bad years and replace its assets. Milling equipment, in particular, must be replaced every twenty years or so to keep up with technological advancements. Twenty years ago, the optimum size mill was 50,000 tons of cane per day (tcd); today it is 80,000 tcd. As the following average cost figures indicate, the miller planters as a whole are currently operating at a loss. but these figures conceal wide variations in the costs of both field and factory operations. Only access to the individual estate accounts would reveal these variations, and this is one reason why the Government, with Bank assistance, has established the Sugar Commission of Enquiry. Under Mauritian law, a Commission of Enquiry can subpoena accounts and other confidential information as evidence for its deliberations.

Miller-Planters' Estimated Average Costs and Returns of Sugar Production, 1982

| | Rs per ton | % of Total |
|-------------------------------------|------------|------------|
| Costs | | |
| Wages, of which | 1,335.30 | 32 |
| agricultural workers | 1,061.50 | (25) |
| non-agricultural workers | 273.80 | (7) |
| Supplies and other charges | 1,031.80 | 25 |
| Export Duty | 672.60 | 16 |
| Depreciation (at replacement value) | 634.90 | 15 |
| Administrative staff salaries | 236.10 | 6 |
| SIF premiums | 261.90 | 6 |
| Total | 4,172.60 | 100 |
| | | ==== |
| Returns | | |
| Raw sugar | 3,476.20 | 96 |
| Molasses | 87.30 | 2 |
| Sale of electricity, white | | |
| sugar premium and other by-products | 37.70 | 1 |
| SIF compensation | 29.80 | _1 |
| | 3,631.00 | 100 |
| Net Returns (Loss) | (541.6) | |

Source: Annex 1, page 9.

Prolonged losses of this magnitude, however, could adversely affect the ability of the industry to replace its assets.

Scope for Productivity Increases. In a mature industry like 10. Mauritius' which has a long-standing reputation as one of the most efficient in the world, there are no short cuts available to boost productivity in the near term. In some other countries, productivity increases might be sought from labor-saving innovations like mechanization, but in Mauritius with 80,000 registered unemployed, this does not seem like a very practical approach. It seems much better to seek long-term improvements in the productivity of factory and field operations which do not worsen the unemployment problem. One area where such improvements seem possible is in the productivity of Mauritius' sugar mills which has been declining. If one compares the performance of the mills during the "normal" 1967-69 period with that of the equally "normal" 1977-79 period, it is apparent that the following key indicators of productivity have fallen (amount in parenthesis): number of crushing hours per day (4.5 per cent); mechanical time efficiency (3.6 percent); mill extraction (0.3 percent); and boiling house efficiency (0.4 percent). As a result of these declines, sucrose losses have increased by 10.3 percent over the past ten years. The drop in mill extraction rates and boiling house efficiency tends to confirm the widespread belief that reinvestment levels in the mills have not been adequate.

11. Another area where productivity increases should be possible is in the planters' field operations. Planters' yields have averaged some 8 tons of sugarcane per arpent less than those of the miller planters, as the following table shows:

| | <u>c</u> | ane Yield | (tons pe | r arpent) | |
|-----------------|----------|-----------|----------|-----------|------|
| | 1976 | 1977 | 1978 | 1979 | 1980 |
| Miller-planters | 37.6 | 35.7 | 36.8 | 37.3 | 27.0 |
| Planters | 26.5 | 26.5 | 27.9 | 28.4 | 20.8 |
| Difference | 11.1 | 9.2 | 8.9 | 8.9 | 6.2 |

Although the gap has been narrowing, there is evidence that at least part of the planter community is unlikely to be responsive to efforts to increase its yields. Part of the problem lies in the small, irregular size holdings of many of the planters. Some of the planters' land may also be inherently inferior. It is also difficult to provide smallholders with some services (e.g. derocking, deep ripping, irrigation, extension) as cheaply as they can be provided to miller planters. Many planters also have full-time jobs in other sectors of the economy, and look upon their cane land as a hedge against inflation and/or a way of earning extra income with minimum effort. Whatever the reasons behind the yield differential between the planters and the miller planters, it is in the country's interest to narrow it, either by producing more from the same land area or the same amount from a smaller area thereby releasing scarce land from sugar cultivation for other productive purposes such as foodcrop and livestock production. For example, if the 1977-80 yield differential between the miller planters and planters could be halved, the same sugar output could be obtained from 10,500 fewer arpents of land. Alternatively, an additional 316,300 tons of cane, or 34,000 tons of sugar, could be produced from the same area. Also in terms of costs, the planters appear less productive, spending about 8 percent more to produce one ton of sugar than the miller planters (18 percent more if the export duty is eliminated). These differentials hold true, even if the value of labor is excluded, as the following table illustrates:

Miller-Planters' and Planters' Costs of Production, 1978 (Rs per ton of sugar)

| | Miller-Pl | anters' Cane | Planters' Cane | | | |
|---|--------------------------------------|-------------------------|--|-------------------------------|--|--|
| | <u>Total</u> | % of <u>Total</u> | <u>Total</u> | % of Total | | |
| Wages and Salaries Supplies Depreciation Other Charges SIF Premiums Export Duty | 981 303 36 121 95 201 | 56 17 2 7 5 | 1,002 289 39 372 111 51 | 54 16 2 20 6 3 | | |
| Total | 1,731 | 100 | 1,864 | 100 | | |
| Total Net of: Export Duty Labor Export Duty and | 1,536 750 | | 1,813 862 | | | |
| Labor | 549 | | 811 | | | |

Overall, in 1978, miller planters' yields per arpent were 30 percent higher while their costs per ton of sugar were 15 percent lower than those of the planters.

12. Consumer Preference for Imported Food. Because of Mauritius' specialization in sugar, most of the island's food requirements have historically been met from imports, principally rice and wheat flour but also meat, dairy products, and fish. With the total population of 957,000 growing at 1.4 percent and an urban population of about 500,000 growing at 3.6 percent, such imports represent a burden on the balance of payments which is likely to grow if nothing is done to reduce it. In 1980, Mauritius imported 88,000 tons of rice, 57,500 tons of wheat flour, 6,400 tons of meat and meat preparations, 8,300 tons of fresh and prepared fish, 19,500 tons of animal and vegetable oil and 8,800 tons of milk. The import bill for these and other similar items was Rs 1,239.7 million in 1980, or over 52 percent of the value of Mauritian agricultural exports in that year (Rs 2,356.4 million). Although it is said that no one would starve in Mauritius if no food was imported, there is a strong consumer preference for imported rice which is especially difficult to change in the short-run.

D. Comparative Advantage

13. Based on an analysis of domestic resource costs (Annex 2) using average industry costs of production in the absence of marginal cost data, the subsidized Lome price, a standard conversion factor of 0.83, and a zero

opportunity cost for labor (it was not possible to calculate an opportunity cost for land), sugar as an export enjoys an unparalleled comparative advantage in Mauritius. No other crop or livestock production activity even comes close. In fact, few such commodities can be produced at a cost which is less than the price at which they can be imported. Therefore, in the absence of market limitations, Mauritius should aim to maximize production of sugar, and use the foreign exchange earned from sugar exports to import food and other goods from countries which can produce them more efficiently (e.g. rice from Southeast Asia). However, the quantity of sugar which Mauritius can export at the preferential price on which its strong comparative advantage is based is limited to some 500,000 tons under the Lome Convention. The price of sugar on the world market is currently below the cost of production of even the most efficient producer country. The immediate issue facing Mauritius is therefore how much sugar should it aim to produce to be reasonably certain of meeting the requirements of its quota market in the EC, and cover its domestic needs. Statistical analysis shows that to produce the 550,000 tons required for the EC and the domestic market in 9 years out of 10, Mauritius should aim to produce 650,000-700,000 tons in any given year, in other words, the current outturn in a "normal" year. Beyond this level, a judgment needs to be made about the expected economic value of marginal, non-quota production, i.e. the expected f.o.b Mauritius price for non-quota sugar at the shadow exchange rate (assuming the additional production in Mauritius does not affect the world price). Incremental production is then likely to be justified or not depending on whether economic production costs are less or greater than that value. This determination is best made by producers. If significant distortions exist in producers costs (e.g. through the exchange rate or Government labor laws), these should be addressed. Both currency overvaluation and high wages constitute implicit taxes on producers, and they also tend to favor a more import-intensive, capital-intensive technology, besides discouraging exports. Similarly, on the output side, distortions need to be addressed. Given the high priced quota market which absorbs 70 percent of production and the lower and unpredictable prices for additional sugar production, the system whereby the price to the producers is an average of the quota market and the non-quota market prices, constitutes an implicit subsidy to producers which is no doubt stimulating excessive resource use in sugar production. This subsidy and the implicit taxes mentioned above may be thought of as compensating each other. However, the compensation is only made for sugar, which means that diversification out of sugar is made even less attractive than it otherwise might be. Neither this anti-diversification effect, nor the other pro-imported capital, anti-employment effect appear appropriate for Mauritius at this time. Having determined the appropriate level of sugar production, the question then becomes how can Mauritius produce this quantity of sugar most efficiently, in terms of its limited land, water, etc. This is basically a question of providing incentives through the tax system and by other means for optimum land utilization. As such, it is a top priority issue for the Sugar Commission (para 9). Finally, there is the question of how can Mauritius best utilize the land, water, etc. thereby released from sugar production to produce more foodcrops and livestock products, thereby expanding its productive capacity and earning or saving more foreign exchange. This is largely a question of research, extension and marketing of non-sugar crops and livestock, i.e. Government

services in support of agricultural diversification. Since it would not involve scarce land and could help replace imports of protein rich foods, fishing seems like a promising area, but not enough is known about Mauritius' fisheries potential.

III. POLICIES AND INSTITUTIONS

14. Although agriculture is basically a private sector activity in Mauritius, Government intervention in the form of taxes, subsidies, market regulation, etc. is considerable. The main features of the agricultural policy and institutional environment are as follows:

A. Sugar Export Duty

First imposed in 1954 at the rate of 10-30 rupee cents per ton to 15. raise revenue to finance the Government budget, the sugar export duty is today one of the two biggest issues between Government and the sugar industry, the other being labor legislation. In 1961, following the recommendations of the Meade report ("The Economic and Social Structure of Mauritius, by Professor J.E. Meade, et al), the export duty was changed to a 5 percent ad valorem duty aimed at discouraging the future large scale expansion of sugar production and encouraging investment in other industries. It was also seen as a way of overcoming the difficulties of collecting income tax from the planters. Beginning with the 1971 crop, however, producers exporting not more than 20 tons (representing about one-tenth of the work force and with their families about one-fifth of the population) were exempted from the export duty. In 1973, the single rate duty was replaced by a progressive rate structure whereby the amount of duty increased with the tonnage exported. These rates were later increased, notably after the 1974 sugar boom.

B. Sugar Export Surcharge

16. In 1979, following the devaluation of the rupee, a 75 percent surcharge was imposed on the export duty, so that the total export duty rates for the different brackets of exporters stood as follows:

| Tons Exported | Percent of Duty |
|---------------|-----------------|
| less than 20 | nil |
| 21-75 | 10.5 |
| 76-1,000 | 12.25 |
| 1,001-3,000 | 15,75 |
| over 3,000 | 23.625 |

In 1982, the new Government reduced the surcharge from 75 to 50 percent, thereby lowering the total duty payable for exporters of over 3,000 tons from 23.625 to 20.25 percent. This resulted in an additional Rs 56 million (US\$ 5 million) in the hands of the sugar industry who were urged to "make the most productive use" of it. However, the industry estimates the actual benefit at only Rs 12 million (US\$1.1 million) because of higher wage and

raw material costs. Some Rs 27 million (US\$ 2.4 million) was expected to go to meet the salary increases approved by Parliament in July 1982. The industry expected its 1982 losses to total Rs 274 million (US\$ 24.6 million), compared with a pre-budget estimate of Rs 286 million (US\$ 25.7 million).

17. As might be expected, the system of sugar export taxation has been severely criticized by the sugar industry. Some of the arguments, not all of which are very convincing: (a) It is immoral and unfair because it is paid whether or not the producer makes profit (i.e. tax is being paid on a loss). (b) It results in different prices being paid to different producers for the same product (sugar). (c) For the largest exporters, it amounts to a tax of nearly 25 percent of gross proceeds which is too high. (d) The export duty rates have not been revised to take account of the reduced profitability of the industry in the 1976-80 period. (e) There is no longer any need to discourage the future large-scale expansion of sugar products since the latter is no longer possible because virtually all arable land is being cultivated and since the sugar industry has not invested in its expansion but rather in other industries. (f) The decision to exempt producers exporting up to 20 tons means that the export duty falls on producers who are already paying income tax and not those who are not. (g) By having to pay income tax on sugar revenue already subject to export duty, large producers, unlike persons or companies, are subject to double taxation. (h) The export duty discourages increased efficiency since a producer may receive less proceeds from increasing his production because he falls into a higher export tax bracket and has to pay the rate applicable to the new category on all the sugar he exports and not only on the marginal exports above the minimum tonnage of the previous category. It also creates an incentive to subdivide land into smaller units resulting in further inefficiencies of management.

C. Labor Legislation

Sugar workers in Mauritius are organized into powerful unions. In the past, the sugar estates used to employ permanently only the number of laborers required for the slack season (December-June), relying on seasonal labor to meet the needs of the harvest season (July-November), mainly for cane cutters and loaders. Desirous of permanent employment, however, the seasonal laborers demanded and received certain employment guarantees under the labor laws. Among other things, they provide that any employee who shall have worked for any employer during the entire harvest shall be entitled to employment by the same employer during the following inter-harvest period. The law further provides that if the worker shall have worked not less than 80 percent of the number of working days during the harvest, he shall have the right to full-time work during the inter-harvest period. If he shall have worked less than 80 percent but more than 55 percent of the number of working days, he shall be entitled to four days work per week. Subsequent labor legislation further provided that whenever a worker has been continuously in the service of his employer for not less than 24 consecutive months, he shall be entitled to full-time work. For many workers, this new provision virtually guaranteed year around full-time employment. In addition, any employee who has worked for the same employer for one year is entitled at the end of the year to a bonus representing 18 percent of his annual remuneration, provided he shall

have worked during and after the harvest of the same year, a number of days representing 62 percent of the number of working days of the harvest and between harvest periods. Any worker who does not qualify for the 18 percent bonus is entitled to a bonus of 8.4 percent of his annual earnings. Not surprisingly, these features of the labor laws have also come under intense attack from the sugar industry which has generally advocated that higher wages be tied to productivity increases or to the fortunes of the industry.

D. Rice Subsidy.

Rice is the staple food of most Mauritians and its consumption is subsidized by the Government. Since virtually all rice is imported, this amounts to a subsidy on imports. Every Mauritian adult is entitled to buy 200 grams (children 100 grams) per day of basic quality rice at the subsidized price of Rs 1 per 0.5 kg (US 0.09 per 1b). This compares to an retail price of about Rs 1.35 per 0.5 kg (US\$ 0.12 per 1b) for potatoes or maize which are not subsidized. Those performing heavy work are entitled to twice the basic ration of subsidized rice. In 1982, the subsidy amounted to 48 percent of the landed cost of imported rice from China (36,000 tons), Burma (18,000 tons) and Thailand (12,000 tons). In 1981, the subsidy cost the Government Rs 300 million (US\$ 27.3 million), including the subsidy implicit in the dual exchange rate (the September 1981 devaluation was applied to all foreign exchange transactions except rice and wheat flour). Apart from the adverse impact on the budget, the rice subsidy raises the basic strategic issue of whether Mauritius which has the potential to produce substitutes for rice and which is facing a... severe balance of payments deficit should be subsidizing rice imports. Economically, it would seem much more sensible for the Government to subsidize domestic production of maize, which has the potential to contribute significantly to livestock development, or potatoes, to the extent that it can be substituted for rice in the domestic diet, provided such crops can be grown at a cost which has realistic prospects of being eventually reduced to their long-term import parity cost.

E. Wheat Flour Subsidy

20. Consumption of imported wheat flour is subsidized in much the same way as imported rice. Consumers are entitled to buy a rationed quantity at the subsidized price of Rs 0.90 per 0.5 kg. For 1982, this implies a subsidy of 52 percent of the landed cost of flour imported from France, and a 41 percent subsidy on flour from Australia, the latter being some 27 percent more expensive than French flour. The financial and strategic issues are the same as for the rice subsidy. Government has plans to build a flour mill and import wheat which would reduce the import content.

F. Tea Subsidy

21. Tea in Mauritius is produced by four privately owned factories (30%), one factory owned by the Ministry of Cooperatives (14%) and three factories operated by the Tea Development Authority, TDA (56%). All factories are running at a loss. The financial problems of the Mauritius

tea industry have arisen because: (a) The quality of Mauritius tea is limited by environmental factors and it is used for blending with higher quality teas from elsewhere. However well made, it can only fetch prices in the medium range. The market for this type of tea is also highly competitive. (b) The cost of production of green leaf on estates is high because of the high wage structure and relatively low labor productivity. The selling price of green leaf produced by smallholders and "metayers" is set by the Tea Board and because of powerful representation in the past has risen to a level which the price of the end product does not justify. (c) The factories in the public and private sectors therefore operate at a loss. In the case of the former the loss is made up by government subventions while in the latter the losses are set off for tax purposes against other profitable enterprises in which the factory owners are engaged. (d) TDA has a large relatively unproductive labor force swollen by trainees who refused to take over plots assigned to them and thereby forego regular employment. Government is making an effort under SAL II to rectify the TDA situation and has set up a Study Group to investigate the tea industry as a whole because it is conscious of the fact that it cannot continue to subsidize the industry to the extent it has been. The issue is whether there is an economic advantage in Mauritius continuing to produce tea for export and this should be clarified by the study.

G. Vegetable Marketing

22. Through the parastatal Agricultural Marketing Board (AMB), Government regulates the market for potatoes, maize, onion, garlic and turmeric. AMB buys these products from producers at minimum prices which are fixed each year by Government on the basis of proposals from AMB. After adding a margin to cover its costs consisting mainly of storage, AMB sells the above products to consumers. It also has a monopoly on imports of the above products. AMB's proposals for minimum prices are made on the basis of yearly updated typical costs of production, and until now the prices offered seem to have been adequate to provide an incentive to producers while not bankrupting AMB. In fact, much of the progress made toward increasing production of potatoes, maize, onion, garlic and turmeric is attributed to AMB. The organization's main challenge for the future is planning to ensure that adequate storage facilities are available to handle the increased quantities of goods produced in response to its guaranteed minimum prices.

H. Meat and Milk Marketing

Through the parastatal Meat Marketing Authority (MMA), Government has tried to regulate the price of beef and milk. Prices of other livestock products (goat, sheep, pig, chicken and deer) are uncontrolled. In practice, however, import prices set the ceiling for locally produced beef and milk prices. Slaughter stock from Australia is currently sold to the butchers at Rs 18.75 per 1b carcass weight, including stamp duty. The price to the butchers for locally produced carcass is Rs 18.15 per 1b. These prices compare to an estimated local cost of production for a feedlot finished first grade animal of Rs 8.76 per 1b liveweight which, at an estimated killing out percentage of 53 percent, translates into Rs 16.50 per 1b carcass weight. There is thus ample room in the import parity or

local market price for local producers to make a profit, in this example Rs 1.65-2.25 per 1b carcass weight or 10-14 percent over costs. Similarly, in the case of locally produced milk, farmgate prices vary from Rs 2.50 to 3.50 per liter depending on proximity to market. Imported milk powder retails at Rs 12 per 1b which will reconstitute to Rs 4.5 liters resulting in a price of Rs 2.67 per liter equivalent. Although there is a tremendous variation between smallholders, the Animal Production Division of the Ministry of Agriculture estimates the cost of production by a smallholder of one liter of milk is Rs 5.36, but this is based on very low yields (98.7 liters per lactation in 210 days with a calving interval of 15 months). With the higher yields obtainable from better feeding and management, milk production for the local market would be profitable and competitive with imported powdered milk, like beef production. Probably due in part to the high natural protection already afforded Mauritius by high transport costs, the real constraints to increased beef and milk production are technical, not price related. Specifically: (a) Herd management is poor and the dairy husbandry routine, inefficient. (b) The extension service has no staff trained in commercial animal husbandry, and no diploma level training is available. (c) The population of biting flies in the cattle environment is high. (d) There is inadequate knowledge of the use of sugar industry by-products in ration for dairy cows. (e) The milk marketing system is inadequate. (f) The cattle feed supply is not always reliable. (g) The A.I. service is variable. The entire livestock subsector was recently the subject of a French supported study which is now in the hands of the Government, and is scheduled to be reviewed as part of the Bank's sector work program after the Government has formulated its comments.

I. Research and Extension

Agricultural research is the responsibility of the Mauritius Sugar Industry Research Institute (MSIRI) which is largely privately funded by the sugar industry. It ranks among the top sugar research institutes in the world. Some research is also carried out by the Ministry of Agriculture and by the University of Mauritius. Agricultural extension is the exclusive responsibility of the Ministry of Agriculture. The chief problem facing MSIRI is lack of funds for foodcrops research which it has been performing with considerable success. Most of the varieties of maize and potatoes now planted in Mauritius were adapted to local conditions by MSIRI, yet foodcrops research is outside the Institute's terms of reference, and should probably be supported by the Government budget. extension service also complains of lack of funds, notably for travel allowances, and the number of visits to farmers by extension officers seems low. However, there is probably also room for the extension service to improve its effectiveness. Like research and extension organizations in other parts of the world, MSIRI and the Ministry of Agriculture tend to operate in isolation from each other. This is particularly the case in the tea subsector where research and extension are uncoordinated and there is no meaningful advice available to the industry.

J. Water Management

25. The overall control, development and distribution of Mauritius' water resources is the responsibility of the Central Water Authority

(CWA). In addition to supplying water throughout the country, CWA grants rights for the use of water and operates water development works which deliver water to various users, including irrigation districts. The Irrigation Authority (IA) was established in 1976 with the objectives of: (a) studying the development of irrigation and making proposals to the CWA for the preparation of irrigation projects, (b) implementing and managing irrigation projects, and (c) undertaking research into the optimal use of water made available by the CWA for irrigation. Present data indicate that Mauritius will have sufficient water to satisfy all its requirements for the foreseeable future, but regional water imbalances are likely to become more and more of a problem, necessitating transfers from surplus to deficit regions. Another problem is local conflicts over the use of water (e.g. between sugarcane plantations with long-standing access and hydropower stations), as well as the total absence of any system of water charges. There is also the high cost of water development works and of operating existing irrigation systems due to the high cost of pumping. The total area under irrigation has been declining in recent years mainly for this reason. Drip irrigation has been introduced on several hundred arpents, but this system has yet to be proven technically and economically viable under Mauritian conditions.

K. Fisheries

Despite its maritime environment, Mauritius has no domestic fishing industry beyond the lagoon where measures have already been taken to curtail overfishing. Boats from other nations, however, are fishing in Mauritius' extensive territorial waters which includes the Saya de Mahla bank and the waters around Diego Garcia, in addition to those around the main island, Rodrigues and the smaller islands of the group. Meanwhile Mauritius imports fish and fish products. For all these reasons, Government would like to promote a domestic fishing industry, yet there is no clear picture of the nature and extent of Mauritius deepsea fisheries resources. Various studies have, however, been carried out in recent years by the FAO and other parties which would seem to be a sensible starting point.

IV. NEED FOR ADJUSTMENT

A. Data Base and Policy Analysis

27. Because of the diversity of soils, topography and climate in Mauritius, land use potential can only be assessed on an area-specific or preferably holding-by-holding basis. Data on each holding's area, cropping pattern, yield, ratoon, etc. is already collected by the Sugar Insurance Fund Board (SIFB) to determine the amount of sugar which should be insured against cyclones or droughts (Annex 2), but this data is not used for sector management or planning purposes. A key constraint is the ability to handle the 35,000 sets of data involved. Automated geographic information (AGI) systems are now available which can do this. A pilot project covering from 10,000 to 30,000 arpents could be studied and set up for about US\$ 250,000. This would provide Government with the means to store and manipulate data about every cane holding on the island including type

of producer, age of ratoon, yield, cost of production, natural resources, mill catchment area, location of roads, urban areas, power, and irrigation supply. The system could be expanded to include data on other crops such as where they are produced, where they are sold and where extension, storage and other services should be located if the production of these crops is to be encouraged. Combined with analysis of overseas markets, the AGI system could be a very useful tool for improving the overall management of the agricultural sector.

- 28. Analysis also needs to be carried out to test the statistical relationship between SIFB's annual estimates of sugar output and actual production. Together with market data, this could then be the basis for setting a target level of sugar production which will produce an actual output sufficient to meet, for example, the requirements of the domestic market and EC quota market at a given level of probability (e.g. 9 years in 10).
- 29. Similar commodity specific analysis should also be done to examine the scope and implications of attempts to diversify. Such analyses would need to be repeated each year, since the comparative advantage of each commodity will vary over time as (a) world market costs and prices change (particularly sugar prices on the free world market), (b) costs of production move hopefully downward as those holdings best suited to produce each commodity at least cost are identified and encouraged to adjust their production mixes accordingly, and (c) the required marketing facilities (storage, processing, distribution, pricing), etc. are developed to promote movement away from imports to local production. Also all diversification activities are not necessarily viable. There is a need to carefully examine the implications of diversification efforts to ensure that the gains from increased local production are not outweighed by higher imports of goods needed to produce them.

B. Sugar Industry Policy

- 30. Sugar is Mauritius' chief export earner and largest employer, yet there is no comprehensive Government policy toward the industry. In the past, Government tax, wage and other policies affecting the industry have tended to be formulated on an ad hoc basis for revenue or other reasons without much regard for their impact on the industry. For example, because all Mauritian cane growers receive an average price for all sugar produced and sold each season, none experience the marginal returns from sugar sold beyond the Lome quota on the world market. Part of the problem lies in the lack of any clear cut goals for the industry shared by Government. The Sugar Commission of Inquiry is intended to lay the groundwork for a comprehensive sugar industry policy which will have the support of all parties concerned management, labor and Government. As part of this policy, several key issues should be addressed:
- 31. <u>Taxation</u>. Sugarcane occupies 90 percent of the cropped area in Mauritius, some of which is known to be used at far less than its potential. Planters' yields in recent years have averaged some 8 tons per arpent less than those of the miller planters, and their costs of production have been generally higher. However, if Mauritius could meet

the requirements of the domestic and export markets from less land (i.e. by raising yields), there would be more land available for agricultural diversification. To accomplish this, Mauritius should give serious consideration to taxing land instead of exports, and to elminating the exemption of small planters (under 20 tons of exports) from taxation. To yield the same revenue as the sugar export tax in 1981/82 (Rs367.9 million). the land tax would have to be Rs1,672 per arpent of arable land (estimated at 220,000 arpents in total). Since smallholders' land would be taxed, miller planters' tax liability would decline from Rs808 to Rs506 per ton of sugar, while smallholders' tax liability would range from Rs200-620 per ton of sugar depending on level of exports. By rewarding smallness, the present sugar export duty and surcharge have created an incentive for land fragmentation when the tax system should be generally encouraging greater consolidation of land holdings in the interests of higher productivity per land area. A flat land tax would penalize less productive patterns of land holding or speculative holdings of land, thereby promoting greater overall productivity of land use. At a later stage, the land tax could be made more equitable by basing it on the estimated earnings potential of the land, possibly with the aid of the island wide valuation of non-urban land going on under the Urban Rehabilitation and Development Project (Loan 1926-MAS). It could even be made progressive with respect to such estimates. The large sugar estates should also continue to pay corporate profits taxes and through their officers, individual income taxes.

- 32. Labor. With a sizeable disparity between the economic and financial cost of sugar production (Annex 2), caused largely by Government tax and wage policies, there is a danger that Mauritius will become uncompetitive costwise with other sugar producing countries. At prevailing exchange rates, production costs are estimated at between US cents 10 and 14 for most developing countries, 2/ compared to US cents 17 per 1b for Mauritius (para 9). The largest single item in the Mauritian industry's cost of production is labor (32 percent of the total), but the figures contain a sizeable welfare element due to the year around employment provisions described above (para 18). Both in the interests of the industry and the country, Government should look for ways to employ the excess labor more productively possibly by providing more incentives for diversification activities.
- 33. Depreciation Allowances. Given the small size of many of Mauritius' sugar mills and their declining efficiency, there are sizeable losses to the economy in the present milling situation. On the other hand, factory consolidation and/or renewal of existing plant and equipment is likely to be expensive. The costs of consolidation/renewal clearly need to be weighed against the benefits, and if the outcome is favorable, Government should consider giving more encouragement by tax or other means for the creation of larger, more efficient mills.

^{2/} Shamsher Singh, "Sub-Saharan Agriculture: Synthesis and Trade Prospects," p. 70.

C. Foodcrops and Livestock Development

- Apart from fiscal measures to encourage more efficient utilization of scarce land, foodcrop production requires a package of measures -- pricing, marketing, research and extension-- designed to (a) shift consumer demand away from presently imported food (rice, wheat flour, meat, milk, fish, etc) towards locally produced food (potatoes. maize, locally produced meat, milk, fish, etc), while simultaneously (b) stimulating the supply of the locally produced goods. Pricing policy is likely to be the most effective tool in the hands of Government to bring about this transformation. In terms of consumer prices, a gradual phase-out of the import price subsidies on rationed rice and wheat flour seems unavoidable if the structural adjustment objective is to be pursued, but other measures such as publicity campaigns and expert analysis of existing dietary habits and the nutritional effects of the proposed changes should also be considered. In terms of producer prices, it will be necessary to decide which, if any, additional agricultural products should benefit from guaranteed minimum prices, and the level at which they should be fixed so as to offer an incentive to producers. The Government would be justified in offering prices up to import parity, to be phased out later as the market develops. Existing support prices should also be reviewed regularly to maintain their incentive effect. However, with the exception of maize, the scope for further import substitution from increased local production is limited. If guaranteed minimum prices involve a subsidy, this could be met by revenue from a tariff on imports of similar foodstuffs. Government should also enter into an agreement with MSIRI covering the funding of essential scientific work on foodcrops which is within MSIRI's competence, but beyond its terms of reference. The extension service should also be strengthened.
- 35. The mainly technical problems of the livestock industry (para 23) could be alleviated by the following actions: (a) Students should be trained by working on intensive dairy production farms in a similar environment overseas (e.g. southeastern USA or parts of India). Such practical work should be for two years and be an essential precursor to any animal production degree or diploma course overseas. (b) The biting fly problem should receive research priority including research into biological control, the aim being to rid Mauritius of the species. Part of the fly's life cycle is spent in rotting sugarcane vegetation, and this research could be undertaken by MSIRI. (c) In the meantime, insecticides should be used to reduce biting fly infestations of livestock herds. Eartags impregnated with a synthetic pyrethroid and which last for four months have recently been developed in Europe. (d) Research into use of sugar industry by-products as livestock feed should also be carried out by MSIRI. The work would need an experienced animal nutritionist and a pre-requisite would be a high yielding dairy herd fed on conventional rations. (e) Consultants should study the need for a private sector cooperative central milk marketing organization and improvements in the reliability of cattle feed supply and A.I. services. The study should include a review of the role played by the MOA livestock breeding stations, including how they could more effectively serve the industry and how they could operate at less cost to the Government. In the case of milk, there might be scope for temporary tariff protection to encourage producers to invest in yield improving measures, but these would have to be accompanied by the technical

interventions listed above. A comprehensive dairy development project along the lines of the Bank's successful involvement in India might also be prepared. A livestock subsector study was recently carried out by Government with the assistance of French technical assistance, and future needs for technical and financial assistance in the livestock subsector are likely to be covered by the French. The Bank should review this report and assist Government identify its policy implications as part of the ESW program. This exercise is scheduled for FY 84.

D. Tea

- As part of its efforts to improve efficiency in the public sector and reduce the drain on its resources, Government has prepared a plan for restructuring TDA along smallholder lines as originally intended in the Bank project. The proposal which has been appraised under SAL II calls for settling 1,500 smallholders comprising TDA trainees and pluckers plus some outside applicants on about 2900 arpents of tea land controlled by TDA. The ex-TDA staff will be subsidized on a scale declining over time, while crops improve until their earnings from tea equate to their employment benefits. The residual surplus TDA staff will be redeployed as soon as practicable to other more productive work. If these measures are implemented, it is estimated that the domestic resource cost of tea, presently estimated atRs15-20 per 1b, could be reduced to Rs8 per 1b.
- 37. The Government has also set up a Study Group to examine the tea sector as a whole which will encompass the private sector factories and the Ministry of Cooperatives factory (Nouvelle France) all of which are running at a loss. The Study Group will address the longer term economic issue of whether the production of tea for export is the optimal method of creating employment for the 15,000 people employed in the tea industry.

Water Management

38. In response to the problem of regional water imbalances, detailed regional (basin) analyses should be carried out including more detailed investigation of water needs and the calculation of regional water balances. In view of local conflicts over the use of water, a thorough review of existing tariffs and charges is recommended to establish a system of water charges for all users, considering the cost of water development, operation of systems, the value of water to the various users and their ability to pay. Because of the high cost of water development works, they should be planned and implemented as multipurpose projects whenever possible.

F. Fisheries

39. To formulate a strategy for the development of the fishing industry, a study would be carried out under the Technical Assistance Project to: (a) review existing fisheries studies and resource surveys concentrating on the nature of the resource and the history of its exploitation; and (b) review the comparative advantage, markets and commercial viability of different fisheries development activities (artisanal, fish culture, commercial long line, trawling along the Saya de

Mahla bank). The results of these studies would be reviewed and discussed with the Bank before proceeding with additional fisheries resource surveys or preparation of specific projects.

G. Summary

40. Agriculture is basic to the economy of Mauritius, and is likely to remain so for the foreseeable future. There is little that Mauritius can do about the natural and external manmade constraints on its agricultural development, but it can change the internal policy and institutional environment. The path to higher growth in agriculture is through increased productivity in the sugar industry. By using less land to produce the same amount of sugarcane, more land would be available for foodcrop production. To promote this transformation in the sugar industry, Government should give serious consideration, after the report of the Sugar Commission is received, to phasing out the present sugar export duty and surcharge and phasing in a tax on arable land to encourage more productive use of scarce land. The big sugar estates would continue to pay corporate profits tax and individual income tax, and in this context, incentives should be considered to encourage modernization and consolidation of Mauritius sugar mills. These measures would enhance Mauritius' competitive position in world markets, and possibly even help the country to increase its market share by lowering its costs. Simultaneously, more encouragement needs to be provided for the consumption and production of locally produced food. The most effective way to bring about a change in the present import oriented pattern of consumption would be to phase out the consumption subsidies on the two main imported staples, rice and wheat flour. On the supply side, existing guaranteed minimum prices must continue to provide adequate incentives relative to sugar. The merits of extending such prices to other crops up to import parity levels should also be considered. Research and extension in support of foodcrops production should also be strengthened. The diversification drive might also help alleviate the island's serious unemployment problem.

V. IMPLICATIONS FOR OPERATIONAL AND SECTOR WORK

41. Operationally, the measures discussed above fall into two categories: (a) those which were not part of SAL I and which should therefore be part of SAL II, the Technical Assistance Project or the ESW program and (b) those which are outstanding from SAL I.

A. SAL I

42. Left over from SAL I is the wide range of issues affecting the sugar industry which have to be addressed as a whole, and on which recommendations for action under SAL II would be premature without the report of the Sugar Commission of Inquiry which is not expected until end December 1983. The main issues are (a) tax reform with consideration being given to replacing the current sugar export tax structure by a land tax, (b) reform of the labor laws to steer workers out of the sugar industry and into more productive employment elsewhere in the economy, if it can be

found, or abroad, and (c) reform of depreciation allowances to encourage replacement of ageing milling plant and equipment and consolidation of the island's 21 mills into larger, more efficient units. Until the Sugar Commission reports, however, there is little which can be done on these issues.

- In the foodcrops subsector, the revised plan of action included in the first SAL, now expected to take the form of a Government "White Paper on Agricultural Diversification", is expected to be the main vehicle for formulating pricing and other measures to promote foodcrop production. The critical issues are: (a) the nature and level of producer price supports for foodcrops, and (b) how to ensure a sound financial basis for foodcrops research. Except for maize, however, the potential for import substitution is limited. Increased production will also necessitate project—type interventions (e.g. livestock), in addition to sound policy.
- Progress in carrying out the recommendation of the Pillay Committee regarding TDA which formed part of the Statement of Development Policy for SAL I has been disappointing. Proposals by Government to restructure TDA along the lines of the original concept of smallholder development are encouraging and should be closely monitored as part of SAL II and the Technical Assistance Project.

B. SAL II and Technical Assistance Project

The second SAL and parallel Technical Assistance Project have been designed to address most of the issues not covered by SAL I. The release of the second tranche of SAL II is tied to satisfactory discussion with the Bank of the outcome of the Sugar Commission. Under the Technical Assistance Project, a number of studies will be undertaken in support of agricultural diversification including a survey of Crown Lands, an index of non-sugar lands, a study of the organization of agricultural diversification and a study of the integrated development of Rodrigues. These are also studies of the tea industry and of TDA and studies for the formulation of a fisheries development strategy and of marine pollution.

C. Sector Work

Bank ESW resources need to be provided to: (a) review the findings of the Sugar Commission of Inquiry (FY84-85 Sugar Industry Study); (b) review the French supported livestock study (FY84 Livestock Study); and (c) review the results of the fisheries study to be financed under the Technical Assistance Project (FY 84 Fisheries Study).

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Agriculture Sector Memorandum

Agricultural and Related CDP, 1976-81 (Rs million at 1976 constant factor cost)

| | 1976 | 1977 | 1978 | 1979 | 1980 1/ | $\frac{1981}{2}$ |
|---|--------------|---------------|--------------|--------------|--------------|------------------|
| Agriculture (of which sugar cultivation) | 794 (596) | 842 (617) | 865 (617) | 874 (638) | 624 (396) | 768 (508) |
| Manufacturing (of which sugar milling) | 669 (208) | 741 (216·) | 754 (216) | 784 (223) | 716 (204) | 792 (210) |
| Total GDP | 4,183 | 4,543 | 4,711 | 4,881 | 4,461 | 4,827 |
| Share of agriculture and sugar milling in Total CDP (%) | 24 | 23 | 23 | 22 | 19 | 20 |
| Share of sugar cultivation and sugar milling in Total GDP (%) | 19 | 18 | 18 | 18 | 13 | 15 |

1/ Provisional

 $\overline{2}$ / Estimates

Source: CSO and mission estimates

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Growth of Population and Agricultural GDP

| | <u>1972</u> | <u>1973</u> | <u>1974</u> | 1975 | 1976 | <u>1977</u> | <u>1978</u> | 1979 | 1980 | <u>1981</u> |
|---|-------------|-------------|-------------|-------|-----------------------|---------------------------------------|---------------------------------------|---------------------------------------|---|---|
| Population ('000) | 851.0 | 860.2 | 871.5 | 882.8 | 894.4 | 908.9 | 924.3 | 940.7 | 956.9 | 971.3 |
| Annual Growth Rate (%) | 1.2 | 1.1 | 1.3 | 1.3 | 1.3 | 1.6 | 1.7 | 1.8 | 1.7 | 1.5 |
| Agricultural GDP (Rs million at 1976 constant factor cost) Annual Growth Rate (%) (Of which sugar cultivation) Annual Growth Rate (%) (Of which non-sugar cultivation) Annual Growth Rate (%) | | | | | 794 (596) (198) | 842 6 (617) 4 (225) 14 | 865 3 (617) - (248) 10 | 874 1 (638) 3 (236) -5 | 624 -29 (396) -38 (228) -3 | 768 23 (508) 28 (260) 14 |
| Manufacturing CDP (Rs million at 1976 constant factor cost) Annual Growth Rate (%) (Of which sugar milling) Annual Growth Rate (%) | | | | | 669 (208) | 741 11 (216) 4 | 754 2 (216) | 784 4 (223) 3 | 716 -9 (204) -9 | 792 11 (210) 3 |
| Total Agricultural GDP (including sugar milling, Rs million at 1976 constant factor cost) Annual Growth Rate (%) | | | | | 1,002 | 1,058 | 1,081 | 1,097 | 828 25 | 978 18 |
| Total Agricultural CDP per canita (Rs) Annual Growth Rate (%) | | | | | 1,120 | 1,164 4 | 1,170 | 1,166 | 865 -26 | 1,007 16 |

Source: Mauritius, Economic Memorandum, Recent Developments and Prospects (May 26, 1982), Statistical Tables 1.1 and 2.3

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Agriculture Sector Memorandum

Agricultural Balance of Trade
(current Rs million)

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | <u>1980</u> 1 | 1981 |
|--------------------------------------|-----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------|
| Agricultural Exports (FOS | <u>)</u> | | | | | | | | |
| Sugar Molasses Tea Fish and | 608.1 40.3 18.9 | 1,537.4 46.2 19.7 | 1,548.8 23.6 16.0 | 1,321.5 31.7 29.2 | 1,428.5 41.0 43.5 | 1,304.8 34.3 55.2 | 1,590.0 69.2 39.3 | 2,168.3 104.0 42.1 | 1,625 110 49 |
| fish preparation | 8.0 | 14.5 | 14.3 | 18.8 | 31.8 | 32.1 | 31.2 | 42.0 | 61 |
| Total | 675.3 | 1,617.8 | 1,602.7 | 1,401-2 | 1,544.8 | 1,426.4 | 1,729.7 | 2,356.4 | 1,845 |
| Annual Growth Rate (% |) - | 140 | -1 | -13 | 10 | -8 | 21 | 36 | -22 |
| Agricultural Imports (CIF | <u>)</u> | | | | | | | | |
| Rice | 7110 | 227.0 | 133.0 | 130.5 | 106.1 | 163.9 | 147.4 | 237.3 | 277. |
| Wheat Flour Meat and | 33.7 | 85.6 | 98.9 | 71.0 | 79.8 | 79.8 | - 85.6 | 168.8 | 204. |
| meat preparations Fish, fresh and | 6.6 | 11.1 | 20.8 | 31.0 | 50.1 | 58.0 | 104.6 | 104.7 | 99. |
| preserves Animal and | 12.9 | 26.7 | 24.2 | 31.0 | 49.7 | 57.8 | 65.5 | 85.0 | 98. |
| vegetable oil Milk and cream | 23.1 24.2 | 70.7 44.7 | 51.8 54.0 | 81.0 63.2 | 79.1 89.1 | 86.4 85.7 | 96.1 91.1 | 129.6 97.4 | 149. 143. |
| Fruits and vegetables | 6.2 | 11.5 | 14.1 | 14.3 | 24.1 | 26.2 | 81.6 | 155.1 | 146. |
| Other food | 62.5 | 93.3 | 114.8 | 145.7 | 183.1 | 226.3 | 179.7 | 236.0 | 227. |
| Beverages and tobacco | 9.3 | 13.4 | 16.5 | 18.9 | 32.0 | 23.0 | 27.3 | 25.8 | 24. |
| Total | 249.5 | 584.0 | 528.1 | 586.6 | 693.1 | 806.1 | 879.4 | 1,239.7 | <u>1,371.</u> |
| Annual Growth Rate (%) |) - | 134 | -10 | 11 | 18 | 16 | 9 | 41 | 11 |
| Agricultural Balance of Trade | 425.8 | 1,033.8 | 1,074.6 | 814.6 | 851.7 | 620.3 | 850.3 | 1,116.7 | 474. |
| Annual Growth Rate (Z) | · - | 143 | 4 | -24 | 5 | 27 | 37 | 31 | -58 |

^{1/} Provisional.

Source: For years 1973-30, Mauritius Economic Memorandum, Recent Developments and Prospects (May 26, 1982), Statistical Tables 3.3 and 3.5; for 1981, Mauritius Ministry of Economic Planning and Development, Central Statistical Office, External Trade Statistics 1981 (April 1982), Summary Tables 3, 4 and 6.

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Agriculture Sector Memorandum

Volume and Unit Prices of Selected Agricultural Exports

| Item | 1973 | 1974 | 1975 | 1976 | <u>1977</u> | 1978 | 1979 | <u> 1980 </u> | / 1981 2/ |
|--------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|---|------------------------------|
| Volume ('000 tons) | | | | | | | | | |
| Sugar Molasses Tea | 699.2 185.2 3.7 | 668.4 169.0 3.1 | 497.5 121.2 2.1 | 547.4 129.1 3.4 | 636.3 194.7 3.3 | 578.6 156.9 4.4 | 612.1 171.6 3.9 | 617.4 154.3 3.6 | 432.2 161.5 4.1 |
| Unit Prices (Rs per ton |) | | | | | | | | |
| Sugar Molasses Tea | 869.7 217.6 5,108.1 | 2,300.0 273.4 6,354.8 | 3,113.2 194.7 7,619.0 | 2,398.8 245.5 8,588.2 | 2,244.7 210.6 13,181.8 | 2,255.1 218.6 12,545.5 | 2,597.6 403.7 10,074.8 | 3,512.0 674.0 11,694.4 | 3,760.0 681.0 12,000.0 |

 $[\]frac{1}{2}$ / Provisional

 $[\]frac{2}{2}$ Estimates

MAURITIUS
Agriculture Sector Memorandum

Volume of Selected Imports of Food and Beverages ('000)

| Item | | 1973 | 1974 | 1975 | 1976 | 1977 | <u>1978</u> | 1979 | 1980 ¹ / | <u>1981</u> 1/ |
|-----------------------------|--------|-------|-------|-------|-------|-------|-------------|-------|---------------------|----------------|
| Rice | tons | 58.1 | 87.5 | 67.0 | 79.2 | 65.5 | 78.5 | 72.3 | 88.0 | 80.4 |
| Wheat Flour | tons | 44.0 | 50.4 | 57.2 | 40.1 | 49.6 | 49.5 | 46.5 | 57.5 | 90.4 |
| Meat & Meat Preparations | tons | 1.2 | 1.5 | 3.5 | 4.4 | 6.4 | 6.3 | 9.5 | 6.4 | - |
| Fish, Fresh & Prepared | tons | 5.2 | 7.4 | 6.1 | 6.9 | 9.2 | 9.6 | 8.9 | 8.3 | ** |
| Animal and Vegetable Oil | tons | 8.6 | 12.4 | 7.9 | 11.7 | 4.1 | 17.1 | 14.2 | 19.5 | |
| Milk | tons | 3.6 | 4.6 | 4.3 | 5.6 | 7.6 | 7.9 | 11.1 | 8.8 | - |
| Whisky | liters | 164.2 | 214.5 | 256.7 | 280.0 | 467.0 | 210.9 | 283.0 | 286.2 | - |

1/ Provisional

MAURITIUS

Agriculture Sector Memorandum

Government Current Revenues, 1972/73 - 1980/81

(Rs million)

| <u>ltem</u> | 72/73 | 73/74 | 74/75 | 75/76 | 76/77 | 77/78 | 78/79 | Z of Total | 79/80 | % of Total | 80/81 | % of Total |
|------------------------|-------|-------|-------|---------|--------------|---------|---------|---------------|---------|---------------|---------|---------------|
| Tax on income, profits | | | | | | | | | | | | |
| capital gains | 77.6 | 122.5 | 191.1 | 389.2 | 376.4 | 283.4 | 311.1 | 22 | 277.2 | 16 | 362.5 | 18 |
| Tax on property | 15.5 | 19.4 | 28.3 | 34.4 | 49.2 | 53.4 | 63.4 | 4 | 69.8 | 4 | 78.6. | 4 |
| Tax on goods and | | | | | | | | | | | | |
| services | 79.5 | 99.4 | 119.6 | 132.6 | 168.7 | 216.1 | 264.6 | 19 | 312.1 | 17 | 364.8 | 18 |
| Import taxes | 107.1 | 141.6 | 187.6 | 260.5 | 349.1 | 412.7 | 465.0 | 33 | 640.4 | 35 | 708.4 | 34 |
| Export duties | 29.9 | 48.2 | 129.8 | 126.1 | 124.9 | 139.8 | 150.1 | 11 | 287.3 | 16 | 268.2 | 13 |
| Other taxes | 3.4 | 8.7 | 3.4 | 3.7 | 4.6 | 4.1 | 6.5 | - | 8.5 | - | 9.0 | - |
| Non-taxes revenue | 28.1 | 16.0 | 54.7 | 108.8 | 95.3 | 122.7 | 156.3 | _11 | 210.4 | 12 | 267.2 | _13 |
| Total Revenues | 341.1 | 455.8 | 714.5 | 1,055.3 | 1,168.2 | 1,232.2 | 1,417.0 | 100 | 1,805.7 | 100 | 2,058.7 | 100 |
| • | | | | | ************ | | | ************ | | | | - |

MAURITIUS

Agriculture Sector Memorandum

Government Current Revenues, 1972/73 - 1980/81

(Rs million)

| Item | 72/73 | 73/74 | 74/75 | 75/76 | 76/77 | 77/78 | 78/79 | % of Total | 79/80 | % of Total | 80/81 | % of Total |
|------------------------|-------|-------|-------|---------|---------|---------|---------|---------------|---------|---------------|---------|---------------|
| Tax on income, profits | | | | | | | | | | | | |
| capital gains | 77.6 | 122.5 | 191.1 | 389.2 | 376.4 | 283.4 | 311.1 | 22 | 277.2 | 16 | 362.5 | 18 |
| Tax on property | 15.5 | 19.4 | 28.3 | 34.4 | 49.2 | 53.4 | 63.4 | 4 | 69.8 | 4 | 78.6 | 4 |
| Tax on goods and | | | | | | | | | | | | |
| services | 79.5 | 99.4 | 119.6 | 132.6 | 168.7 | 216.1 | 264.6 | 19 | 312.1 | 17 | 364.8 | 18 |
| Import taxes | 107.1 | 141.6 | 187.6 | 260.5 | 349.1 | 412.7 | 465.0 | 33 | 640.4 | 35 | 708.4 | 34 |
| Export duties | 29.9 | 48.2 | 129.8 | 126.1 | 124.9 | 139.8 | 150.1 | 11 | , 287.3 | 16 | 268.2 | 13 |
| Other taxes | 3.4 | 8.7 | 3.4 | 3.7 | 4.6 | 4.1 | 6.5 | _ | 8.5 | - | 9.0 | - |
| Non-taxes revenue | 28.1 | 16.0 | 54.7 | 108.8 | 95.3 | 122.7 | 156.3 | 11 | 210.4 | 12 | 267.2 | 13 |
| Total Revenues | 341.1 | 455.8 | 714.5 | 1,055.3 | 1,168.2 | 1,232.2 | 1,417.0 | 100 | 1,805.7 | 100 | 2,058.7 | 100 |

Table

MAURITIUS
Agriculture Sector Memorandum

Government Annual Expenditures, 1972/73 - 1980/81 (Rs million)

| <u> [tem</u> | 72/73 | 73/74 | 74/75 | 75/76 | <u>76/77</u> | 77/78 | 78/79 | % of Total | 79/80 | % of Total | 80/81 | % of Total |
|-------------------------|--------|---------|---------|---------|---|---------|---------|---------------|-------------|---------------|---------|---------------|
| Wages and salaries | 122.9 | 182.2 | 231.2 | 385.2 | 488.9 | 548.7 | 682.6 | 41 | 6,81.8 | 37 | 795.5 | 34 |
| Purchases of goods | | | | | | | | | | | | |
| and services | 61.3 | 81.5 | 117.2 | 107.6 | 138.7 | 116.9 | 160.0 | 10 | 190.5 | 10 | 252.6 | 11 |
| Interest payments | 35.1 | 31.1 | 33.9 | 51.4 | 73.3 | 116.8 | 179.4 | 10 | 343,1 | 18 | 462.0 | 20 |
| Subsidies and transfers | 66.6 | 201.0 | 286.6 | 367.3 | 472.5 | 548.8 | 647.1 | 39 | 651.6 | 35 | 808.1 | 35 |
| - local government | (7.0) | (18.0) | (24.0) | (46.0) | (55.0) | (62.0) | (84.0) | | (94.0) | | (107.9) | |
| - education | (3.0) | (5.0) | (10.0) | (16.0) | (23.0) | (104.0) | (110.0) | | (127.0) | | (148.2) | |
| - rice and wheat | _ | (107.0) | (157.0) | (121.0) | (100.0) | (56.0) | (111.0) | | (130.0) | | (203.0) | |
| - public provisions | (10.0) | (25.0) | (37.0) | (42.0) | (68.0) | (75.0) | (86.0) | | (97.0) | | (116.5) | |
| - Hational Pension Fund | (14.0) | (20.0) | (25.0) | (36.0) | (22.0) | (100.0) | (113.0) | | (118.0) | | (146.0) | |
| - other transfers | (23.6) | (16.0) | (33.6) | (106.3) | (204.5) | (151.8) | (143.1) | | (85.6) | | (41.5) | |
| Total current | | | | | | | | | | | | |
| expenditures | 285.9 | 495.8 | 668.9 | 911.5 | 1,173.4 | 1,331.2 | 1,669.1 | 100 | 1,867.0 | 100 | 2,318.2 | 100 |
| | | | ST-1993 | - | *************************************** | - | | **** | | | | |

MAURITIUS Agriculture 'Sector Memorandum Agricultural Employment in Large Establishments 1/

| | 1977 | | 1978 | | 1 | 979 | | 1981 | |
|---|------------|------------|------------|---------------------|------------|------------|------------|------------|------------|
| | March | Sept. | March | Sept. $\frac{2}{1}$ | March | Sept. 2/ | March3/ | Sept. | March |
| Sugar ⁴ / | 54,391 | 58,499 | 51,332 | 53,982 | 48,714 | 52,668 | 47,493 | 51,146 | 47,271 |
| Other Agriculture 5/ | 6,993 | 6,798 | 7,078 | 6,785 | 6,898 | 6,700 | 6,521 | 6,896 | 6,231 |
| Total | 61,384 | 65,297 | _58,410 | 60,767 | 55,612 | 59,368 | 54,014 | 58,042 | 53,502 |
| All Sectors | 194,032 | 194,762 | 195,168 | 198,435 | 199,629 | 199,114 | 197,509 | 197,139 | 192,918 |
| Share of Agriculture (%) (of which sugar) | 32 (28) | 34 (30) | 30 (26) | 31 (27) | 28 (24) | 30 (26) | 27 (24) | 29 (26) | 28 (25) |

^{1/} Includes industrial and commercial establishments employing 10 or more workers and sugar cane plantations where 25 arpents or more are harvested.

^{2/} Revised estimates.
3/ Provisional
4/ Includes employees in sugar factories.
5/ Includes employees in tea factories.

Agriculture Sector Memorandum

Area Harvested, Yield and Production of Cane and Sugar

| | 1974 | 1975 | 1976 | <u>1977</u> | 1978 | 1979 | 1980 |
|---|-------------------------------|-------------------------------|--|-------------------------------|--|-------------------------------|-------------------------------|
| Area Harvested ('000 arpents) Miller planters Planters | $\frac{189.3}{104.0}$ 85.3 | 189.6 104.4 85.2 | 191.6 105.7 85.9 | 191.0 105.1 85.9 | 190.2 106.2 84.0 | 188.9 106.7 82.2 | 187.5 106.4 81.1 |
| Cane Production ('000 tons) Miller planters Planters | 5,964.0 3,864.0 2,100.0 | 4,316.0 2,783.0 1,533.0 | 6,402.0 3,977.0 2,425.0 | 6,022.0 3,747.0 2,275.0 | 6,260.0 3,914.0 2,346.0 | 6,313.1 8,976.6 2,336.5 | 4,564.4 2,874.1 1,690.3 |
| Cane Yield (tons per arpent) Miller planters Planters | $\frac{31.5}{37.1}$ 24.6 | $\frac{22.8}{26.7}$ 18.0 | $\begin{array}{r} 33.4 \\ \hline 37.6 \\ 28.2 \end{array}$ | $\frac{31.5}{35.7}$ 26.5 | $\begin{array}{r} 32.9 \\ \hline 36.9 \\ 27.9 \end{array}$ | 33.4 37.3 28.4 | 24.3 27.0 20.8 |
| Sugar Production ('000 tons) White Raw | 696.8 48.9 647.9 | 468.3 25.5 442.8 | 689.9 52.7 637.2 | 665.4 48.0 617.4 | 665.2 41.7 623.5 | $\frac{688.4}{42.3}$ 646.1 | 475.5 31.6 443.9 |
| Molasses production ('000 tons) | 172.8 | 126.4 | 204.3 | 191.0 | 197.2 | 203.8 | 133.8 |

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Note: 1 arpent = 1.043 acres

Source: Mauritius Chamber of Agriculture

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Agriculture Sector Memorandum

Sugar Production and Disposal 1/(000 tons)

| | 1974/75 | 1975/76 | 1976/77 | 1977/78 | 1978/79 | 1979/80 | 1980/81 |
|--------------------------------|---------|---------|---------|---------|---------|---------|---------|
| Stock at beginning of the year | 17.3 | 13.6 | 39.5 | 23.9 | 31.7 | 45.7 | 38.5 |
| Production | 689.1 | 501.9 | 679.2 | 664.5 | 670.4 | 662.9 | 490.8 |
| Exports | 658.0 | 440.7 | 658.1 | 618.4 | 619.3 | 628.2 | 466.0 |
| (of which United Kingdom) | (401.9) | (433.8) | (570.8) | (494.9) | (480.3) | (445.6) | (363.4) |
| Local consumption | 34.8 | 35.3 | 36.7 | 38.3 | 37.1 | 41.9 | 38.3 |
| Stocks at end of the year | 13.6 | 39.5 | 23.9 | 31.7 | 45.7 | 38.5 | 25.0 |

1/ Sugar Year: July/June

Source: Mauritius Chamber of Agriculture

MAURITIUS Agriculture Sector Memorandum Producer Prices and Export Taxes for Sugar

| Size of Producer | 1977-78 | | 1978~79 | | 1979-80 | | 1980-81 | |
|--------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| (metric tons) | | Export tax | | Export tax | | Export tax | | Export tax |
| | Rs per ton |
| 20 or less | 2,022.19 | - | 2,102,74 | _ | 2,721.11 | - | 3,177.01 | _ |
| 21-75 | 1,906.84 | 115.36 | 1,983.98 | 118.76 | 2,490.61 | 227.09 | 2,812.89 | 304.12 |
| 76-1,000 | 1,887.62 | 134.57 | 1,964.18 | 139.56 | 2,450.36 | 265.15 | 2,762.20 | 354.81 |
| 1,001-3,000 | 1,842.84 | 173.02 | 1,915.81 | 178.15 | 2,371.64 | 339.97 | 2,646.28 | 456.18 |
| More than $3,000^{-1}$ / | 1,752.76 | 259.53 | 1,821.78 | 267.22 | 2,185.30 | 510.90 | 2,409.91 | 684.28 |
| Millers 2/ | 1,733.47 | 259.53 | 1,802.72 | 267.22 | 2,185.10 | 510.90 | 2,409.91 | 684.28 |

Source: Mauritius Chamber of Agriculture.

 $[\]frac{1}{2}$ / Miller - planters $\frac{2}{2}$ / Millers producing over 3,000 tons.

MAURITIUS Agriculture Sector Memorandum Foodcrops - Area and Production

| | 19 | 1977 | | 1978 | | 1979 | | 1980 | |
|-----------------|-----------|------------|-------------|--------------|-----------|------------|-----------|------------|--|
| | Area | Production | Area | : Production | Area | Production | Area | Production | |
| | (arpents) | (tons) | (arpents) | (tons) | (arpents) | (tons) | (arpents) | (tons) | |
| Vegetables | | | | | | | | | |
| | 548 | 851 | 540 | 887 | 524 | 872 | 771 | 1,123 | |
| Beans | 232 | 1,531 | 270 | 1,673 | 240 | 1,479 | 271 | 1,399 | |
| Cucumber | 168 | 1,538 | 179 | 1,436 | 150 | 1,292 | 339 | 2,172 | |
| Pumpk In | 728 | 1,094 | 898 | 1,428 | 653 | 1,082 | 683 | 1,071 | |
| Groundnuts | 1,261 | 1,328 | 1,184 | 1,144 | 1,110 | 1,271 | 773 | 732 | |
| Maize | 1,702 | 10,905 | 1,744 | 12,153 | 1,371 | 8,329 | 1,674 | 11,694 | |
| Potatoes | 1,746 | 6,928 | 1,751 | 7,254 | 1,895 | 8,359 | 1,468 | 6,121 | |
| Tomatoes | 170 | 2,001 | 207 | 2,379 | 219 | 2,634 | 289 | 3,416 | |
| Cabbage | 294 | 1,287 | 355 | 1,684 | 433 | 1,934 | 485 | 2,196 | |
| Ontous Other | 1,619 | 8,236 | 1,793 | 8,514 | 1,411 | 6,659 | 1,665 | 6,843 | |
| fruits | | | | | | | | | |
| Bananas | 754 | 7,586 | 780 | 7,154 | 692 | 6,663 | 605 | 2,625 | |
| Other | 137 | 607 | 120 | 542 | 84 | 452 | 64 | 258 | |
| Office | | | | | | | | | |
| Total | 79,359 | 43,892 | 9,821 | 46,248 | 8,682 | 40,926 | 9,087 | 39,650 | |
| IOLAL | ,,,,,,, | ,-,- | | | | | | | |

Note: 1 arpent = 1.043 acres Source: Central Statistical Office.

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

THE SUGAR INDUSTRY 1/

1. For over 200 years, Mauritius has been used as a site for the sugar industry. Population was settled to provide manpower; communications were developed to transport the cane and sugar, and it is wrong to suggest that the industry is a "state within a state": the state has slowly. developed and it is now striving to encompass the sugar industry. The last land use map of Mauritius was published in 1965, but figures extracted from the census of 1972 illustrate the position. The total area held by sugar growers can not be reconciled with the effective area under cane, 205,218 arpents in 1972.

Land utilization (in acres)

| Agriculture, of which: | | 262,500 |
|--|--------------------------------------|-----------------------------------|
| sugarcane, see above, tea tobacco, foodcrops, etc. | 242,100 15,400 5,000 | |
| Forest, scrub, grass, of which: | | 159,300 |
| forest plantations natural forests savannah, grass, etc. scrub, other bush | 16,740 5,900 18,400 118,260 | |
| Reservoirs, ponds Swamps, rocks Main roads Built up areas | | 2,900 3,500 3,300 29,300 |
| Total land area of Mauritius | | 460,800 |

2. No sugar cane is grown on the smaller islands and only Rodrigues is of significant size and of any agricultural potential (area: 40 sq. miles; population 30,000).

Effective Areas Under Cultivation (acres, Mauritius only)

| | 1977 | 1978 | 1979 | 1980 | <u>1981</u> |
|------------------|-------------------|-------------------|-------------------|------------------|------------------|
| Sugarcane Tea | 215,500 14,400 | 214,300 14,400 | 211,800 10,220 | 211,400 9,675 | 209,010 9,370 |
| Tobacco | 1,350 | 1,530 | 1,905 | 2,160 | 1,835 |

^{1/} with emphasis on miller planters.

Acreages in foodcrops are not included, as the available figures include pure stand, rotational land and interline cultivation. The estimated area of pure stand foodcrops is 5,000 acres.

- 3. Land use surveys and agricultural census figures are rapidly overtaken by events, but MISRI and the Department of Agriculture are trying to monitor changes. Several factors affect the availability of land for agriculture are:
 - (a) Cyclonic winds exceeding 50 km/h occur from December to May. Damage is frequent: between 1957-1980 cyclones accounted for major agricultural disasters in 1960, 1975 and 1980 and significant local losses occurred in 5 more years. Land use is restricted in the more exposed areas and the residual effects of damage are hard to assess.
 - (b) There are three main climatic zones: sub-humid, humid and super-humid. In the sub-humid belt, irrigation is highly desirable for cane and essential for most foodcrops, supplementary irrigation is beneficial in the humid area, but most of the water resources are found in the super-humid centre of the island, where irrigation is not indispensable. Given present technology the available water is insufficient for the competing domestic, agricultural and energy demands. Innovations, such as piping water by gravity under pressure and drip irrigation are being developed, and they show promise of water economy, but they are either very costly or still experimental.
 - (c) Owing to volcanic origins some of the topography is very rugged. Limited areas can be reclaimed by terracing and the sambur deer introduced from Java is well adapted to feeding on the scant vegetation.
 - (d) The presence of stones, boulders and flat rock is a major constraint, but where economic justification is established, heavy machines are skillfully employed.
 - (e) Various forms of aquaculture are being developed: freshwater prawn is grown in ponds, tilapia is fattened in salt water to stop them from breeding, and expleted lagoons and estuaries are re-populated.
 - (f) Another recent development is multiple cropping, foodcrops are grown on cane land during the months between harvesting the final ration and replanting the cane, or between the rows of young cane until the canopy closes over.
 - (g) Land of agricultural potential is used to accommodate housing. Between 1977 and 1981 about 6,000 arpents of sugar cane land went out of cultivation. Some of this land could have been retained by encouraging urban development in barren areas.

- Changes have taken place, but nothing challenged the supremacy of sugarcane for centuries. The case for specialization is plausible; given equitable terms of trade, farmers will produce crops which grow well and economically on their land. Under modern conditions the economic background has become very complex. Sugarcane is a giant tropical grass that can be grown indefinitely on the same land. It responds (subject to the law of diminishing returns) to intensive methods, but it is very tolerant to extensive treatment. High inputs will stimulate high yields, but persistent modest yields can be secured by minimal inputs. As far as modern records exist, over 90% of the cultivated land in Mauritius was in sugar cane. Since the second World War the metropolitan countries have adjusted the terms of trade, to maintain the industry, at first through the Commonwealth Sugar Agreement and latter through the some conventions. (The second Lome Convention will expire in 1985). As a result, Mauritius has been exporting sugar (and some tea) and the people who came to the island to grow these crops have retained their dietary habits and they still largely depend on imported food.
- Although it is alleged that even if no food could be imported, no 5. one would starve, there is little flexibility in the system. Sugarcane is harvested yearly, but it is only replanted after 8-10 years and the capital invested in the sugar factories cannot be amortized, even when the going is good, in less than 15-20 years. Only the largest miller-planters have a little leeway between extensive and intensive standards. When people still accepted modest living standards and the infant state survived on a small revenue, there had been ample room for maneuver and the system worked. But as wages and taxes kept rising, particularly after snort periods of boom on the sugar market, as terms of trade deteriorated and inflation, devaluation and credit squeeze undermined the financial position, constraints and difficulties have merged into a prolonged crisis. During the same period several sugar industries collapsed in other parts of the world. In Mauritius a Commission of Inquiry is planned for 1983 to provide Government with an analysis of the issues and to facilitate the formulation of fresh policies. The fundamental question is: should the sugar industry remain at the center of agriculture after the current decade and if the answer is not a firm affirmative, are there any alternatives?
- 6. The problem has agricultural, financial, economic, social and political aspects. There are no economically feasible solutions which would be equally acceptable to the cane growers, the millers, the workers and to the politicians.
- 7. Since the recent election Government has adopted a conciliatory tone towards the sugar industry and it has decided to reduce the surcharge on the export duty on sugar (10%-13.5% + surcharge) from 75% to 50%. The value of this concession is about Rs 56 m and the sugar sector has been urged "to make the most productive use" of it. There is also a new investment allowance of 10% to apply for the current year.
- 8. Nevertheless it is Government's plan to make provision for the compulsory acquisition of "certain sectors of the economy" with deferred payment terms. In ministerial references to the sugar industry two (so far unidentified) sugar estates and/or 20,000 arpents of land have been mentioned in this context. A more precisely formulated statement speaks of

two new authorities which will have overall control over the various activities undertaken in the sugar industry and will advise Government on policies relating to the sugar sector.

- With the exception of Rose Belle sugar estate (production 25,000 tons), the sugar industry is privately owned and although there is no panic, the leaders of the industry are looking into the future with anxiety. The 1980 crop suffered from four cyclones (one of them of exceptional power) followed by unfavorable weather, and the 1981 crop was seriously damaged by drought and several lesser cyclones. The resulting financial stringency was aggravated by inflation (the consumer price index rose from 137.3 (average) in 1979 to 238.4 by December 1981), credit squeeze, high interest rates and general lack of confidence. Even the sugar industry's reserve funds, when recycled through the banking system. were only partly available to meet the shortage of working capital. For the first time since 1979 a normal sugar crop is forecast for 1982, but the slump on the free market for sugar will deprive the industry of a badly needed boost. Up to 10 millers (from a total number of 21) are believed to be in serious difficulties, and as the industry is operating at a loss, a general liquidity crisis is forecast for March/April 1983.
- The Sugar Sector Study Unit (SSSU) has collected much detailed information, but this is still awaiting expert analysis. The following financial figures have been extracted from global statements provided to the mission by MSPA and the Chamber of Agriculture and the agricultural data have been compiled from various published and draft reports and from records collected by the SSSU.
- It is not possible to measure the efficiency of a sugar industry by any simple series of figures. There is the obvious division between field and factory and the grey areas between burning and cutting and milling, where avoidable delay can cause serious loss of sugar. A given tonnage per arpent may represent a record crop for an unirrigated farm in the sub-humid zone, but a near failure in a more fortunate area. Owing to differences in size, age and machinery there may occur comparable differences between factory performances.

Performance of the Sugar Industry

| Year | Tons cane per arpent | Sugar Made tel Quel | Tons sugar per arpent | Remarks |
|------|----------------------|------------------------|--------------------------|---------|
| 1972 | 33.2 | 686,000 | 3.61 | |
| 1973 | 32.5 | 718,000 | 3.75 | |
| 1974 | 31.5 | 697,000 | 3.68 | |
| 1975 | 22.8 | 468,000 | 2.47 | cyclone |
| 1976 | 33.4 | 690,000 | 3.60 | |
| 1977 | 31.5 | 665,000 | 3.48 | |
| 1978 | 32.9 | 665,000 | 3.50 | |
| 1979 | 33.4 | 688,000 | 3.62 | |
| 1980 | 24.3 | 475,000 | 2.54 | cyclone |
| 1981 | 28.6 | 575,000 | 3.10 | drought |

12. Apart from cyclone years the figures show, by standards of tropical agriculture, reasonable consistency. The average cane yield per arpent hides great discrepancies, particularly between miller-planters and planters. The reasons for this are well researched, but an effective antidete is still to be found. Nevertheless the Review Committee on Sugar Cane Planters' yield (of the Chamber of Agriculture) found that planters' yields increased by 4 tons of cane per arpent between two chosen periods 1966-1970 and 1974-1979, but the gap between miller planters and other planters remained 9 tons.

Yield of Cane and Sugar (98.5° Pol) 1977-1981 (in tons/arpent)

| | 1 | 977 | 1 | 978 | 1 | 979 | 1 | 980 | 1 | 981 |
|---------------------|------|-------|------|-------|------|-------|------|-------|------|-------|
| | Cane | Sugar |
| Miller/ planters | 84.6 | 9.37 | 87.3 | 9.31 | 88.3 | 9.64 | 64.0 | 6.69 | 77.5 | 8.41 |
| Planters | 62.8 | 6.96 | 66.2 | 7.06 | 67.4 | 7.37 | 49.4 | 5.16 | 54.7 | 5.96 |
| Average | 74.7 | 8.27 | 78.0 | 8.31 | 79.2 | 8.65 | 57.7 | 6.03 | 67.8 | 7.35 |

13. The planters account for about 40% of the total cane area and almost half of this land is held by 30,000 individuals who own less than 5 arpents each and frequently even such holdings are in several parcels of land.

Frequency Distribution of Planters

| | | 197 | 79 | 19 | 80 |
|-------|-----------|--------|---------------------|--------|---------------------|
| Range | (arpents) | Number | Harvested (arpents) | Number | Harvested (arpents) |
| | | | | | |
| 0.01 | - 4.99 | 29,541 | 38,645 | 29,805 | 38,799 |
| 5 | - 9.99 | 1,829 | 11,878 | 1,861 | 12,124 |
| 10 | - 24.99 | 630 | 9,511 | 613 | 9,019 |
| 25 | - 49.99 | 97 | 3,502 | 90 | 3,220 |
| 50 | - 99.99 | 56 | 3,745 | 58 | 3,839 |
| 100 | -199.99 | 20 | 2,550 | 22 | 3,379 |
| 200 | -499.99 | 23 | 6,540 | 19 | 5,525 |
| 500 a | ind over | 7 | 5,819 | 7 | 5,232 |
| | Total | 32,183 | 82,190 | 32,475 | 81,117 |

Miller Planters

14. Planters exporting less than 20 tonnes of sugar pay no export duty and their ex-syndicate (pool) price per tonne of sugar being net of export duty, is considerably higher than that of other producers. The tax is levied on a sliding scale and the full rate applies to the miller planters exporting more than 3,000 tons (as all do).

Ex-Syndicate Price Per ton of sugar after adjustment

| | 1979/80 | 1980/81 |
|----------------------------------|-------------|-------------|
| Millers | Rs 2,185.10 | Rs 2,409.91 |
| Planters exporting up to 20 tons | Rs 2,721.11 | Rs 3,117.01 |

- The production figures place Mauritius among the more efficient beneficiaries of the Lome convention and Mauritius enjoys the largest "agreed quantity" i.e. 487,200 metric tons white sugar equivalent or about 503,000 tel quel. (The total, for 13 countries, is about 1 1/4 million tons). EC has undertaken to purchase these quantities of sugar "which cannot be marketed in the community at a price equivalent to or in excess of the guaranteed price". The price is negotiated annually, within the price range obtaining in the community, i.e. based on the prices paid to the beet sugar producers of Western Europe. In recognition of climatic hazards, the convention includes an escape clause: when the exporting state fails to deliver its agreed quantity in full for reasons of force majeure, the Commission allows the necessary additional period for delivery.
- 16. The EC countries do not need this sugar, which is refined in Europe and eventually it reaches the world market (often at a loss to the EC). This arrangement was amongst the conditions negotiated when the UK joined the EC and it is part of the increasingly controversial CAP (Common Agricultural Policy).
- The domestic market in Mauritius absorbs about 40,000 tons of sugar (of various grades) at traditionally low prices which are fixed by Government. Mauritius also has (in theory) access to the US and Canadian markets, but when there is a substantial surplus above the EEC quota, most of it is placed on the free market. Mauritius is a signatory to the International Sugar Agreement. The free market is the outlet of all sugars not covered by special agreements and it is strongly influenced by levels of sugar stocks and crop forecasts. It reached one of its lowest points in 1982.
- 18. The provisional estimate for the 1982 sugar crop is 700,000 tons and the estimated gross prices for this sugar are tabled together with actual realizations in 1979.

Sugar Prices (per ton, tel quel)

| | | | 1982 | 1982 estimates | | |
|-----|-----------------|----------------|-------------|-------------------|--|--|
| 197 | 9 Actuals in Rs | (ex-syndicate) | in £, Gross | in Rs (at Rs19/£) | | |
| Rs | 2,539 | EC Quota | 236 | 4,484 | | |
| Rs | 478 | Domestic | - | 1,750 | | |
| Rs | 1,718 | Free market | 100 | 1,900 | | |
| Rs. | 2,144 | Average (ex s | /ndicate) | Rs 3,476 | | |

Note The 1979 ex-syndicate prices are not comparable to the estimated gross prices for 1982, but the averages are shown "ex-syndicate" for both years.

19. The following table compares costs of production on a typical estate, actuals for 1979 and estimates for 1982. The totals exclude sugar insurance premium, export duty and interest.

Cane Production Cost (Rs per arpent)

| | 1979 (actual) | 1982 (estimate) |
|------------------------------|---------------|-----------------|
| | (average) | |
| | | |
| Direct expenses | 1,719.38 | 2,782.33 |
| Transport of supplies | 158.07 | 401.75 |
| Transport of laborers | 67.94 | 200.87 |
| Cutting and loading | 666.11 | 1,056.77 |
| Transport of canes | 609.21 | 1,192.14 |
| Total Direct Expenses | 3,220.71 | 5,633.86 |
| Overheads | 2,327.43 | 3,566.17 |
| Total | 5,548.14 | 9,200.03 |
| Cane yield per arpent (tons) | 37.35 | 35 |
| Cost of producing 1 ton cane | 163.39 | 263.15 |
| Cost of came per 1 ton sugar | 1,477.27 | 2,416.08 |

Milling Cost Summary per Tonne of 98.5° Pol Sugar (Rs per ton of 98.5° Pol Sugar)

| | 1979 (actual) 1982 (estimate) (average) | | | |
|---------------------------------|---|------------------------|--|--|
| Direct expenses Bags and thread | 51.36 18.33 | 74.39 1.00 | | |
| Bagging and loading Overheads | 4.74 486.14 | 1.00 1.43 756.06 | | |
| Transport to Port Louis | 28.00 | 42.00 | | |
| Cost at docks | 588.57 | 874.88 | | |

Total Cost of Production (Rs per ton of 98.5° Pol Sugar)

| | <u>1979 (actual)</u> | 1982 (estimate) |
|-----------------|----------------------|-----------------|
| Cane production | 1,477.27 | 2,416.08 |
| Processing | 588.57 | 874.88 |
| Total | 2,065.84 | 3,280.96 |

These costs include depreciation at replacement cost on assets used for cultivation, irrigation and on factory, but not on transport and weighing equipment. The cost of milling represents 28.5% in 1979 and 26.7% in 1982. Overhead represents a major part of all costs and their allocation between field and factory has not been analyzed. A considerable proportion of the overheads seem to be fixed, but there is no distinction made between fixed and variable items in the available statements.

20. The following statement summarizes the estimated total revenue against the estimated total expense of producing 1 ton of sugar in 1982 (i.e. taxes are also included).

Estimated Revenue and Expenditure Related to 1 ton of Sugar in 1982 (Rs)

Revenue

| Raw sugar revenue Molasses | 3,476.2 87.3 |
|---|--|
| Sale of electricity, white sugar premium and other by-products SIF Compensation | 37.7 29.8 |
| Total Revenue | 3,631.0 |
| Expenditures | |
| SIF premiums Export duty Agricultural workers' wages Non-agricultural workers' wages Administrative Staff salaries Supplies and other charges | 261.9 672.6 1,061.5 273.8 236.1 1,031.8 |
| Depreciation at F.R.V. Total Cost | <u>634.9</u> <u>4,172.6</u> |
| (Loss) per ton | (<u>541.6</u>) |

Note this table includes items of expenditure which do not constitute costs of production.

- 21. The industry complains that it has lost control over its own destiny: its receipts are determined by the EC Commission, the world market and the Government and the largest item (50%) of the total cost of production, the cost of manpower, is also controlled by the state. Conditions vary, but taxation, and the export duty in particular is inflexible.
- 22. In a mature industry there is only limited scope for technological advances. In the sugar industry in Mauritius all that can be hoped for in the short and even medium term is that such improvements will balance the adverse effects of stringency, such as running old ratoons, curtailing irrigation and holding on to obsolete machinery. The evident desire to diversify and thereby broaden the base of the industry's operations is, for the time being, largely frustrated by shaken confidence, lack of profits and a negative cash flow.

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

AGRICULTURAL PRODUCTION AND PROSPECTS FOR DIVERSIFICATION

I. INTRODUCTION

- 1. The island of Mauritius lies between longtitudes 57°17' and 57°48' east and latitudes 19°50' and 20°32' south in the southwest Indian Ocean some 800 km east of the Malagasy Republic, 3,000 km northeast of South Africa, 4,000 km southwest of Columbo, Sri Lanka and 6,300 km northwest of Perth, Australia.
- 2. Excluding outlying small islands it has a surface area of about 186,000 ha. It is elliptical in shape with a major (NNE-SSW) axis of 61 km and a minor axis of 46 km. Except for some consolidated coral and shell debris in isolated remnant raised beaches and coral reefs and beach and dune sands around most of the coast, Mauritius is entirely volcanic. This fact is reflected in the soil types of the island which fall into two main groups:
 - (a) the typical mature ferrallitic soils or latosols in which decomposition of the parent basaltic lava rock has proceeded to the point that only large rounded boulders and stones and no undecomposed minerals remain in the soil complex; and
 - (b) the typical immature soils which contain minerals and angular stones and gravels.

The mature soils can be further classified into Low Humic Latosols, Humic Latosols and Humic Ferruginous Latosols and the immature soils into Latosolic Reddish Prairie and Latosolic Brown Forest soils. Other soil groups of lesser importance are the Dark Magnesium Group and the Grey Hydromorphic soils.

- 3. Topographically, the island rises to a central plateau (425-500 m) from coastal plains (under 100 m) through sloping plains of intermediate altitude interspersed with areas of sleep relief. The coastal plains are located on the north and west coast. The sloping plains surround the central plateau and extend to the sea along the southern and western coast.
- 4. The island enjoys a subtropical maritime climate with a warmer and wetter summer from November to April and a cooler drier winter from May to October. The average annual rainfall is about 2,000 mm with extremes of about 4,000 mm (central plateau) to 1,000 mm (west coast). The wettest months are January through April (peak March). The driest months are September and October but individual monthly rainfalls can vary widely and

do cause droughts and floods. Average annual temperatures vary with location from 25°C on the west coast to 15°C on the central plateau, as do hours of sunshine (3,000 west coast; 2,000 central plateau), and relative humidity (75% and 90% respectively). Locally three climatic zones are identified. These tend to follow the topography and are superhumid (central plateau), humid (sloping plains) and subhumid (coastal plains). Agroclimatically this can be further classified into six climatic types (see Figs.1 and 2) all but one of which (central plateau, Belle River) experience a period of moisture deficit and could therefore benefit from some irrigation.

The island lies in the cyclone area of the southwest Indian Ocean. These cyclones (high winds with or without rains) can occur from December to May and drought, flood and cyclone either alone or in combination can cause damage and have periodically given rise to serious agricultural production (and other) losses. Although unpredictable, such events represent an inescapable hazard and the losses sustained significantly influence both individual annual and long term average levels of agricultural production.

II. LAND USE, PRODUCTION AND YIELDS

- 6. Land use. Currently sugar occupies about 91% of the total cropped area in Mauritius. Tea occupies about 4%, tobacco 1% and all food crops about 4%. The available land use data (Table 1) suggests that the total area under
 - (a) sugar cane has declined along with the areas harvested each year;
 - (b) tea is declining;
 - (c) tobacco is relatively constant but may be increasing slowly;
 - (d) food crops has fluctuated since the mid 1960s but has never exceeded a total of 10,000 arpents;
 - (e) forest plantations has fluctuated and may have decreased since the early 1970s; and the total of
 - (f) built-up, reservoir and ponds and other land areas have been steadily increasing.

With the possible exception of sugar, and to a lesser extent tea and tobacco the data is not sufficiently accurate, continuous or consistently disaggregated to draw definitive conclusions beyond the obvious (i) predominance of sugar, (ii) encroachment of housing onto cultivable land and (iii) the rapid increase from the early to mid-1960s then plateauing of the areas used for maize, Irish potatoes and groundnuts and the rise and subsequent fall of the area used for rice.

- 7. In addition, the absence of information relating to the intensity of land use precludes any empirical analysis of the extent to which multiple cropping of pure stand foodcrops, rotational cropping (of foodcrops between successive cane crops) and interlining (of foodcrops) between cane rows immediately following planting and or harvest is being practiced.
- 8. Finally, with the exception of rice $\frac{1}{f}$, there is a paucity of information relating land capability to current land use. It is therefore difficult to identify those areas with the highest potential for increased productivity. Accordingly, investment to gather new and update currently available land use and land capability data should be given high priority.
- 9. Production and Yields. The production and yield data presented in Tables 2 and 3 demonstrate the wide year by year variation that occurs in the case of sugarcane. This is also reflected in the output of commercial sugar and its by-products. No clear trends are obvious but, unless yields of cane per arpent increase, total output can be expected to move downwards in the future in response to the declining (Table 1 and para 6) areas under sugar cane.
- The output of tea (green leaf) has increased slowly over the last decade and the crop in 1982, the highest so far recorded, was 13% higher than that 10 years previous. There is variation from year to year but this is known to have been caused by strikes, labor problems, pruning cycles, severe cyclones and areas actually being harvested. These variations make area output relationships difficult to interpret.
- 11. Tobacco output rose stongly in 1980 (71%) and 1981 (85%) relative to the average output reported in 1977, 1978 and 1979. In 1980 52% of this increase was due to an increase in the area under production and 48% to the realization of high yields. In 1981 nearly 90% of the increase in output was due to an increase in yield (the area under production having fallen to within 20% of the 1977, ..., 1979 average of 1,533 arpents). No background data is available to interpret the appearance of this possible strong upward trend in the output and yields of tobacco but its occurrence warrants closer investigation since in 1981 Mauritius, imported approximately Rs 10 million of tobacco products 93% of which was in unmanafactured form for local processing and blending with local leaf.
- 12. The output of food crops has changed considerably over the period 1976 to 1981. Table 4 shows area/output/yield relationships that vary by crop with all crops exhibiting an increase in output also exhibiting an increase in yield. Five of the 6 crops listed also show a static or reduced area of production. The increased output was therefore achieved either partially or entirely as a result of improved productivity.

^{1/ &}quot;Rice Production Review and Prospects," Ministry of Agriculture and Natural Resources and the Environment, June 1974.

- 13. Only one of the 9 crops exhibiting a reduction in output (maize) also experienced a reduction in the area under production. This crop also experienced a 4% reduction in yield. Of the remaining eight crops exhibiting a reduction in output, five experienced an increase in yields. There is insufficient background data to explain these observations.
- Overall, therefore, yield increases were experienced by 11 of the 15 crops listed. However, the magnitude of both the increases and decreases in yield, given the nature of the data and the relatively short time period from which it has been gathered, does not provide conclusive evidence that these variations in yields represent trends. Most lie well within the variability that could occur as a result of seasonal differences. It is also known that many of the crops are produced under different production systems so that a change in the proportion of output coming from different production systems could also account for the range of yield variation observed.
- 15. With an estimated 250,000 arpents (106,000 ha) of land potentially suitable for annual crop production and about 230,000 arpents (90%) already in production including about 203,000 arpents under sugar the scope for any significant diversification must imply either a reduction in the areas used for sugar and/or an expansion of interlining and rotational cropping within existing cane areas. The potential for both exists but neither need imply a reduction in sugar output if at the same time it is possible for the Mauritian sugar industry to increase and/or sustain yields. It therefore follows that a realistic assessment of the costs and benefits of realizing specified increases in the productivity of the Mauritian sugar industry is essential to any meaningful assessment of the scope for agricultural diversification. The only exception is the extent to which interline and/or rotational cropping can be practiced without reducing the area or yields or increasing the cost of growing sugar cane and the potential for doing this is a direct function of the production system(s) practiced.

III. PRODUCTION SYSTEMS

- 16. In Mauritius, all crops except tea and perhaps tobacco are or can be grown inconjunction with sugar either as an interline or rotation crop and without necessarily reducing either the area under sugar cane or the yields of cane realized. The production systems which permit this to occur are described in the following paragraphs.
- 17. Sugar is a perennial crop. From planting to the first harvest the crop is referred to as a "virgin" crop. Virgin crops are generally harvested from about 15 to 18 months after planting. The 18 month virgin crops are referred to as "Grande saison" plantings. The 15 month virgin crops are referred to as "Petite saison" plantings. The crops that regrow from the harvested virgin crop are referred to as first, second, third etc. ratoon crops. Yields from the first ratoon crop are generally higher than either the yields from virgin or subsequent ratoon crops and from 6 to 10 or more ratoon crops are generally grown from each planting. The recommended number of ratoons is 8.

- 18. Currently most Mauritian cane is grown in rows that are 5 feet apart. A little is being replanted in the so-called "pineapple" configuration which has alternate rows that are 7 feet and 3 feet apart. The pineapple configuration makes "interlining" easier. Interlining is the practice of growing a short season (3 to 4 month) crop (the so-called "interline" crop) between the rows of sugar cane immediately after planting in virgin crops and immediately after harvest in ratoon crops.
- 19. Pure stands of various short season crops can also be grown as a "rotation" crop after harvesting the last ration crop and before planting the next cane crop. Longer growing season crops (or two short season crops) can also be grown if the period between harvest and replanting permits. There are in-fact several variations. These arise because of variations in the time at which the last ration crop is harvested since the time of planting is basically confined to April (Grande saison) and September (Petite saison). The implications of this are outlined in the following paragraphs.
- A Grande saison crop (Fig. 3) is generally planted in April and harvested for the first time in November some 18 months later. If allowed to regenerate the resultant "ratoon crop" is harvested every 12 months thereafter. This is the usual practice in Mauritius and from 6 to 10 or more ratoon crops are generally harvested before the crop is replanted. If followed strictly the last ratoon crop under a Grande saison chronology would be harvested in November. The old crop would be removed from the field by December or January and the next Grande saison crop planted in the following April. This would leave a three to four month period from December to April during which land clearing operations could be carried out and a pure stand rotation crop could be grown.
- 21. Under a "Petite saison" chronology (Fig. 4) the crop is planted about September and harvested for the first time in the following December some 15 months later. Thereafter, from 6 to 10 or more ration crops are harvested: annually if the ensuing crop is to be planted under the Grande saison chronology; but on an 11 month interval if the ensuing crop is to be planted under the Petite saison chronology. If the Petite saison chronology is followed strictly an 11 month harvest cycle is used to progressively move the month of harvest of successive ration crops from November back to July thus leaving time by the sixth ration crop to plant the next Petite saison crop by September. Alternatively, subsequent ration crops can have a 12 month growing period. However, the use of successive Petite saison plantings leaves no time for either land clearing, or a pure stand rotational crop and this is one major difference between the Grande and Petite saison cropping systems.
- 22. A second major difference is the ability of the producer to harvest over an eight year cycle 1 virgin and 7 rations from a strictly followed Petite saison chronology and 1 virgin and 6 rations from a strictly followed Grand saison chronology. In practice, however, neither chronology has to be, or is, followed strictly since the time of harvest can be and is varied particularly with the older rations.

- 23. Generally, the shorter the plant to harvest intervals in virgin crops and the shorter the between harvest intervals of ration crops the lower the cane yields realized. As a result Petite saison virgin crops invariably yield less cane than Grande saison virgin crops and frequently first ration crop yields can exceed virgin crop yields. However, because the harvesting intervals between successive harvests in both Grande and Petite saison plantings can be and are modified by planters it is difficult to empirically demonstrate this yield difference from average ratoon crop data under field conditions. The available empirical data is presented in Table 5 but this fails to identify rations by the month in which they were originally planted. It does, however, suggest that at least for the so-called miller planters: (a) about 70% of all plantings follow the Grande saison chronology and 30% the Petite saison chronology; (b) occassionally first ratoon yields can exceed Petite saison virgin crop yields; and (c) the yields of ration crops decline with age.
- 24. Under both cropping systems it is theoretically possible to grow interline crops in the three to four month period immediately following planting (Fig. 3 and 4). But the months involved differ from April through August with the Grande saison and September through December with the Petite saison. Depending on location, the rainfall in Mauritius in these months would on average be sufficient to grow some such interline crops without recourse to irrigation, but the risk of agricultural drought is greater in the months of September to December.
- 25. Interline cropping is also possible and practiced to a limited extent immediately following harvest of the first and second ration crops with both Grande and Petite saison cane crops. However, with the third and subsequent ration crops the use of interlining is unlikely to gain favor unless a 3' x 7' cane row spacing is used so that the interline crop can be grown in the 7' wide spacing.
- The precise timing of ratoon interline crops is dependent on the time of harvest, and with roughly equal tonnages of cane being received into the mills in each of the months July through December and about one-half the monthly July-November tonnage being received in June and December it is obvious that neither the Grande or Petite saison chronology (as depicted in Figs. 3 and 4) is followed very strictly beyond the first few ratoons. However, an estimate of the range in harvest times that can be expected in Mauritius is made in Table 6 using the yield variations reported in Table 5 for each crop type (virgin, Grande saison; virgin, Petite saison; and age of successive ratoons); the observed flow of cane (tons) into mills; and the fact that for at least the virgin and first few ratoon crops planters would adhere relatively strictly to the chronologies shown in Fig.3 and 4. It also uses the detailed data presented in Table 5 for miller planters to disaggregate the owner-planter and tenant planter average area harvested and average yield data.
- 27. Applying the percentages in the body of Table 5 to the land areas of each crop type harvested will therefore give an estimate of the total land area available for interlining following planting and/or harvest.

- Rotation crops are grown between successive sugar crops but there are many variations between a final cane harvest (which can occur in any of the 6 months June to December) and either a Grande saison planting (April) or a Petite saison planting (September). Again specific data is not available but an estimate of the potential land area (Table 8) available for rotational cropping is made from the data presented in Table 7. This estimate assumes all planters replant at the first opportunity, that about 3.5% of the total cane area harvested each year is derocked and is therefore not available for rotational cropping if harvest occurs in December, 2/ and that 50% of the area havested in August can be ready for replanting in September (an assumption that also preserves the observed 70% Grande: 30% Petite replanting relationship). The estimate is based on the structure of the Mauritian sugar industry shown in Table 9.
- 29. With the exception of tea and perhaps tobacco all crops can be grown either in pure or mixed stands. Most sugar is grown as a pure stand but when it is interlined the interline crop may be a mixture of several different crops or confined to one. Rotation crops can also be confined to one or a mixture of several different crops. Moreover, the months available for growing both interline and rotation crops varies (see para.24 and Tables 6 and 7). As a result the choice of a specific crop or mix of crops for interlining or rotation is limited by the particular set of months available.
- Other constraints would also reduce the potential areas available for interlining and/or rotation. These would include, location, topography soil condition, and the need for irrigation if any. It would be further influenced by the willingness of the planter to engage in interlining and/or rotational cropping. Little data is available to indicate the extent to which the potential for interlining and rotational cropping would be reduced by the above constraints. Nor is there sufficient data to assess what costs (benefits) might be incurred (accrue) if attempts were made to remove some of these constraints. In fact, such cost/benefit ratios would be very location (even arpent), crop and planter specific. Further confusing the situation is the practice of these farmers to simultaneously grow small areas of many food crops on one arpent frequently with one or two rows of one crop followed by one or two rows of another; sometimes with alternating rows of several crops; sometimes varying planting dates in order to spread harvest, and the times of sale, the demand for labor and other inputs. As a result the concept of being able to define the cost of production for a particular crop becomes very difficult to determine except under pure stand conditions (which is itself very sensitive to both economies and diseconomies of scale) and is frequently not representative of the situation under which these particular commodites are actually produced.
- 31. It is therefore concluded that the first and most important production system for Mauritius to quantify in detail is pure stand sugar production. The second must be the sugar plus interlining and/or rotation cropping. The third would be the mixed crop farming situation involving no sugar. This ranking will only change if the financial and economic returns to be generated from sugar vis-a-vis other crops can be validly demonstrated to lie strongly in favor of the other crops. Whilst such a

^{2/} This is equivalent to about 40% of the estimated area that is harvested in December.

finding may prove valid at the margin (on specific arpents in specific locations for specific producers) it is most unlikely to remain valid for large areas and volumes of production for at least two reasons. First, because sugar could never have assumed such a predominant role in Mauritian agriculture without its having a distinct local and international comparitive advantage; and second, the fact that locally the number of arable arpents on which sugar has a comparative advantage vis-a-vis other crops probably exceeds by many times the number of arpents on which other crops can be demonstrated to have a comparative advantage. It follows that the key to quantifying the scope for diversification in Mauritian agriculture is to first identify those areas in which sugar is unquestionably the most financially and economically rewarding form of agricultural production which implies a detailed knowledge of the variation that does currently exist in the cost of producing sugar vis-a-vis other crops on a location and producer specific basis.

IV. SUGAR

- 32. The existing Mauritian sugar industry is the result of an evolutionary process that commenced over 200 years ago. The island was originally settled to provide the manpower required to produce sugar. In fact the entire history of the island's development has been geared to the production of sugar and only in the last few decades have other activities rivalled its importance to the economy. Although its contribution to total GDP has now fallen to around 10% the industry remains unchallenged with regard to employment and export earnings.
- 33. Functionally, the industry can be divided between (a) the production of cane, (b) milling, (c) labor relations, (d) insurance against cyclone, flood and fire, (e) marketing and (f) research.
- 34. <u>Production</u>. The production of cane is carried out by three groups of producers: the miller planters; the owner planters; and the tenant (metayers or renter) planters. The relative importance of these three groups to the industry is shown below:

| | Total Cane Area | Total Cane Production | Nos. Planters |
|--|-----------------------|--------------------------|--|
| Miller-planters Owner-planters Tenant planters | 55.0% <u>1/</u> 42.5% | 62.7% <u>1/</u> 35.6% | $\begin{array}{c} 21 & \underline{2}/\\33,673\\1,370\end{array}$ |
| | 100.0% | 100.0% | |

Source: The Mauritius Chamber of Agriculture. Reviewing Committee on Planters' Sugar Cane Yields. Second Report December 1980

^{1/} Derived as a balancing item.

^{2/} Assumed equal to number of processing factories.

- 35. The area and yields of miller planters is much better documented than that for owner and tenant planters (Table 5). There is, however, sufficient information to clearly demonstrate that on average over the period 1977-1980:
 - (a) Average miller planter yields were 22% greater than owner planter yields, and 36% greater than tenant planter yields.
 - (b) The area of virgin crop harvested by miller planters was 10.5% of the total area harvested by miller planters, and of this 10.5%. 70% was planted under a Grande saison chronology and 30% under a Petite saison chronology.
 - (c) Yield of miller planters varied by type of crop with first ratoon yields being 83.6% of Grande saison virgin yields and 97% of Petite saison virgin yields with the yields of all subsequent ratoon crops declining progressively to 73% of the Grande saison virgin yields (84% Petite) by the seventh and older ratoon.
- The implication is that if the average yields of owner planters can be increased then either the total cane production can be raised or the same average total cane production can be produced off a much smaller area. For instance, if average owner planter yields could be raised to equal miller planter yields the same output could be produced off 7,800 fewer ha (18,480 arpents) of land, or an additional 632,550 tons of cane (68,000 tons of sugar) could be produced off the same area. If the 1977-1980 miller planter - owner planter yield difference were only halved then the same output could be produced off 4,420 fewer ha (10,465 arpents) of land, or an additional 316,275 tons of cane (34,000 tons of sugar) could be produced off the same area. This potential is significant and if such increments in owner planter yields can be realized the next logical questions are whether Mauritius should increase the production of sugar or other crops and if the latter then which other crops. The answer should be decided on which course of action produces the greatest net economic benefit to Mauritius.
- 37. To this end the following analysis has disaggregated the Mauritian sugar industry into six types of planters and nine categories of crop. The estimated areas and yield of each crop category by each type of planter has been extrapolated by applying the scalars derived in Table 5 from the miller planter data shown therein to each of the other categories of planters. The results, whilst not definitive are taken as indicative of the present physical structure and performance of the Mauritian cane growing industry.
- 38. The cost of producing cane is then calculated for each type of planter by examining the cost of eleven activities namely: (1) land preparation, (2) fertilizing, (3) the use of scums (4) planting, (5) weeding, (6) trashing and piling, (7) cutting and loading, (8) the transport of cane to the mills, (9) earthing up, (10) road repairs and (11)

land clearing. Of these the first, third and fourth are only associated with virgin crops; the first through fourth occur in the same month; the seventh through tenth occur in the same month; the eleventh is assumed to occur in the four months preceding land preparation for Grande saison virgin crops only; the fifth occurs equally in the four months following planting (virgin crops) and all harvests (except for the last ratoon); and the second, fertilizing, is carried out immediately after weeding.

- 39. These eleven activities are common to both the Grande and Petite saison chronologies but the months concerned vary according to the time of planting (Fig. 3 and Fig. 4) and the time of harvest (Table 6) thus providing sufficient information to generate a demand for labor profile. The results are presented in Fig. 5, 6 and 7.
- Details of the physical inputs and costs of each of the eleven identified activities are presented in Appendix 1, Table 1 (Sheets A through G) of this Annex. From a cost of production point of view only two types of producers need to be identified. Type I producers include all owner planters operating less than 20 arpents of cane and all tenant planters. The Type II producer group includes all owner planters operating 20 arpents or more of cane and all miller planters.
- 41. There are several reasons for this division. First, it is difficult for planters operating 20 arpents or more to do this without engaging some permanent unskilled employees and the wage rates for permanent employees (Rs62.46 per man day or Rs 37.81 per women day) is almost double that for casual labor (Rs.32.85 per man day or Rs17.41 per women day). Furthermore under existing legislation employees engaged for more than a minimum period are entitled to permanent employment.
- 42. Second, significant differences appear in the per arpent cost of transporting the heavy equipment required for land preparation and land clearing when one vis-a-vis several planters hire the equipment required to prepare or derock their land prior to planting.
- 43. Third, the Type II producers are reported to use less labor for trashing and piling (11.7 women days per arpent versus 17.3 women days for Type I producers), and less labor for cutting and loading cane (0.65 man days per ton cane versus 1.07 for Type I producers) but incur additional costs as a result of mechanical loading.
- Fourth, it is reported that the cost of transport for Type II producers is less than for Type I producers (Rs18.61 per ton versus Rs21.19).
- 45. Finally, all producers are reported to incur overhead costs. For miller planters these have been estimated to be about Rs3,100 per arpent in 1982 (or Rs3,086.2 per arpent if the estimated costs of producing cane by a typical estate and the estimated costs generated by the above cost assumptions are to coincide precisely). Current data for the overhead

costs incurred to produce cane by owner planter overheads is not available but extrapolating from 1978 data suggests these would be at least 30% of the costs identified in Appendix 1 of this Annex.

- In all other respects (except those costs which vary with yield) the costs of production of the two type of producers are assumed to be the same even though it is known that a significant number of Type II producers also use herbicides for weeding and a few also practice mechanical cutting and loading. The results are shown in Tables 10, 11 and 12. They depict the cost of production relative to the demand for inputs. Actual costs could be higher to the extent that, for example, excessive labor must be engaged because of legislative regulations; or lower to the extent that for example the use of herbicides proves cheaper than manual weeding, and/or the cost of weeding is offset by interline cropping at the same time as weeding is normally carried out, and/or fertilizer and other input usage is less than assumed. Despite these and other simplifying assumptions the results are presented as a realistic reflection of the variation that occurs in the cost of producing sugar by different types of producers.
- Milling is carried out by 21 factories. All but one are privately owned by miller-planters. All vary in age but most are in need of repair, maintenance and/or replacement if current levels of processing efficiency are to be sustained even in the near future. Moreover few are being operated at their optimal capacities and it is claimed that unless the milling capacity of the island is rationalized vis-a-vis throughput and location (some mills closed, others overhauled, some modernized) the future average costs of milling each ton of cane will rise faster than would otherwise be the case and at a rate that would justify at least in economic terms the needed investment. In addition there is the potential to combine such a rationalization with (a) the installation of equipment that can be used to upgrade the capacity of the existing factories to generate electric power for the main grid burning bagasse particularly if the bagasse is appropriately processed (dried, baled) to be stored for use on a year round basis; and (b) revised catchment areas, road allignments and mill maintenance/replacement programs. Details of the cost of milling cane used in Table 10, 11 and 12 are shown in Table 13. They are not disaggregated by type of producer because there is no mill specific type of producer data available.
- 48. Gost of Production. The production of sugar involves several activities namely the production of sugar cane, milling, marketing, insuring the crop, research and extension. Of these only the cost of extension is funded in its entirety by Government. The cost of insurance, marketing and research is met by the industry at large through the payment of premiums and operating costs of the SIFB, the direct and administrative expenses of the MSS, and a cess on production for research. In Mauritius all of these costs are funded by deducting the amounts involved from the gross proceeds received on the sale of sugar so that the Ex-Syndicate prices paid by the Mauritius Sugar Syndicate (MSS see paras 89-106) to cane growers and millers are already net of these charges.

- However, because miller planters are involved in both the production and milling of cane and these two activities are readily vertically integrated the allocation of costs between the cane growing operations of the miller planters on the one hand and their milling operations on the other are frequently the subject of debate. This debate assumes particular importance in Mauritius because the miller is effectively paid in kind receiving 26% of the sugar and the molasses and all the bagasse that is produced from the cane he mills which he must then sell at the going market rates to cover his costs of milling. In the case of sugar this going market rate is the MSS Ex-Syndicate price for millers. In the case of molasses it is the price the miller realizes from a combination of local and export sales, and in the case of bagasse it is the combination of limited direct sales of bagasse per se plus any electricity sold to the national grid over and above that which is generated and used to power the milling operation. It follows that the ability of a miller to cover the cost of milling (including the maintenance and replacement of his capital investment) is a function of the price of sugar, the price of molasses, and the price he gets for any bagasse and/or electricity he can sell.
- 50. At the same time the millers 26% share of all the sugar and molasses produce must be negotiated against the 74% share of these outputs which remain the property of the sugar cane producers. Although all millers in Mauritius are also sugar cane producers and supply some 60 to 65% of all cane produced, the arbitrator in these negotiations is the Government and the political power lies overwhelmingly in favor of the owner planters. In such a situation it is easy to appreciate how the 26:74 split has become the center of an intensive debate between the miller planters on the one hand and the owner planters on the other. Obviously there is a real need to ensure this sharing ratio is set at an equitable level then adjusted over time in an objective manner by linking it for example to relative changes in the Ex-Syndicate prices received by millers vis-a-vis changes in the price of selected items which represent major cost components for millers and which can be simply and clearly identified as such by both miller planters and owner planters.
- 51. Given: (a) some objective means of relating the cost of milling with the returns to milling and (b) devising an equitable way of continuing to fund the cost of insurance, marketing and research by deducting the required amounts from the gross proceeds received on the sale of sugar and (c) assuming extension remains a Government responsibility, the cost of producing sugar in Mauritius is reduced to the cost of growing cane and the cost of milling.
- Economic costs are then derived by assuming: (a) a foreign exchange cost component for labor equal to 10% of the total financial cost of labor; (b) a zero opportunity cost for the local cost component of labor; and (c) a standard conversion factor of 0.83 for all local currency components. These assumptions reflect (i) presence of imported foodstuffs in the diet of all Mauritians; (ii) the high levels of registered unemployment and the existence of widespread under employment; and (c) the

existence of distorted domestic prices for a range of goods and services used in the production of sugar. In Table 14 the domestic resource cost (DRC) of producing one ton of sugar is estimated assuming sugar on the dock at Port Louis is worth US\$375 per ton. This is about the value the Mauritian Sugar Syndicate expects to receive for sugar sold to the European Common Market under the Lome convention in 1982/83. The exercise is repeated using a price of US\$135 per ton (about US cents 6 to 7 per 1b) which is about the current on dock Port Louis free world market price. Finally, the on dock Port Louis price of sugar is calculated for each type of producer assuming a DRC of US\$1 = Rs13.6 which is about the shadow exchange rate implied by the use of a standard conversion factor of 0.83.

- Domestic Resource Costs of greater than Rs13.6 mean it is costing Mauritius more to earn a unit of foreign exchange (in this case US\$1) by producing sugar than it would to earn foreign exchange in some other way and then use the hard currency so generated to import its sugar requirements. The results depicted in Table 14 clearly demonstrate the facts that (a) Mauritius will lose foreign exchange by exporting sugar at current free world market price levels; (b) generate a handsome surplus (vis-a-vis a shadow exchange rate of US\$1 = Rs13.6) by exporting at expected convention price levels; and (c) would break-even at free on dock Port Louis sugar prices of about US\$165 per ton.
- Between producer types the financial and economic cost of producing sugar varies by about 15% and 9% respectively. In addition the ranking of producers also varies depending on whether the costs of production are measured in economic or financial terms. In both cases however the 0.01-4.99 arpent owner planters are the cheapest. However, the 100 arpent plus owner planters, the miller planters and the 20 arpent plus owner planters (Type II producers) move from fourth, fifth and sixth place on the basis of financial costs to second, fourth and fifth place on the basis of economic costs (Tables 10 & 12). This is a direct reflection of the cost of labor (see para 41 and 52 (b)) which in economic terms in partially offset by the impact of the differing levels of overhead costs used (para 45). For instance, the economic cost of the fourth ranked miller - planter's overheads are 53% greater than the top ranked 0.01-4.99 arpent owner planters. If these overhead costs were set equal for both of these planters, the miller planters would (a) displace the 0.01-4.99 owner planters as the most economic producers of sugar in Mauritius and (b) would rank a close second (within Rs56/ton sugar) even in financial terms despite paying nearly double the price for labor.
- In physical terms the miller planters out perform all other types of producers (para. 35 and 36). In terms of Domestic Resource Costs (Table 14) the difference between the different types of producers is about 11% when the foreign exchange value for sugar free on dock Port Louis is set at US\$375 per ton and widens considerably to about 32% at a price of US\$135 per ton (68% if the tenant planter results are included). Using a shadow exchange rate of US\$1 = Rs13.6 suggests the breakeven free on dock Port Louis value of sugar would be around US\$165 per ton.

- Since both land and foreign exchange are in short supply any attempt to produce more foreign exchange by increasing the 0.01-4.99 owner planters contribution to total output will be offset by the increased areas of land this will demand (marginally higher DRC's can be expected but at significantly lower yields). But, the reverse is possible. That is for every arpent that moves from owner planter yields to miller planter yields there will be a marginal reduction in the DRC (or rupees spent per dollar generated) but a significant increase in output of 7.9 tons cane or 0.85 tons sugar.
- 57. Several conclusions can be drawn. First, Mauritius must gear its sugar marketing research to determine its best bet predictions of (a) Lome convention prices and quantities for the ensuing harvest by April-May each year; and (b) the free world market price(s) at which it can sell specified quantities of non convention sugar. Second, the Mauritian government, sugar industry and relevant unions must aim to produce as comprehensive and valid a set of cost of production data for each holding as soon as possible and gear this effort to producing annual predictions of both cost of production, land capability for alternative use and crop outturn for the ensuing harvest by April-May each year. Third, Mauritius must then use this information to (a) move towards the statistical determination of that level of sugar outturn which when marketed at the predicted prices would maximize the economic returns to the industry at a given level of probability that particular season; (b) identify equitable ways of adjusting that outturn as from April-May, and (c) examine in depth the scope for containing the financial and economic costs of producing each ton of sugar. Taking each of these points in turn:
- The Mauritius Sugar Syndicate (para 89) is already in a good position to address points (a) and (b) above. The Sugar Insurance Fund Board already collects holding specific data (para. 82). A data collection network already exists and with some modification could be used to generate the detailed cost of production and land capability for alternative use information that needs to be collected. However, the incremental costs of doing this should not be borne by the SIFB except to the extent that it can be actuarially shown to benefit existing SIFB activities and functions. Effectively this means none of the incremental costs should be borne by SIFB which might therefore be called upon to act as an agency for a fee. With regard to predicting the ensuing crop outturn, SIFB's estimates of insurable sugar would adequately fulfill this need if it could be ready by late May (para 77-79).
- The statistical determination of that level of sugar outturn which would maximize the economic returns to the industry at a given level of probability for a particular season could be commenced using already available (if not collated) data. The first steps in such a process are outlined in paras 102-106 and coupled with current price/quota expectations suggest that Mauritius should not attempt to expand its current level of sugar outturn beyond 700,000 tons per year. Despite the possibility of proceeding to some indicative conclusions relatively quickly from such an approach it is stressed that: the statistical procedure outlined is very "rough" and "dirty"; it is a planning tool, not a decision making

operation; and should be viewed as a first step in a long, on-going thrust towards putting Mauritius — its government, its sugar industry, its workers and hence people—in a position where they can walk with calculated risk towards whatever objectives they choose despite the fact that they are and will remain extremely exposed to many highly volatile variables that are basically beyond their control. Accordingly, the phrase "move towards" is used advisedly: the process may take as long or longer than the concept of insuring sugar to produce results that even approach its ultimate potential as a decision and policy making tool.

- Equitable ways of adjusting sugar outturn from the ensuing harvest from as late as April-May will take time to devise and probably longer to implement. Nevertheless possibilities do exist. For example, if holding specific data is available, and sugar outturn is predicted to exceed convention quotas by a large amount and selling on free world markets is predicted to generate economic (perhaps even financial) losses -- then a case exists to consider not harvesting some of the crop, or alternatively to encourage planters to examine their alternatives such as to harvest older rations early thus releasing land for one or two rotation crops, or perhaps three if they were to harvest in July and replant as a Petite saison crop some 13 months later. Some planters may even consider holding a portion of their cane over to take a double harvest in the next year. A few of those in a position to do this might also be in a position to consider interlining that portion of their crop that they do harvest. A key element in all these options is knowing with a reasonable degree of certainty when such options should be considered. From the government's and industry's point of view it would be just as important to know where those planters who might be in a position to take such actions are located so that potential response levels can be assessed, extension workers can be appropriately briefed and located and supportive policy measures devised if such are deemed necessary.
- 61. Finally, the in depth examination of the scope for containing the financial and economic costs of producing each ton of sugar must be viewed as a long term on-going study. Once detailed, holding specific data is to hand planters should have access to farm management analysis that would permit them to assess the financial implications of proceeding with a specific on-farm investment such as derocking, rock pile removal, irrigation, levelling, moving to pineapple spacing to facilitate interlining, opening their rotation to include an additional rotation crop etc. Such analysis could be done relatively simply using the framework sketched in Figs. 3 and Figs. 4 as a guide to calculating the cash flows to be discounted to produce arpent specific results. It could be undertaken by subject matter specialists within the existing extension service. The service need not be free but as the number of analyses carried out increases so does the data base for policy and decision making. On an industry wide basis, the results produced in Tables 10 through 14 reflect the sugar industry's structure and performance as shown in Table 9. Is this the structure Mauritius should have? Why not equal areas in all crop types? What would be the impact on the financial and economic cost of production? How would this inflence the best-bet outturn under a given set

of convention prices/quotas & free world prices? What would this mean in terms of diversification? What would it mean in terms of the aggregate demand for labor?

- 62. The labor profiles (Fig. 5, 6 and 7) show the seasonal demand for labor implied by the identified demand for inputs detailed in Appendix 1 Table 1 sheets A through G. They have not been calibrated in the sense that for example they imply miller planters employ only 155,000 days of labor in May. In fact, miller planters may have a permanent work force of perhaps 500,000 day of labor. If this is the case, are all those days of labor that are not demanded for sugar production under-employed? Is this a cost miller planters could avoid or put to better use given different legislation, more opportunities for diversification? Or are miller planters, through the existing labor legislation operating a form of unemployment reduction? What is the profit maximizing level of permanent employees for the larger cane growers under existing legislation and under any alternative sets of legislative regulation that might be reasonably considered? Are the yields of the 5-19.99 and 20-99.99 arpent owner planters lower than the 0.01-4.99 arpent planters because of an inability to financially afford permanent employees in a situation where it is not practical to properly husband cane holdings of say 10 or more arpents using only casual labor?
- There are a host of different answers to all these question. Running and re-running the analysis described would eventually be self defeating. Sophisticated methodology cannot replace the need for actual accurate and current data and for Mauritius it should be possible at reasonable cost to gather such data, and combine both methodology and valid up-to-date data.
- Insurance. The Sugar Insurance Fund Board (SIFB) was originally known as the Cyclone and Drought Insurance Board of Mauritius and was established by statute on October 5, 1946. The Fund is regularly reviewed by actuaries on behalf of the insured and the laws governing the operation of the Fund are amended by Government as and when necessary. The latest amending legislation was Act No. 16 of 1976.
- The object of the fund is to pay compensation to planters and millers whenever the Board is satisfied that planters and millers have incurred losses caused by cyclones, droughts, excessive rainfall or fire. To finance such compensation the Board collects an annual premium from all millers and planters whether or not they register their cane plantations 3/ and uses that money for the payment of compensation in "event" years.
- 66. Event years occur whenever there are losses in sugar production caused by either a cyclone or a drought or an excessive rainfall. If a crop year has not been declared an event year, no compensation will be paid by the Board except for fire losses where no declaration is required.

^{3/} Every planter must register his cane plantations before the 31st May. If he is not satisfied with the registered particulars of his plot, he must ask for his grievances to be noted at the time of registration.

- 67. The Board on its own may make a declaration regarding the previous crop year at any time before the 31st January. However, it may, upon request by any planter, also make a declaration after that date but not later than the 15th June.
- 68. The Fund can legally pay compensation only if the year under consideration has been declared a cyclone year or a drought year or a year of excessive rainfall and if the insured has made a loss. No compensation is payable to an insured who is not registered with the Board for that crop.
- 69. The sugar produced by a planter or miller in an event year is compared to his insurable sugar for that crop year to determine his loss.
- 70. The insurable sugar of a planter is the product of the average sugar per acre produced by him in his 3 normal years $\frac{4}{}$ and the acreage harvested for the crop considered. The value of the compensable loss will depend on the ranking of the insured.
- Any compensation payable to any planter is paid to his middleman or C.C.S. through his broker and through the Mauritius Sugar Syndicate (para 89). A premium and compensation slip is issued to the broker through the Mauritius Sugar Syndicate and it must be handed over by the broker or agency whenever payment is effected to the planter so that the latter may know the amount of compensation paid to him and the amount of premium paid by him. The sugar calculations of a planter are made on the SIFB extraction rates. These are very nearly the extraction rates of the Control Board for the region or for the planter.
- 72. When a planter has no claim in any particular year, his ranking for the next year is improved automatically. Thus, for the following year, he will pay a premium at a lower % rate and in case the following year is an event year, he will bear a smaller proportion of the first loss and get as compensation a greater percentage of the shortfall.
- 73. Administratively the personnel of the SIFB is divided into two main groups: that of the head office at Port Louis and that of the 7 sub-offices throughout the island. The head office which is used at the same time as headquarters, comprises the central administration, the secretariat, the accounts branch and the survey division. The inspectorate forms part of the sub-office.
- 74. The personnel of the Fund is provided with opportunity to undergo the technical training necessary for the exercise of its duties; thus, many of its members follow courses in accountancy, sugar technology, secretariat and surveying at the John Kennedy College and the University of Mauritius.

^{4/} Where "normal" represents the three highest yields of sugar per arpent acheived by that planter in the last 12 years.

- 75. The nature of the work in which the staff is engaged demands a high degree of efficiency, and the Board of Directors calls for professional and academic qualifications from those who apply for any post.
- 76. The Administrative costs are approximately 6% of the annual premium collected.
- 77. A summary of the functioning of the Fund, starting from the registration slip to the payment of compensation, may be given as follows: the sub-office personnel effects the registration of the planters before the 31st May of each year, for the following crop, on slips produced by computer at the head office. The slips are returned to head office after registration. The information entered on these slips is transferred to punched cards and thereafter read on the magnetic tapes of the computer. Lists of registered acreages are produced. These, in turn, are sent to the insured who insert their tonnage figures of canes harvested and affix their signature thereto.
- These crop returns are then sent to the head office where they are checked by the accounts branch and are then submitted to the computer for the preparation of the production lists. These lists are then sent to the accounts branch which notifies any abnormal production figure to the sub-office concerned. The inspectors then undertake the verification of these data and carry out investigations, the conclusions of which are sent to the head office. If necessary, they obtain the assistance of the surveyor and his assistants. A computer programme is provided for the determination of the control number and the ranking of each insured, consideration being given to the premium paid and the compensation received during the preceding crop year. The list containing these data undergoes a check at the accounts branch before the computer produces the lists establishing the insurable sugar and the premium for each insured.
- 79. Premium slips after being controlled are sent to the Mauritius Sugar Syndicate before the 30th April and to the insured after that date.
- 80. When the accounts branch of the head office gets the production figures of the insured and the amendments resulting from the investigations by the inspectors, it prepares amended lists which, when submitted to the computer, determine the shortfall suffered by the planters or groups of planters and the compensation accruing to them. The compensation slips produced by the computer together with cheques are sent through the Mauritius Sugar Syndicate to the broker of each insured for distribution.
- 81. In carrying out its task, the head office depends to a large extent on the efficiency of the sub-offices. The reports of the inspectors on the maintenance and cultivation of the cane plantations are a vital factor in determining the shortfall and the compensation for each insured.
- 82. The inspectors carry out 6 inspections of plantations of large planters and 4 inspections of plantations of small planters per crop year. These inspections are entered in reports defining the maintenance of the

fields, the variety and category of the canes of the planter, the frequency and extent of irrigation and of fertilisation and the general condition of the field, thus making it possible to establish whether the losses sustained have been caused by the negligence of the insured or are caused by an insured risk.

- 83. The area on which there may have been old rations of a low yield, dead stools or other growth affecting the cane, is reduced to an effective acreage so as to determine the compensation due to the planter. A reduction in acreage and thus in insurable sugar results in a corresponding reduction in the premium to be paid by the planter.
- 84. The main survey office is at the head office of the Fund and comprises a drawing office with special equipment. There is also a survey section at each regional office. The surveyor is in charge of these sections and works in conjunction with his assistants at the head office and at the sub-offices.
- 85. The survey of the areas under cultivation which vary because of crop rotation, sale or acquisition of land, new plantations and agricultural diversification, must be verified before each harvest. The cadaster must always be kept up-to-date.
- 86. Maps of different scales locate the position of the factory areas, the localities in the factory areas, the large and small planters' plantations separately. The target of the Fund is to draw up maps with great details showing the name of each planter and the area of each of his fields. These maps are under preparation but, in most cases, information in respect of the planters exist at present on lists and sketches.
- 87. The survey helps the inspectors in all cases of new redelimitation of localities in relation to topography, the nature of the soil and the rainfall, in order to ensure that their insurable sugar is representative. These localities group small planters cultivating less than thirty arpents of land.
- 88. The operations of the SIFB represent a unique success story and quite apart from achieving its objectives it has created a set of data (paras. 81 through 87) from which it should be possible to relatively quickly generate the area, ratoon, rotation and interline crop specific information by type of planter in a form that will permit an objective analysis by production system, natural resources, agronomic practices, climate and type of producer at only nominal cost. Overtime this could also include data on the length of the growing season preceding each cane harvest. Within a year all this data could be presented cartographically using existing computer hardware and automated geographical information system software. The feasibility of printing out within days accurate updates of landuse maps which can be overlaid with maps detailing other

- data $\frac{5}{}$ / would provide the vehicle that is needed to objectively monitor, evaluate and plan optimal development strategies for Mauritian agriculture in the immediate, medium and long term. The first steps that would be necessary to accomplish this are set out in paras 102-106.
- 89. Marketing. The Mauritius Sugar Syndicate (MSS) is responsible for marketing the entire sugar crop. It is also the vehicle through which the SIFB collects its premiums and pays out any compensation. It is also responsible for collecting various statutory expenses, specifically those payable to the Sugar Industry Development Fund, the Sugar Industry Labor Welfare Fund, the Arbitration and Control Board (including a special contribution to this Board by the millers), export duties, the Mauritius Sugar Industry Research Institute (cess on production), the Sugar Industry Reserve Fund and the export fees payable to the Marine Authority.
- 90. In so doing the MSS establishes the prices for all categories of sugar sold to all markets pays the relevant statutory expenses, deducts its own direct, financial and administrative costs and calculates the Ex-Syndicate Price per ton of sugar (98.5° Pol.) for each category of sugar supplier. Under existing legislation there are eight such categories of sugar suppliers and these fall into three basic groups namely millers, miller planters and planters. The sub-groups are all identified by level of supply and/or production of cane. All suppliers delivering more than 3,000 t fall into the same sub-group and this is the case with all millers and miller planters. Consequently, it is only the owner planters that are divided into sub-groups. The derivation of the Ex-Syndicate price paid by MSS per ton of sugar to each category of supplier from total export sales is shown in Table 15.
- 91. Financially the Ex-Syndicate pricing mechanism discriminates against larger suppliers and the principal vehicle giving rise to this discrimination is the export duty. Some measure of the extent of the discrimination can be read off Table 15 by comparing the the Ex-Syndicate price expressed as a percentage of the average Ex-Syndicate price and this shows the largest suppliers receive as little as 95.3% of the average and the smallest as much as 118.0% of the average or an additional Rs518.47 per ton. In terms of quantity supplied and value received the 3 largest suppliers deliver 0.5% to 1.4% more of all sugar delivered than they receive of the total value of all sugar sold when the sugar is valued at

^{5/} Such as yield, age of ratoon, soils, various agronomic practices, climatic conditions during that particular growing season, length of growing season, type of producer, estimates of soil water deficits and the need for and actual use of irrigation, land ownership, rents paid, infrastructures, urban areas, individual homesites, tracks, electricity and water distribution grids/networks, fertilizer and other input supply points, factory areas etc.

the Ex-Syndicate prices. Since the fourth and fifth largest suppliers tend to deliver about the same proportion of all sugar delivered as they receive of the total value (at Ex-Syndicate prices) this means all the difference in value is being reallocated to the three smallest suppliers who receive between 0.1 and 3.4% more of the total value of all sugar delivered (at Ex-Syndicate prices) than they contribute in tons of sugar. The result is a significant financial incentive for the smallest suppliers of sugar to remain in production. Since the largest suppliers of sugar are either the most efficient physical producers of sugarcane or millers the justification for retaining the discriminatory elements of this pricing mechanism is questionable.

- 92. In this respect it should be pointed out that in Mauritius the miller is effectively paid in kind receiving 26% of the sugar and the molasses and all the bagasse that is produced from the cane he mills. The scums which have little if any intrinsic value are available to the producer who can receive his share of the scums for the cost of transport. Accordingly, the Ex-Syndicate price received by millers should be assessed against the costs of milling, the efficacy of the milling process and the millers share of the sugar and by-products produced which in some instances include the sale of electric power that is generated from the burning of bagasse.
- 93. Mauritius has three basic outlets for its sugar. The local market (about 38,000 tons), the export quota to the EEC in terms of the Lome Convention (502,000 tons) and the free world market. Its commitment to the Lome Covention ensures a guaranteed access and price for about 70-75% of production in a normal year at prices which were in 1979/80 LSg 211.15 per ton and LSg 222.04 per ton in 1980/81.
- The domestic prices for sugar are fixed by Government. Domestic sales are heavily subsidized. As from July 11, 1981 the prices were set at Rs 2,310 per ton of white sugar, Rs 1,710 per ton of raw sugar and Rs 3,000 per ton of white sugar used for industrial purposes. From August 19, 1980 to July 11, 1981 the prices were set at Rs 1,850 per ton of white sugar and Rs 1,250 per ton of raw sugar and there was no special price for white sugar purchased for industrial purposes. From November 1979 to August 1980 these prices had been set at Rs 880 and Rs 580 per ton respectively. The current (post July 11, 1981) price levels are probably about 50% of the cost of production. The 1980 to 1981 level was about 60% of the cost of production and at that time the sugar producing community was subsidizing the difference at a cost that was then estimated to be about Rs 50 million annually.
- 95. Free world prices vary widely. In July 1979 they fluctuated around LSg 102 per ton on a London Daily Price (LDP) basis until the end of September when they surged forward through all the International Sugar Agreement (ISA) trigger points to reach a high of LSg 287 per ton LDP in February 1980 before subsiding to LSg 195 in March and rising to Lsg 410 in November before dropping to LSg 168 in May 1981. Since then they have moved below LSg90.

- 96. Unfortunately for Mauritius the high 1980 prices corresponded with a low crop outturn (as a result of the cyclonic conditions which occurred in early 1980). The consequent loss of sugar revenue was estimated at some Rs 1 billion since the 1980 crop finally turned out to be about one third below the estimate of a normal crop.
- 97. Such variations in the tonnage of sugar Mauritius has available for sale to the free world market is not unusual. Its volatility is further aggrevated because it is a residual of final crop outturn less the level of prior commitments which are at present basically confined to those of the Lome Convention, the domestic market and any ISA Stock requirements that together currently total about 550,000 tons per year. At these levels (vis-a-vis production) the quantity available for export to the free world market becomes extremely variable as indicated by actual performance since the first year of the ACP Sugar Protocol (1975)

| Crop Year | Production | Tonnage exported to the free market | |
|-----------|------------|-------------------------------------|--|
| 1975/76 | 469,232 * | 1,785 | |
| 1976/77 | 681,955 | 77,561 | |
| 1977/78 | 666,805 | 115,881 | |
| 1978/79 | 665,120 | 110,612 | |
| 1979/80 | 688,383 | 127,894 | |
| 1980/81 | 475,494 * | NIL | |
| 1981/82 | 574,525 * | NIL | |

^{*} cyclonic years.

98. Because of this variation the MSS closely monitors the likelihood of having to sell on the free world market and the existing and likely future free world market demand for sugar in terms of both the physical (quantities and qualitative requirements) and financial (net return) possibilities. In 1982/83 a 700,000 ton outturn is anticipated. Prior commitments amount to a maximum of 574,000 tons and comprise:

| EEC - 1981/82 deficit & shortf - 1982/83 quota | fall reallocation | 15,000 502,000 | tons tons |
|---|-------------------|-------------------|--------------|
| Local Consumption | | | |
| - Raws | 5,000 | | |
| - Whites | 32,000 | | |
| | | 37,000 | tons |
| ISA Stocks | | 20,000 | tons |
| | | 574,000 | tons |

The difference of 126,000 tons is available for sale to the world market: a figure which could be increased to 136,000 tons if that portion of the ISA Stocks which has to be stored by the end of 1983 (that is 10,000 tons) is taken from the 1983 harvest.

- 99. Traditionally the bulk of Mauritian free market sugar has been sold to the U.S. and Canada. However, recent developments in the U.S. have severely restricted the tonnage which Mauritius can ship in 1982 and total Mauritian imports to the U.S. are now limited to some 30,000 tons annually. Prior to the U.S. decision to impose quotas the marketing strategy of the MSS was geared to shipping the totality of Mauritius free market sugars to the U.S. because it offered a premium of some LSg 30 over any alternative outlet and could be supplied without violating any of the constraints of the GSP regulations. Although these recently imposed US quotas will remain in force as long as market conditions warrant in the eyes of the American Administration they are of a temporary nature and the possibility exists of them being raised or completely removed which is a factor that must be taken into account in any MSS marketing strategy.
- 100. On the other hand, the Canadian market has evolved into a buyers' market in which the Canadian refiners can impose their own pricing terms: alternative suppliers (Cuba, Australia and South Africa) have a freight advantage and the net Canadian preference which now stands at about LSg 3.00 per ton (due to the weakening of the Canadian dollar versus the pound sterling) is insufficient to interest Mauritius as it would involve selling at a substantial discount relative to the LDP or London Terminal prices.
- It follows that the MSS will have to develop new markets and several are being actively explored but of those which offer appropriate physical demands none are currently financially attractive. Accordingly the future prospects of the Mauritian sugar industry being able to profitably market its output will be a function of future EEC Lome Convention and free world market prices vis-a-vis costs of production. Both the Lome Convention and free world market prices must be considered as exogenous variables with Mauritius assuming the role of a price taker. The current and future cost to Mauritius of producing sugar is also partially exogenous since all agricultural chemicals, machinery (or its components), fuel and lubricants and several other inputs that are essential to the production process must be imported. Moreover, unless the scope that exists for Mauritius to reduce its endogenous costs of producing sugar to levels that allow at least an economic and if possible a financial profit to be realized from sales on the free world market then the only major variable that remains within Mauritius' control is to adjust its outturn levels but this also is subject to wide sporadic variation depending on the vagarities of the season. Even so it could be argued that the Mauritian sugar industry (defined in its widest sense) should aim for outturn levels which, relative to the markets in which it can profitably sell and in light of such uncertainties, will on average maintain a specified probability of meeting its prior commitments.
- 102. For example, assume the industry decides to produce no more sugar than that required to meet its prior commitments (para. 98) in say 9 years out of ten. Then what should be its target level of outturn? Although

this is a gross over simplification $\frac{6}{}$, it is sufficient to demonstrate the feasibility of introducing new dimensions into current marketing strategies with the ultimate aim of optimizing outturn levels against specified objectives.

103. Using the data presented in Table 16 and letting
$$Y_t = BY_t^p + E_t$$
 $t = 1, \dots, T$

where

 $Y_t = actual outturn (tons) in year t$

 Y_tP = insured sugar (tons) in year t

B =the average proportion (Y_t/Y_tP) at varying levels of outturn

and

 E_t = a random disturbance which assumes a specific value in each year and is distributed normally about $Y_t = BY_t^p$ with a mean of 0 and a variance of $[(Y_t^p)^2.62]$

then, least squares estimates (namely B and 6^2) of B and 6^2 can be derived as shown in Table 16 from already available data using the formulae

$$\hat{B} = \frac{1}{T} \sum_{t=1}^{T} \left\{ \frac{Y_t}{Y_t^p} \right\}$$

$$\hat{G}^2 = \frac{1}{(T-1)} \sum_{t=1}^{T} \left\{ \frac{Y_t}{Y_t^p - B} \right\}^2$$

104. This model is graphically presented in Fig. 8 which demonstrates the assumption that as total actual outturn Y_t increases the variance of E_t about the line $Y_t = BY_tP$ is assumed to increase proportionately but remains normally distributed about $Y_t = B \ Y_tP$ with a mean of 0, and an increasing variance of $[6^2 \cdot (Y_tP)^2] \cdot Q_t$ (the level of prior commitment) is plotted in at $Y_t = 550,000$ tons and intersects with the one-sided (lower) 90% confidence interval at a Y_tP of 694,000 tons. That is, if the Mauritius sugar industry decided to produce no more sugar than that required to meet its prior commitments in 9 years out of 10 (the 90% confidence limit) then it should set its current target at a level of insured sugar production of 694,000 tons.

^{6/} It is a gross over simplification because even if there were a zero probability of realizing a financial or economic profit by selling on the free world market in one particular year the optimum outturn level for Mauritius would still be a function of the probability of incurring specific losses whenever a surplus of sugar appears that has to be sold on the free world market at a loss in another year in order to ensure that nine years out of ten it has sufficient outturn to at least meet its prior commitments.

Algebraically, it can be shown that the hatched area under the lower tail of the normal distribution for Y_t plotted in Fig. 8 will equal 10% of the total area under the graph at a Y_tP of 694,000 tons by solving for Y_tP in the following formula:

 $Y_tP = Q_t/[C(P)6+B]$ where $Q_t = 550,000$ B = 0.848 (see Table 8) $6^2 = 0.043$ (see Table 8)

and C(p) = -1.282 when p (probability) of area under the <u>lower 7</u>/ tail of a normal distribution is set equal to 0.1 (the 90% confidence interval) and where the value of C(p) can be read off existing statistical tables (see Table 17)

106. Using this type of approach would enable Mauritius to establish a statistical link between production targets and market prospects. In the above example the level of insured sugar production required to produce an actual sugar outturn 9 years in 10 has been calculated. It follows that if a mechanism can be developed to estimate insured sugar production then a similar methodology could be developed to estimate actual sugar outturn at a given level of probability. More importantly, with an expanded data base, market information gathered by MSS could be fed into a planning center (possibly the Ministry of Economic Planning) and used in conjunction with detailed cost of production data to consider alternative objectives such as maximizing the expected net economic and financial returns from marketing a given level of outturn in a market in which Mauritius is basically a price taker. Another allied objective would be to minimize the economic and financial cost of producing that level of outturn. This would require an ability to predict costs of production by level of outturn but once this can be done it would be possible to link both of the above objectives and determine the financial and economic trade-offs that could be expected to flow from various marketing strategies for differing outturn levels. Although the data, statistical methodology and modelling needed to meet such an objective would take time to collate, devise and construct, the pay-off in terms of effective policy making would be invaluable given the uncertainties under which the Mauritian sugar industry and Government has to operate.

^{7/} Hence the negative sign attached to the Table 17 value of C(p).

V. SCOPE FOR DIVERSIFICATION

107. In a recent White Paper on Agricultural Diversification (published February 1983) Government has stated that its food policy will be dictated by three considerations Government budget, balance of payments and employment creation. Against these consideration it then listed the following targets and crop production objectives for 1983-1987:

| | | | Total | |
|----------------|----------------------|-------------|------------------|------------|
| | Out | tput | Arpents | Growing |
| Crop | Current | target | Required | Period |
| | ('000 tons) | ('000 tons) | (PSE) <u>1</u> / | (months) |
| Maize | 1,000 | 15,000 | 9,300 | Sep-Dec |
| Onions | 2,300 | 4,300 | 7 50 | Mar-Aug |
| Garlic | 215 | 450 | 150 | Mar-Aug |
| Ginger | 440 | 2,000 | 250 | Nov-Aug |
| Turmeric | - | 230 | 150 | Year round |
| Groundnuts | 1,940 | 2,500 | 1,600 | Oct-Feb |
| Beans (dry) | about 1,000 $2/$ | 1,600 | 3,500 | May-Sep |
| Peas (dry) | •• | 1,500 | 5,000 | Apr-Aug |
| Chillies (dry) | about 350 <u>2</u> / | 225 | 500 | May-Dec |
| Corriander | Negligible | 260 | 500 | Apr-Aug |

- (a) Ban the importation of tamarind and encourage the marketing of local backyard production which it currently estimates could be fostered to meet a 160 ton (1987) domestic demand;
- (b) Re-establish spice and rice production with a view to replacing/reducing imports and being expanded for export in the case of spices;

^{1/} Pure stand equivalent.

^{2/} Green weights

^{108.} The White Paper also indicated Government's intention to:

- (c) Establish soya-bean as an interline and rotation crop and mushroom production (using paddy straw); and
- (d) To encourage the commercial exploitation of coconut plantations on Agalega Island and an expansion of existing domestic citrus production "by providing planting material".
- 109. A comparision of the potential for interlining and rotational cropping (Table 8) with the above total areas and growing period data indicates that all of the areas required to meet the maize and groundnut target (12,000 arpents) could be accommodated within the existing sugar area. The balance (about 10,000 arpents) could also be made available by widening the existing sugar cane last harvest replant rotation period as suggested in para 60. Moreover, if the current average yield of owner-planters could be raised to equal that of the miller planters (para 36) all of the additional land required could be made available without reducing the current "normal" year sugar outturn level. The availability of land is not therefore an immediate and binding constraint to the realization of Government's diversification objectives.
- However, a key constraint will be the unrivalled comparative advantage of sugar vis-a-vis alternative forms of land use which will in aggregate give rise to the changes in land use required to produce Government's target levels of output. In this respect the physical, financial and economic input/output data needed to analyse the situation at the margin for any of the crops involved is not available. In the case of sugar the Domestic Resource Cost (DRC) based on average costs of production and using a shadow exchange rate of US\$1 = Rs13.6 and a zero opportunity cost for labor ranges from US\$1 = Rs3.0 when sold at the LOME convention of US\$365 upto US\$1 = Rs22.4 to Rs37.7 when sold at the current non-convention price of about US\$135. DRCs for potatoes and maize (Table 18) for example can, in specific cases, compete with sugar either as import substitutes or exports (DRCs of US\$1 = Rs1 to Rs12) but this compares producer, arpent and season specific results for maize and potatoes with established industry wide average results that cover 4 seasons (including one cyclone year), 190,000 arpents and include the high overhead costs (averaging 30% of the estimated cost of producing each ton of cane) in the case of sugar, where the single most important variable in determining the range in DRCs calculated is the price received when the sugar is sold. The inclusion of a 30% overhead cost in the maize and potato DRC estimates would raise the DRCs to US\$1 = Rs2.3 to Rs30.0 (as exports). That is, as the existing output of import substitutes increases their comparative advantage vis-a-vis sugar can be expected to decrease simply because of the overhead costs that will need to be incurred to provide the increased demand for production inputs and output marketing, distribution and storage and in some instances processing or drying facilities which are at present either not available or already fully utilized.
- 111. An additional impediment is the fact that for many existing (potential) producers the financial costs of producting most of the diversification crops of interest to Government (will) exceed the cost at which the same commodity can be imported. Yet there is evidence that over

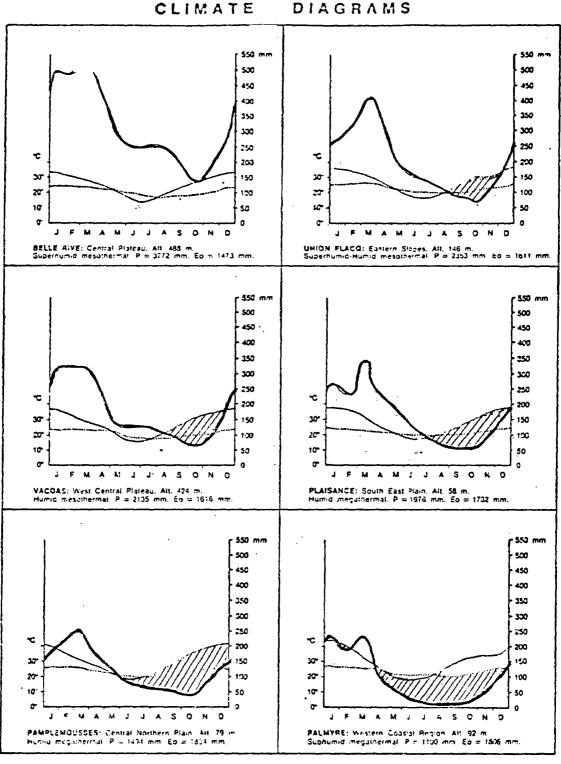
time these production costs can be significantly reduced. Potatoes is a case in point. It follows that without some form of Government intervention (price support/guarantees, production input subsidies etc.), producers in a position to diversify either by switching out of cane growing or by intensifying their land use by rotational and/or interline cropping will be reticent to do so until it is clearly obvious that such a change can be made within the resources and capabilities available to that producer and will give rise to a higher level of cash income to that household from all sources. Since many of these "potential" producers are part time cane growers who hold salaried positions the incremental cash returns that will be required to give rise to higher levels of cash income from all sources could be substantial particularly as the new forms of land use envisaged are, with few exceptions (for example, coconuts) both labor intensive and managerially more complex.

- 112. To summarize: In the immediate future the scope for diversification could be expanded from the existing 10,000 arpents (pure stand equivalent) of foodcropps to perhaps 15,000 (which is about equal to Government's 1987 target) or even 20,000 arpents provided it is possible to create a production environment that will provide the individual producer with the incentive to change. Even when 20,000 arpents of food crops are produced this will only represent about 10% of the existing area used for cane production. But, in creating the circumstances (production/policy environment) within which this change in land use could be expected to occur it will be economically important for Mauritius to maintain its "normal" year sugar outturn potential at about 650,000 to 700,000 tons (or 15%-20% above its LOME covention quotas plus domestic sugar demands).
- Ideally, since arable land is scarce, the most efficient way of accomodating this 15,000 - 20,000 arpents of foodcropping would be to simultaneously encourage a maximum of interlining and rotational cropping and the realization of higher per arpent cane and sugar yields. In the absence of the detailed land use/capability and other physical, financial and economic input/output data needed to analyse the situation at the margin for all the crops involved it is important that the cost and price signals, tax and other fiscal/monetary policy measures Government allows to be reflected at the farm-gate encourage individual producers to adopt land-use patterns which in aggregate are consistent with Government objectives and the resources Government can allocate for this purpose. It is equally important that whatever approach Government chooses to adopt is sufficiently flexible to permit relatively rapid adjustment in order to accomodate the rapidity with which the circumstances under which Mauritian agriculture must operate can be changed by factors that are beyond . Government's control. The most important of these exogenous factors are the volatity of the non-convention world price for sugar and the incidence and severity of unfavorable climatic conditions. Together they place Mauritius in the position of a price-taker operating under conditions of uncertainty: Uncertainty at the margin with regard to the price at which the last ton of sugar will be sold and with regard to the total outturn of sugar in a particular season. Under such conditions the extent to which whatever policy package is adopted to move the aggregate result of

Individual producer's decisions towards the most efficient use of available resources (land, labor and capital) relative to Government objectives at each point in time at least-cost becomes crucial.

- 114. Currently, all Mauritian cane growers receive an average price for all sugar produced and sold each season. Because 70-96% of each season's outturn is sold to the EC, 4-10% is sold domestically at heavily subsidized prices and only 0-20% is sold at non-convention world prices this average price is heavily weighted towards the LOME convention price. As a result no Mauritian cane grower experiences the marginal financial returns associated with the production of sugar that has to be sold beyond the LOME quota at non-convention world market prices. This means that the cane growers decision to diversify/intensify land use is heavily biassed towards cane growing. It is therefore concluded that the prospects for agricultural diversification in Mauritius are inextricably linked to what nappens to sugar and that under existing conditions only the most efficient and best located planters who are also full-time operators (and hence free of the labor and alternative sources of income contraints mentioned in para 111) would have any financial incentive to engage in either pure stand, rotational or interline food crop production.
- One way of allowing the returns to sugar growing at the margin to be reflected at every planter's farm gate would be to issue quotas to each producer for the quantity of sugar that could be sold at the LOME convention price. Any additional sugar produced could be processed and narketed at cost and paid for at whatever prices were actually realized. In other words cane growers could experience a financial loss from sugar produced beyond the allocated quota and at the margin would be forced to weigh the risk of realizing a low (or the windfall gain of a high) non-convention price when planning their next season's land use. Under such circumstances the prospects of realizing higher financial returns by diversifying (or intensifying) their land use to include the production of food crops would be able to compete with sugar at the margin -- even at existing input/output physical and price ratios. In effect the production environment would be geared to encouraging rotational and interline cropping within sugar lands (as producers seek complementary ways to simultaneously maintain sugar outturn and increase foodcrop output) without detracting from the incentive to substitute pure stands of food crops for pure stands of cane wherever such a choice can be justified by the individual farmer concerned.
- Such quotas could be traded either freely or under licence. Sovernment could reserve the right to adjust them en-masse -- with or without compensation. The cash received by the seller of a quota could be subject to high levels of taxation unless reinvested in approved forms of diversification activities. This, coupled with a flat land tax on all arable land could provide Government with a policy package that could be tuned to produce the production environment under which individual farmer decisions would be much more closely alligned to Government objectives than is currently the case -- particularly if Government also introduces import taxes on consumable foodstuff imports and uses these to finance guaranteed prices for locally produced substitutes and/or the provision of the

production inputs, marketing, distribution, storage and processing facilities that are at present not available or inadequate. In addition, although the end result of introducing the concept of saleable quotas to bifurcate the sugar market is difficult to predict it should be possible with sufficient forethought and planning for the introduction of a saleable quota system to: (a) lead to a reallocation of such quotas by sale towards the most efficient cane growers whilst simultaneously providing both; (b) the sellers of such quotas with the financial means to diversify and (c) the fiscal policy mechanisms through which Government can create the production environment required to encourage individual producers to utilize their resources in a manner that is consistent with the resources each producer commands, Government's overall objectives and the need for flexibility (para 113). Moreover, since the outturn of sugar in a "normal" year is already about the level Mauritius should aim to produce in order to meet its LOME convention quota and domestic requirements (and has been about this level for nearly two decades) the initial allocation of quotas could be done on an historical basis.

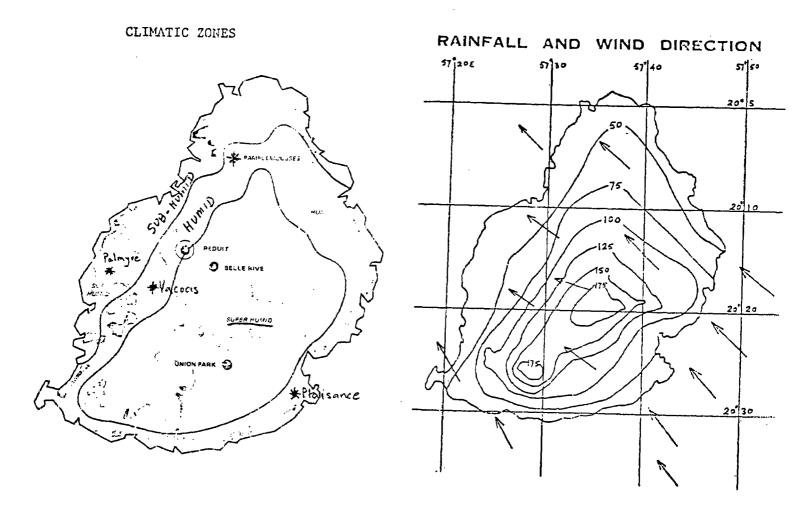


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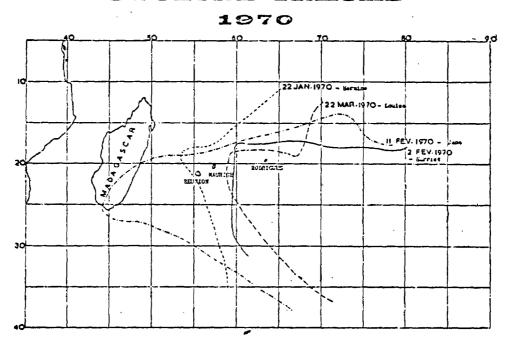
SOURCE: Mauritius and U.N. Development Programme May 1973.

- (1) Notes on the T. 100 (cm Agro-climatic Map of Mauritius, MSIR) Officializate Paper No. 23 (Materix, P. & Davy, C. G., 1979)
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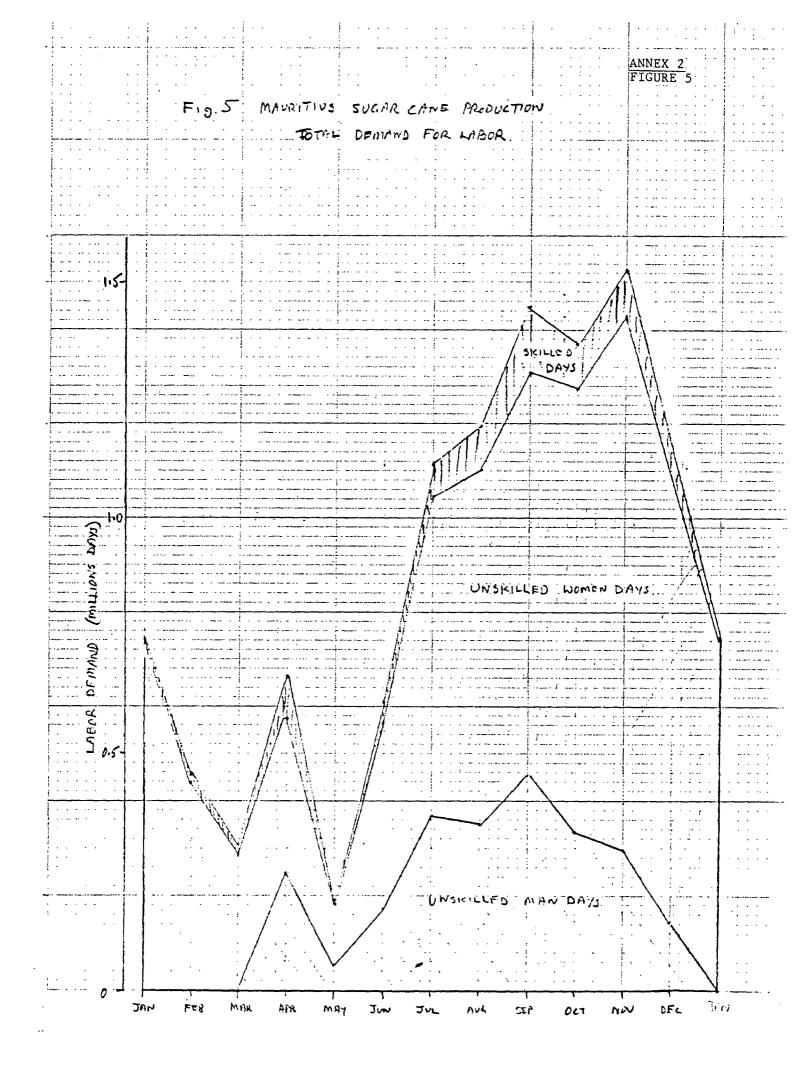
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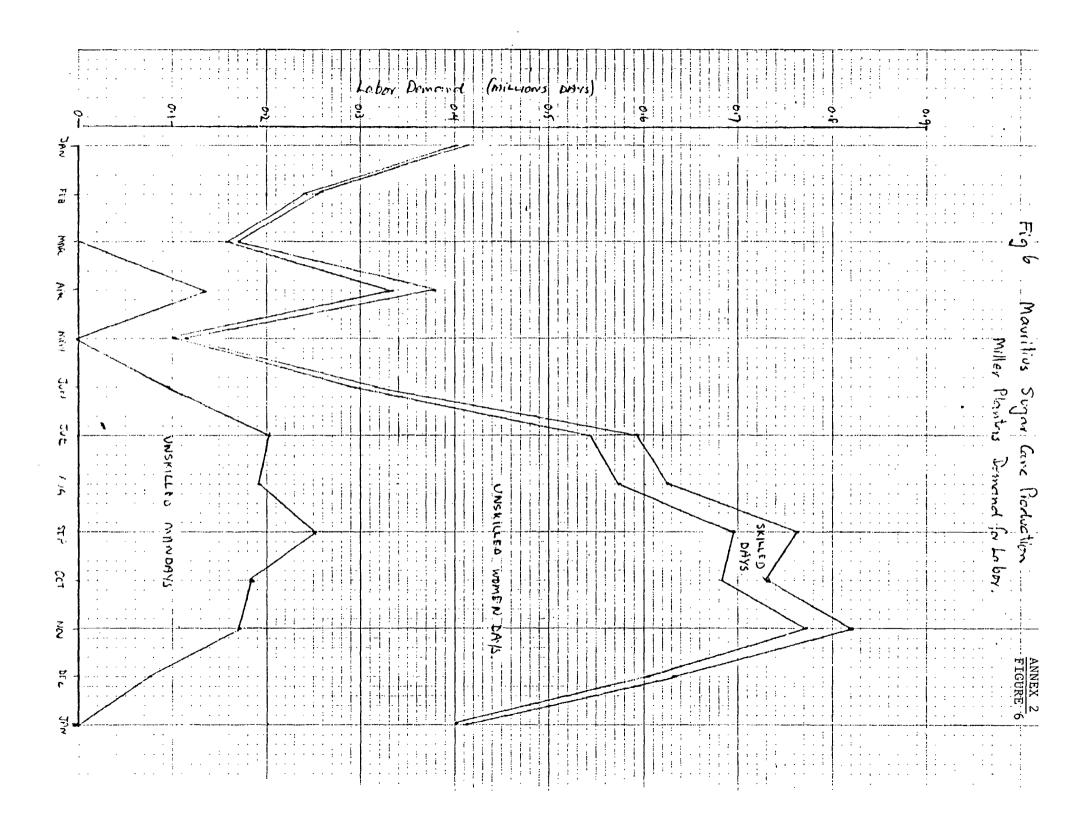
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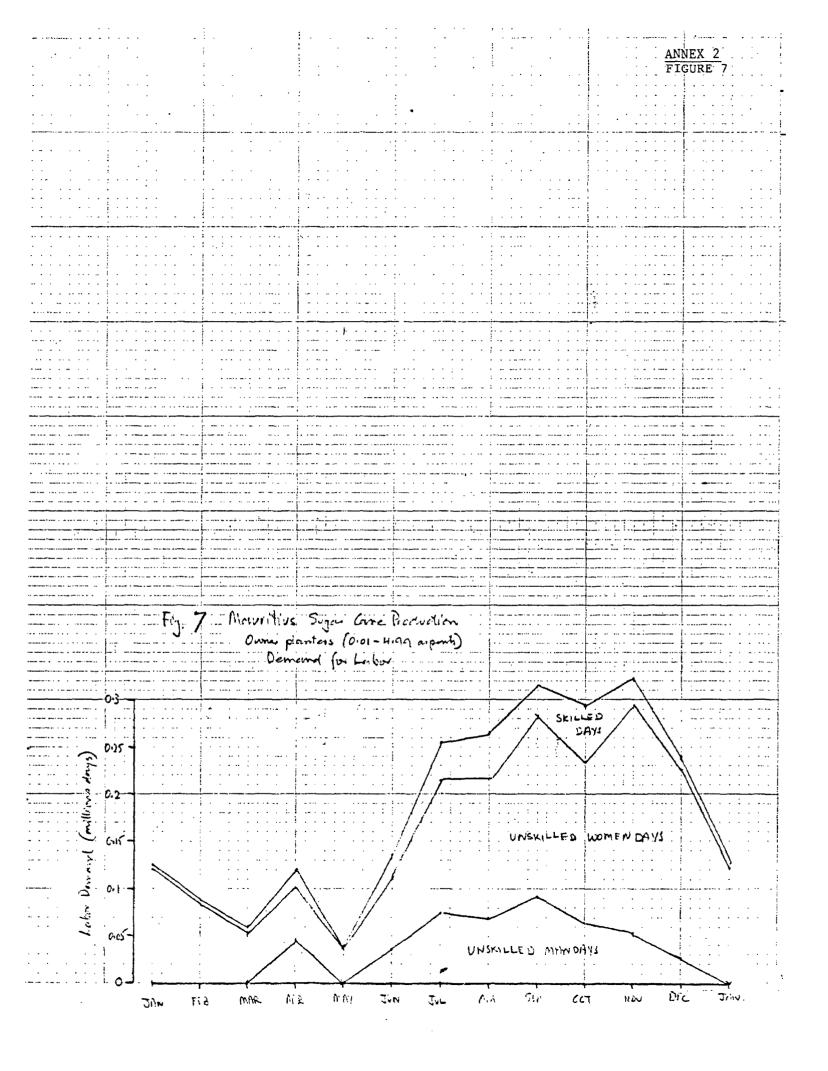
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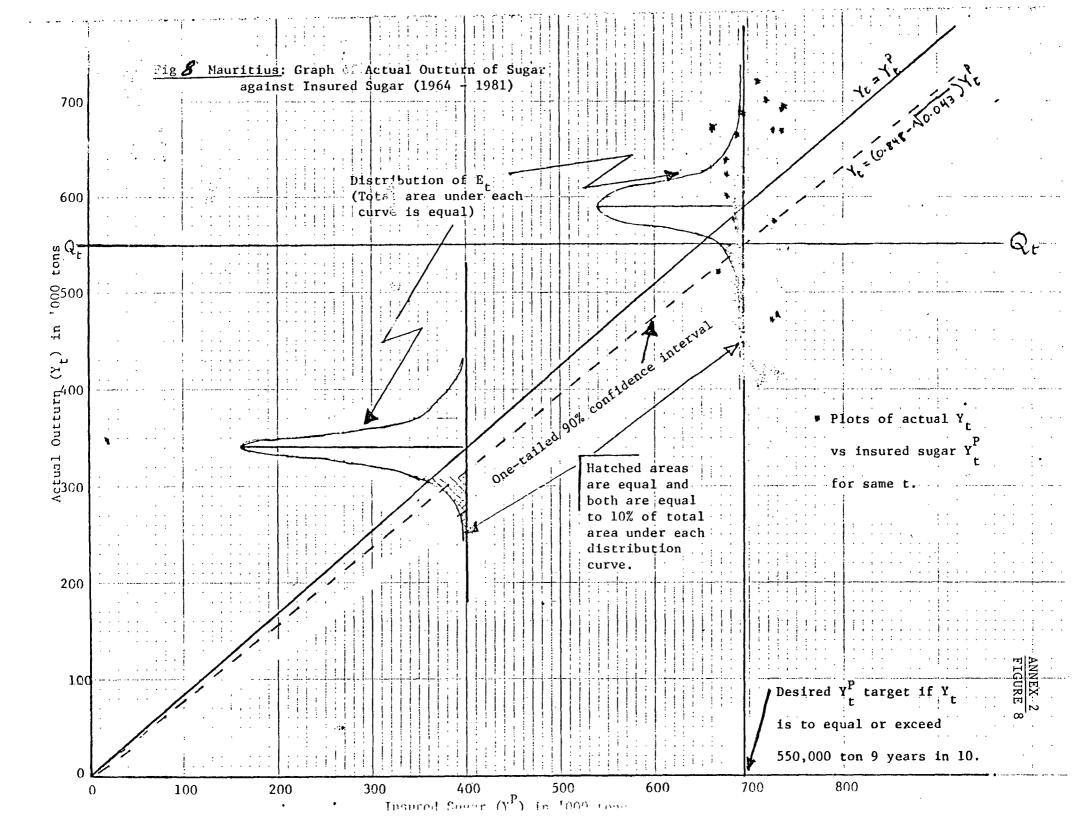
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| âM S. | .0 888.0 | 846.0 + 785.0 | | + fus.0 + 8115.0 | | + 846.0 + 2HE.0 | | + 248.0 + AH4.0 | | + 785°0 + 785°0 | | + EU27.0 + SH2.0 | | + SV8.0 + IHT.0 137.0 | SWS.0 + IWS.0 EHC.0 13C.0 | | IW2.0 | B 2 | |
| | | A8E.0 | 847.0 | + 1,46.0 | 747.0 | + 987'0 | 311.0 | + 282.0 | 212.0 | + :49.0 | 787. (| + 814.0 | UIC.0 | + 211.0 | S16.0 - L116.0 | | 188.0 3290-1 | 23 284 | |
| | | ED 19:0 | 8019:0 | £215.0 | 1312.0 4 | 0,51C6 + | 0.5106 | 0'2162 + | | AC18.0 | | 0.110 | £316.0 + | ರಿ15(*0 | 1316.0 | | 1516.0 | 31 | • |
| | *0-8cm 0. | 0.61R8 8835.0 | CASERA CASECAT | | 7#1C.0 | + 2818.0 + 283€.0 | | 0.81R5 + | | + 1810.0 + (5522.0 | | + £810.1 + £832.0 | a 3, 0 | 1.01R2 4 SE37.0 | #2425.0 #127.0 #26.0 | | R2427.0 19125.0 | CB 18 628 | 8 20 02 A 20 00 0 |









| | | | 1965 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|--|---|--------|--|----------------------------------|---|--|--|--|--|--|---|--|---|---|--|
| Sugar Cane: | Total (Harvested) (Not Harvested) 1/ | (| 205,555 (194,924) (36,858) | 204,723 (189,283) (15,440) | 205,218 (190,128) (15,090) | 207,029 (191,827) (15,207) | 205,432 (189,300) (16,132) | 204,677 (189,512 (15,165) | 206,500 (191,600) (14,900) | 206,600 (191,000) (15,600) | 205,500 (190,200) (15,300) | 203,100 (188,900) (14,200) | 202,700 (187,500) (25,200) | 200,400 (185,448) (14,912) | |
| Tea | | | 6,327 | 12,272 | 14,765 | 12,080 | 12,931 | 13,135 | 13,691 | 13,800 | 13,800 | 9,800 | 9,300 | 9,000 | NA |
| | eta Allocated ea Harvested) | | 958 | 958 | 1,054 | 1,054 | 1,246 | 1,390 | 1,629 | 1,294 (1,300) | 1,819 (1,455) | 2,559 (1,805) | 2,543 (2,073) | 1,900 (1,800) | KA Na |
| Food Crops | Total | | | | | | | | | | | | | | |
| Total | Harvested 4/ | | 9,803 | | 7,548 | 8,630 | 9,537 | 9,326 | 9,965 | 9,359 | 9,821 | 8,692 | 9,087 | 9,702 | 10,123 |
| (Grown (Trish (Boans (Pines) (Brinj) (Toast (Gingo (Cree) | c) 11cs) 11cs) 11cs) 11cs) 11cs 11cs 11c | | 426 666 59 93 635 1,015 887 68 271 1,800 79 1,742 1,641 1,021 | | 592 39 - 41 1,009 1,303 499 100 - 1,217 150 - 932 1,042 624 | 505 56 90 33 1,690 1,409 421 132 166 1,194 159 947 890 1,064 474 | 1,615 40 72 14 887 1,277 510 217 148 1,259 221 667 1,447 907 | 1,232 28 26 22 811 1,482 663 96 132 1,493 101 996 1,315 894 | 1,500 36 45 24 897 1,868 664 176 129 1,343 132 878 1,250 770 342 | 1,261 30 48 28 728 1,702 583 137 141 1,746 81 917 1,094 754 | 1,184 34,45 32,899 1,744 572 120 150 1,751 101 1,137 1,187 780 86 | 1,110 21 24 20 650 1,271 570 84 93 1,895 66 980 1,199 692 | 773 12 37 14 683 1,674 836 64 119 1,468 65 1,267 1,382 605 88 | 1,041 6 38 49 1324 1,829 623 86 154 1,577 30 921 1,365 602 57 | 1,285 15 59 82 1,310 1,500 522 40 105 1,924 70 915 1,339 770 7 |
| Total | Agriculture | | 222,643 | | 228,585 | 228,793 | 222,215 | 228,528 | 218,094 | 231,059 | 230,621 | 223,392 | 223,187 | 221,002 | %A |
| Forest Plan | natations | | 10,993 | | 16,050 | | 15,400 | | | | | | 14,220 | | |
| Bullt up Ar | reas | | 28,015 | | 28,090 | | 31,270 | | | | | | 31,284 | | |
| Reservoirs | & Ponda | | 2,796 | | 2,780 | | 3,080 | | | | | | 3,810 | | |
| Other Lands | s | | 133,817 | | 143,200 | | 139,777 | | | | | | 165,900 | | |
| (Unsul (Travi | r or Unutilized) itable for Sustained ks, Rockpiles, Bedroc cain Slopes) | | .an) 6,183 | | 136,680 <u>7/</u> 6,520 | | 38,380 77,707 23,690 | | | | | | 38,394 77,736 23,700 26,070 | | |
| TUEAL | Aı | rpents | 412,343 | | 404,898 | | | | | | | | 438,401 | | |
| | he | ı. | 174,043 | | 170,900 | | | | | | | | 185,040 | | |

^{1/} Derived as difference between total and harvested.
2/ Excludes roads, rivers and waste land as from 1979.
3/ Included in food crops total.
4/ Estimated by MOANR&E. Includes some double counting Estimated by MOANRSE. Includes some double counting since the estimates are of the effective areas harvested and include the aggregate areas of different crops grown on the same land in one year as well as food crops interplanted with sugar cane.

Include margoze, calabash, chouchou, cucumber, patolle, pipengaille, pumpkin, squash, voehm.

Include beet, cabbage, carror, cauliflower, chillies (long and small), garlic, leek, lettuce, onion, petsai, sweet pepper, ladies' finger (lalo).

^{7/} Includes under or unutilized, unsuitable for sustained production and mountain slopes.

| | | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 . | 1982 |
|----------------|------------------------|--------------|--------------|---------------|---------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | | | | - = = = = - | | | '000 tonu | <u> </u> | | | | | |
| Sugar | | | | | | | | | | | | | |
| Cane | Total | 5,255 | 6,315 | 6,243 | 5,964.0 | 4,316.0 | 6,402.0 | 6,022.0 | 6,260.0 | 6,313.1 | 4,564.4 | 5,302.0 | 6,446.6 |
| | (Miller Planters) | (1,822) | (2,412) | (2,389) | (3,864.0) (2,100.0) | (2,783.0) (1,533.0) | (3,977.0) (2,425.0) | (3,747.0) (2,275.0) | (3,914.0) (2,346.0) | (3,976.6) (2,336.5) | (2,874.1) (1,690.3) | (3,455.0) (1,847.0) | (3,893.3) (2,553.4) |
| | (Planters) | (3,433) | (3,903) | (3,854) | (2,100.0) | (1,333.0) | (2,423.0) | (2,2/3.0) | (2,340.0) | (2,330.3) | (1,050.3) | (1,647.0) | (2,333.4) |
| Sugar | Total | 621.1 | 686.3 | 718.4 | 696.8 | 468.3 | 689.9 | 665.4 | 665.2 | 688.4 | 475.5 | 575.0 | 690.0 1/ |
| | White | (33.7) | (54.9) | (56.0) | (48.9) | (25.5) | (52.7) | (48.0) | (41.7) | 42.3) | (31.6) | (38.0) | NA - |
| | Raw | (587.3) | (631.3) | (662.4) | (647.9) | (442.8) | (637.2) | (617.4) | (623.5) | (646.1) | (433.9) | (537.0) | NA |
| Holass | Sé8 | 140.1 | 176.4 | 184.8 | 172.8 | 126.4 | 204.3 | 195 | 202 | 208 | 136 | 159 | NA. |
| Вадача | se se | 1,441 | 1,677 | 1,714 | 1,580 | 1,265 | 1,765 | 1,728 | 1,806 | . 1,831 | 1,410 | 1,837 | NA |
| Scumi | | 168-6 | 196.0 | 200.1 | 200.8 | 153.1 | 208.3 | 205 | 210 | 214 | 177 | 208 | NA |
| | | | | | · · · · · · · · · · · · · · · · · · · | | -tonnes | | ···· | | | | |
| Tea: G | reen Leaf | 19,837 | 23,543 | 20,365 | 19,646 | 15,777 | 22,444 | 23,607 | 25,733 | 25,718 | 22,438 | 24,926 | 26,577 |
| M | ade tea | 4,089 | 4,679 | 4,078 | 3,971 | 3,139 | 4,334 | 4,727 | 5,106 | 5,128 | 5,072 | 4,386 | NA. |
| Tobacco | leaf | 562 | 614 | 677 | 771 | 686 | . 666 | 588 | 731 | 705 | 1,153 | 1,247 | KA |
| Food (2) | ops | | | | | | | | | | | | |
| Maize | | 504 | 470 | 442 | 1,684 | 1,195 | 1,584 | 1,328 | 1,144 | 1,171 | 732 | 1,081 | 1,375 |
| Manfo | | 252 | 248 | 433 | 271 | 211 | 260 | 226 | 246 | 182 | 86 | 75 | 80 |
| | lle (Eddoes) | 465 | 472 | 530 | 354 | 97 | 187 | 209 | 214 | 120 | 172 | 157 | 285 |
| | Potatoes | 254 | 213 | 179 | 83 | 117 | 123 | 131 | 164 1,428 | 105 | 85 1 , 071 | 234 | 335 1,940 |
| | dinit <u>2/</u> | 1,062 | 1,471 | 1,984 | 1,545 | 1,270 9,518 | 1,150 11,944 | 1,094 10,905 | 12,153 | 1,081 8,329 | 11,694 | 1,854 15,999 | 13,500 |
| | Potatoes & peas | 8,928 513 | 7,516 497 | 10,068 440 | 9,254 760 | 966 | 912 | 876 | 911 | 904 | 11,162 | .880 | 765 |
| | • | 815 | 415 | 673 | 1,056 | 483 | 687 | 607 | 542 | 452 | 258 | 476 | 535 |
| Pines Retor | ppre al (Egg Plant) | 2,714 | 1,490 | 1,012 | 947 | 743 | 729 | 785 | 878 | 533 | 573 | 812 | 845 |
| Torat | | 6,058 | 5,440 | 4,778 | 6,715 | 6,021 | 5,439 | 6,928 | 7,254 | 8,359 | 6,121 | 6,739 | 9,530 |
| Claye | | 984 | 1,000 | 1,161 | 1,788 | 750 | 826 | 515 | 608 | 387 | 348 | 168 | 440 |
| Creen | | 6,517 | 7,390 | 6,862 | 4,513 | 5,835 | 5,671 | 5,745 | 6,368 | 5,472 | 5,910 | 4,665 | 5,445 |
| | Vegetables | 7,845 | 6,491 | 6,799 | 8,966 | 8,067 | 7,286 | 6,682 | 6,987 | 7,121 | 8,454 | 7,544 | 7,240 |
| Banan | | 12,005 | 9,990 | 10,214 | 8,727 | 3,702 | 7,540 | 7,586 | 7,154 | 6,663 | 2,625 | 5,430 | 6,415 |
| Rice | _ | 1,084 | 1,149 | 883 | 668 | 496 | 465 | 275 | 197 | 36 | 159 | 127 | 10 |
| | | , | | | | | | | | | | | |

Sources: Collected by Mauritius Ministry of Agriculture and Natural Resources and the Environment.

^{1/} Estimated.

^{2/} Green.

^{!/} Harvested arpents.

^{2/} Harvested areas include roads, tracks etc.

Table 4

Food Crops: Area Production Yield Relationships

| | Area (A | rpents) | Output (t Averag | | | ns/arpent) age |
|---------------------|-----------|-----------|---------------------|------------|-----------|-------------------|
| | 1976 & 77 | 1978 & 79 | 1976,,1978 | 1979,,1981 | 1976 & 77 | 1978 & 79 |
| Declining Output | | | | | | |
| Halze | 1,380 | 1,147 | 1,352 | 995 | 1.055 | 1.015 |
| Mantoe | 33 | 28 | 244 | 114 | 7.375 | 7.955 |
| Arouville (Eddoes) | 47 | 35 | 610 | 150 | 4.255 | 4.880 |
| Pineapple | 157 | 102 | 612 | 395 | 4.165 | 4.950 |
| Brinjal (Egg Plant) | 135 | 122 | 797 | 639 | 5.610 | 5.790 |
| Ginger | 107 | 84 | 650 | 301 | 6.310 | 5.940 |
| Creepers | 898 | 1,059 | 5,928 | 5,349 | 6.365 | 5.590 |
| Banana | 762 | 736 | 7,427 | 4,906 | 9.925 | 9.295 |
| Rice | 176 | 52 | 312 | 107 | 2.215 | 2.265 |
| Increasing Output | | | | | | |
| Sweet potato | 26 | 26 | 139 | 141 | 4.905 | 5.190 |
| Groundnut | 813 | 774 | 1,224 | 1,335 | 1.390 | 1.625 |
| Irish Potato | 1,785 | 1,507 | 11,667 | 12,007 | 6.400 | 6.750 |
| Beans & Peas | 624 | 571 | 899 | 982 | 1.460 | 1.590 |
| Tomatoes | 1,545 | 1,823 | 6,540 | 7,073 | 4.010 | 4.275 |
| Mixed Vegetables | 762 | 597 | 6,985 | 7,706 | 5.90 | 5.915 |

Table 5: Mauritius: Cane-Area Harvested & Yields 1/

| | 1977 1978 | | 197 | 9 | 1980 | ı | 1981 | Averag 1977-19 | | Scalar | | | |
|--------------------------|-----------|-------|--------|-------|--------|-------|--------|-------------------|---------|---------|----------|---------|----------|
| | ha | t/ha | ha | t/ha | ha | t/ha | ha | t/ha | ha t/ha | Arpents | t/arpent | Area 2/ | Yield 3/ |
| Miller Planters | | | | | | | | | | | | | |
| Virgin Canes | | | | | | | | | | | | | |
| Grande Salson | 3,595 | 103.6 | 3,431 | 109.0 | 3,092 | 115.0 | 3,018 | 83.2 | | 7,697 | 44.7 | , 0.073 | 1.269 |
| Petite Salson | 888- | 89.6 | 1,753 | 96.7 | 1,690 | 98.3 | 1,375 | 69.4 | | 3,374 | 38.9 | 0.032 | 1.195 |
| Ratoon 1st | 5,104 | 90.5 | 5,118 | 91.0 | 5,734 | 93.4 | 5,253 | 68.6 | | 12,547 | 37.3 | 0.119 | 1.061 |
| 2 nd | 5,324 | 84.6 | 5,182 | 88.2 | 5,121 | 88.2 | 5,764 | 64.6 | | 12,653 | 35.2 | 0.120 | 1.000 |
| 3rd | 5,658 | 81.5 | 5,211 | 86.0 | 5,146 | 86.1 | 5,127 | 62.2 | | 12,442 | 34.4 | 0.118 | 0.976 |
| 4th | 5,920 | 81.3 | 52.93 | 83.2 | 5,091 | 84.8 | 5,018 | 61.3 | | 12,548 | 33.9 | 0.119 | 0.962 |
| 5 th | 5,693 | 80.3 | 5,420 | 83.9 | 5,012 | 83.7 | 4,899 | 60.1 | | 12,337 | 33.5 | 0.117 | 0.953 |
| 6th | 4,967 | 79.6 | 4,945 | 82.7 | 4,865 | 84.2 | 4,423 | 60.5 | | 11,282 | 33.5 | 0.197 | 0.953 |
| Older | 7,199 | 78.7 | 8,474 | 62.2 | 9,283 | 82.3 | 9,967 | 60.5 | | 20,561 | 32.7 | 0.195 | 0.930 |
| | | | | | | | | | | | | 1.000 | |
| Total Miller Planters | 44,348 | 84.6 | 44,827 | 87.3 | 45,034 | 88.3 | 44,906 | 64.0 | | 105,441 | 35.2 | | |
| Total Owner Planters | 34,289 | 63.3 | 33,543 | 66.9 | 32,889 | 68.1 | 32,446 | 50.0 | | 79,951 | 27.5 | | |
| Total Tenant Planters | 1,968 | 53.1- | 1,907 | 53.2 | 1,801 | 53.3 | 1,792 | 38.4 | | 4,693 | 22.4 | | |
| ISLAND TOTALS & AVERAGES | 80,605 | 74.7 | 80,277 | 78.0 | 79,724 | 79.2 | 79,144 | 57.7 | | 190,085 | 31.6 | | |

^{1/} To convert ha to arpents miltiply by 2.3692. To convert t/ha to T/arpent divide by 2.3692.

^{2/} Area of each particular crop to total miller planter average area.

^{3/} Ratio of average 1977-1980 yield for particular crop to overall miller planter average.

Table 6. Estimated 1/ Distribution of Harvest Time by Months (Percentage)

| | | | | и о и | TH | | | |
|---------------|------|-------|-------|-------|-------|-------|------|--------|
| Crop | JUN | JUL | AUG | SEP | oct | NOV | DEC | TOTAL |
| Grande salson | | | | | | 4.47 | 4.76 | 9.23 |
| Ratoon 1 | | | | | 1.53 | 7.28 | | 8.81 |
| 2 | | | | | 8.40 | | | 8.40 |
| 3 | | | | 7.31 | 0.67 | | | 7.98 |
| 4 | | | 2.61 | 5.82 | | | | 7.98 |
| 5 | | | 7.73 | | | | | 7.73 |
| 6 | | 5.57 | 1.58 | | | | | 7.15 |
| 7+ | 5.57 | 7.08 | | | | | | 12.65 |
| Petite Saison | | | | | 1.18 | 1.18 | 1.18 | 3.54 |
| Ratoon 1 | | | | | 1.28 | 1.28 | 1.28 | 3.84 |
| 2 | | | | | 1.21 | 1.22 | 1.21 | 3.64 |
| 3 | | | | 1.19 | 1.20 | 1.20 | | 3.59 |
| 4 | | | 1.16 | 1.17 | 1.16 | | | 3.49 |
| 5 | | 1.12 | 1.13 | 1.14 | | | | 3.39 |
| 6 | 1.02 | 1.03 | 1.04 | | | | | 3.09 |
| 7+ | 1.83 | 1.83 | 1.83 | | | | | 5.49 |
| | 8.42 | 16.63 | 16.63 | 16.63 | 16.63 | 16.63 | 8.43 | 100.00 |

^{1/} Totals by crop estimated from data in Table 5. Totals by month estimated from tonnage of cane flows into mills. Data in body of table estimated by interpolating for each month against monthly & crop totals commencing with December and the virgin crops and working progressively through table to June and the oldest ration.

Table 7. Estimated Potential for Rotational Cropping

| | | First | · | Rotational | Cropping Potential |
|-----------|-----------|-----------------|--------------------|----------------|--------------------------|
| | vest | Opportunity | Area | nl - 1 | 4 m = - |
| Time | Area | to replant | Derocked | Period | Area |
| (month) | (% Total) | (month) | (% harvested area) | (months & no.) | (% total Harvested area) |
| December | 8.5 | April | 40.0 | Jan Apr. 4 | 3.5 |
| November | 17.0 | April | 0.0 | Dec Apr. 5 | 17.0 |
| October | 17.0 | April | 0.0 | Nov Apr 6. | 17.0 |
| September | 17.0 | April | 0.0 | Oct Apr. 7 | 17.0 |
| August | 17.0 | 50% Apr/50% Sep | 0.0 | Sep Apr. 8/0 | 8.5 |
| July | 17.0 | September | 0.0 | Aug Sep. 1 | 0.0 |
| June | 8.5 | September | 0.0 | Jul Sep. 2 | 0.0 |

Table 8: Mauritius: Potential for Interline and Rotational Cropping

Rotational Cropping

| Jan - Apr | (Arpents) | 800 |
|-----------|-----------|-------|
| Dec - Apr | (Arpents) | 3,400 |
| Nov - Apr | (Arpents) | 3,400 |
| Oct - Apr | (Arpents) | 3,400 |
| Sep - Apr | (Arpents) | 1,600 |

12,600

| Interline Cropping | | Virgin Crop | 1st Ratoon | 2nd Ratoon | Sub-Total | 3rd Ratoon | Total |
|------------------------|------------------------|-------------|------------------|-----------------|------------------|------------------|------------------|
| Jan - Apl Dec - Mar | (Arpents) (Arpents) | | 10,200 10,400 | 5,000 15,500 | 15,200 25,900 | 2,000 8,800 | 17,200 34,700 |
| Nov - Feb Oct - Jan | (Arpents) (Arpents) | 6,100 | 2,000 | 2,300 | 4,300 6,100 | 24,000 34,200 | 28,300 40,300 |
| Sep – Dec Aug – Nov | (Arpents) (Arpents) | | | | | 25,300 22,600 | 25,300 22,600 |
| Jul - Oct Jun - Sep | (Arpents) (Arpents) | | | | | 7,800 | 7,800 |
| May - Aug | (Arpents) | 20,000 | 22,600 | 22,800 | 13,900 65,400 | 124,700 | 13,900 |

Table 9 - Mauritius: Cane Production Industry Structure and Performance (1974-1979)

| | | | | TYPE OF PRODUCER BY Millers Owner Planters by Size of Holding (arpents) | | | | | | |
|--------------------------------------|--------------------|-----------------------|-------------------------------------|---|----------------------|-----------------------|-------------------------|----------------------------|---------------------------------|-----------------------------------|
| | | | Island | Hillers | | | | | | Tenant |
| | | Unit | Total | Planters | 100.00+ | 20 - 99.99 | 5 - 19.99 | 0.01-4.99 | Sub-Total | Planters |
| Cultivated Area: Relative to Isla | nd Total | arpent X | $\frac{205,205 \frac{a}{0}}{100.0}$ | 116,717 <u>a/</u> 56.9 | | | | | 83,358 $\frac{a}{6}$ | 5,130 2.5 <u>b</u> / |
| Harvested Area: Relative to Cult | | arpent Z | 190,085 a/ 92.6 100.0 | 105,441 90.3 55.4 | 15,558 8.2 | 10,011 | 17,438 9.2 | 36,944 19.4 | 79, 9 51 95.9 42.1 | 4,693 <u>b</u> / . 91.5 2.5 |
| Relative to Isla | nd lotal | <u> </u> | 100.0 | 33.4 | 0.2 | 3.3 | 7.2 | 13.4 | 42.1 | |
| | | (1) | | | (19.5) | (12.5) | (21.8) | (46.2) | (100.0) | |
| Number of Planters | ı | Nos. Z (%) | 35,066 100.0 | 21 0.06 | 49 0.14 (0.15) | 253 0.72 (0.75) | 2,049 5.89 (6.08) | 31,322 89.32 (93.02) | 33,673 96.03 (100.0) | 1,372 3.91 |
| Cane Produced | | '000 tons % (%) | $\frac{6,014}{100.0}$ | 3,710 a/ 61.7 | 478 8.0 (21.8) | 267 4.4 (12.1) | 446 7.4 (20.3) | 1,008 16.8 (45.8) | 2,199 36.6 (100.0) | 105 |
| Ylelds: Average | | tons/arpent | | 35.2 | 30.7 | 26.7 | 25.6. | 27.3 | 27.5 | 22.4 |
| Relative to Isla | | z | 100.0 | 111.4 | 97.2 | 84.5 | 81.0 | 86.4 | 87.0 | 70.1 |
| Relative to Hill | | z | 89.8 | 100.0 | 87.2 | 75.9 | 72.7 | 77.5 | 78.1 | 63.6 |
| Relative to Owne | er-Planter | z | 114.9 | 128.0 | 111.6 | 97.1 | 93.1 | 99.3 | 100.9 | 81.5 |
| Harvested Areas ar | nd Ylelds (Scalar) | 1/ | | | | | | | | |
| Grande salson | area (0.073) | arpents | 13,876 | 7,697 | 1,135 | 731 | 1,273 | 2,697 | 5,836 | 343 |
| | Yield (1.269) | tons/arpent | 40.1 | 44.7 | 39.0 | 33.9 | 32.5 | 34.6 | 34.9 | 28.4 |
| Petite saison | area (0.032) | arpents | 6,083 | 3,374 | 49.8 | 320 | 558 | 1,182 | 2,559 | 150 |
| | Yield (1.105) | tons/arpent | 34.9 | 38.9 | 33.9 | 29.5 | 28.3 | 30.2 | 30.4 | 24.8 |
| lst Ratoon | area (0.119) | arpents | 22,620 | 12,547 | 1,851 | 1,191 | 2,075 | 4,398 | 9,515 | 558 |
| | Yield (1.061) | tons/arpent | 33.5 | 37.3 | 32.6 | 28.3 | 27.2 | 29.0 | 29.2 | 23.8 |
| 2nd Ratoon | area (0.120) | arpents | 22,810 | 12,653 | 1,867 | 1,201 | 2,093 | 4,433 | 9,594 | 563 |
| | Yield (1.000) | tons/arpent | 31.6 | 35.2 | 30.7 | 26.7 | 25.6 | 27.3 | 27.5 | 22.4 |
| 3rd Ratoon | area (0.118) | arpents | 22,430 | 12,442 | 1,836 | 1,181 | 2,058 | 4,359 | 9,434 | 554 |
| | Yield (0.976) | tons/arpeni | 30.8 | 34.4 | 30.0 | 26.1 | 25.0 | 26.6 | 26.8 | 21.9 |
| 4th Ratoon | area (0.119) | arpents | 22,620 | 12,548 | 1,851 | 1,192 | 2,075 | 4,396 | 9,514 | 558 |
| | Yield (0.962) | tons/arpent | 30.4 | 33.9 | 29.5 | 25.7 | 24.6 | 26.3 | 26.5 | 21.5 |
| 5th Ratoon | area (0.117) | arpents | 22,240 | 12,337 | 1,820 | 1,172 | 2,040 | 4,322 | 9,354 | 549 |
| | Yleld (0.953) | tons/arpent | | 33.5 | 29.3 | 25.4 | 24.4 | 26.0 | 26.2 | 21.3 |
| 6th Ratoon | area (0.107) | arpents | 20,339 | 11,282 | 1,665 | 1,071 | 1,866 | 3,953 | 8,555 | 502 |
| | Yield (0.953) | tons/arpent | • | 33.5 | 29.3 | 25.4 | 24.4 | 26.0 | 26.2 | 21.3 |
| Older Ratoon | area (0.195) | arpents | 37,067 | 20,561 | 3,034 | 1,952 | 3,400 | 7,204 | 15,590 | 915 |
| | Yleld (0.930) | tons/arpen | 29.4 | 32.7 | 28.6 | 24.8 | 23.8 | 25.4 | 25.6 | 20.8 |

Sources: The Mauritius Chamber of Agriculture, The President's Report 1980-81 for a/.
The Hauritius Chamber of Agriculture, Reviewing Committee on Planter's Sugar Cane Yields, Second Report December 1980 for b/.
Mauritius Sugar Industry Research Institute Annual Reports 1977, 1978, 1979 and 1980 (Derivation shown in Table 5 of this Annex).

^{1/} These scalars are derived in Table 5 of this Annex, and produce the data shown in the body of this table when multiplied by the harvested area or the average yield indicated for the Island Total and each type of producer.

Table 10 - Mauritius: Financial Cost of Sugar Production (Excludes export duty and SIF premiums)

| | | Island Total | | | TYPE OF PROD | UCER BY | | |
|-------------------------------|-------------------|--------------|----------|---------|------------------|-----------|----------|-----------------|
| | | or | Millers | | Plantera by Size | | | Tenant |
| | | Average | Planters | 100.00+ | 20 - 99.99 | 5 - 19.99 | 0.01 - 5 | Planters |
| Cane Production | | | | | | | • | |
| Island totals | | | | | | | | |
| Identified inputs | (Rs.Millions) | 1,064.3 | 644.4 | 93.7 | 57.8 | 78.4 | 169.7 | 20.3 |
| Overheads | (Rs.Millions) | 451.2 | 325.3 | 28.1 | 17.3 | 23.5 | 50.9 | $-\frac{6.1}{}$ |
| Total | (Rs.Millions) | 1,515.5 | 969.7 | 121.8 | 75.1 | 101.9 | 220.6 | 26.4 |
| Harvested area | ('000 arpents) | 190.1 | 105.4 | 15.6 | 10.0 | 17.4 | 36.9 | 4.7 |
| Averages per arpent | | | | | | | | |
| Identified inputs | (Rs/arpent) | 5,740 | 6,114 | 6,006 | 5,780 | 4,506 | 4,599 | 4,319 |
| Overheads | (Rs/arpent) | 2,373 | 3,056 | 1,802 | 1,734 | 1,352 | 1,380 | 1,296 |
| Total | (Rs/arpent) | 8,077 | 9,200 | 7,808 | 7,514 | 5,858 | 5,979 | 5,615 |
| Cane: Total output | ('000 tona) | 6,014 | 3.710 | 478 | 267 | 446 | 1.008 | 105 |
| Yield/arpent | (t/arpent) | 31.6 | 35.2 | 30.7 | 26.7 | 25.6 | 27.3 | 22.4 |
| Averages per ton cane | | | | | | | | |
| Identified inputs | (Re/ton cane) | 177 | 174 | 196 | 216 | 176 | 168 | 193 |
| Overheads | (Rs/ton cane) | 75 | 87 | | 65 | 52 | 51 | 58 |
| Total | (Rs/ton cane) | 252 | 261 | 255 | 281 | 228 | 219 | 251 |
| Sugar Production | · | | | | | | | |
| | | | | | | | | |
| Sugar: Yield/ton cane | (%) | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 |
| Averages per ton sugar | | | | | | | | |
| Identified inputs | (Rs/ton sugar) | 1,647 | 1,619 | 1,823 | 2,009 | 1,637 | 1,563 | 1,795 |
| Overheads | (Rs/ton sugar) | 697 | 809 | 549 | 605 | 484 | 474 | 540 |
| Sub-Total | (Rs/ton sugar) | 2,344 | 2,428 | 2,372 | 2,614 | 2,121 | 2,037 | 2,335 |
| Milling & transport | (Rs/ton sugar) | 875 | 875 | 875 | 875 | 875 | 875 | 875 |
| Total Cost on dock Port Louis | (Rs/ton sugar) | 3,219 | 3,303 | 3,247 | 3,489 | 2,996 | . 2,912 | 3,210 |
| Total Cost on dock Port Louis | | 284.9 | 292.3 | 287.3 | 308.8 | 265.1 | 257.7 | 284.1 |
| Total Cost on dock Port Louis | (US cents/lb suga | τ) 12.7 | 13.0 | 12.8 | 13.8 | 11.8 | 11.5 | 12.6 |

Table 11 - Mauritius: Financial Cost of Sugar Production Foreign Exchange Component (Excludes export duty and SIP premiums)

| | | Island Total TYPE OF PRODUCER BY | | | | | | |
|---|---|----------------------------------|----------------|--------------|--------------------|--------------|--------------|--------------|
| | | or | Millers | Owner P | lanters by Size of | Holding (a | rpents) | Tenant |
| | | Average | Planters | 100.00+ | 20 - 99.99 | 5 - 19.99 | 0.01 - 4.99 | Planters |
| Cane Production | | | | | | | | |
| Island totals | | | | | | | | |
| ldentified inputs | (Rs.Millions) | 399.5 | 232.4 | 33.0 | 20.5 | 33.3 | 71.6 | 8.7 |
| Overheads | (Rs.Millions) | 167.4 | 117.3 | 9.9 | 6.1 | 10.0 | 21.5 | 2.6 |
| Total | (Rs.Millions) | 566.9 | 349.7 | 42.9 | 26.6 | 43.3 | 93.1 | 11.3 |
| Harvested area | ('000 arpents) | 190-1 | 105.4 | 15.6 | 10.017.4 | 36.9 | 4.7 | |
| Averages per arpent | | | | | | | | |
| ldentified inputs Overheads | (Rs/arpent) (Rs/arpent) | 2,101 881 | 2,205 1,113 | 2,115 635 | 2,050 610 | 1,914 574 | 1,940 583 | 1,851 553 |
| *************************************** | (no, arpent) | | | | | | | |
| Total | (Rs/arpent) | 2,982 | 3,318 | 2,750 | 2,660 | 2,488 | 2,523 | 1,404 |
| Cane: Total output | ('000 tons) | 6,014 | 3,710 | 478 | 267 | 446 | 1,008 | 105 |
| Yield/arpent | (t/arpent) | 31.6 | 35.2 | 30.7 | 26.7 | 25.6 | 27.3 | 22.4 |
| Averages per ton cane | | | | | | | | |
| Identified inputs | (Rs/ton cane) | 66.4 | 62.6 | 69.0 | 76.8 | 74.7 | 71.0 | 82.9 |
| Overheads | (Rs/ton cane) | 27.8 | 31.6 | 20.7 | 22.8 | 22.4 | 21.3 | 24.8 |
| Total | (Rs/ton cane) | 94.2 | 94.2 | 89.7 | 99.6 | 97.1 | '92.3 | 107.7 |
| Sugar Production | | | | | | | | |
| Sugar: Yield/ton cane | (1) | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 |
| Averages per ton sugar Cane | | | | | | | | |
| Identified inputs | (Rs/ton sugar) | 617.7 | 582.3 | 641.9 | 714.4 | 694.9 | 660.5 | 771.2 |
| 'Overheads | (Rs/ton sugar) | 258.6 | 294.0 | 192.6 | 212.1 | 208.4 | 198.1 | 230.7 |
| Sub-Total | (Rs/ton sugar) | 876.3 | 876.3 | 834.5 | 926.5 | 903.3 | 858.6 | 1,001.9 |
| Milling & transport | (Rs/ton sugar) | 283.6 | 283.6 | 283.6 | 283.6 | 283.6 | 283.6 | 283.6 |
| Total Cost on dock Port Louis | (Rs/ton sugar) | 1,159.9 | 1,159.9 | 1,118.1 | 1,210.1 | 1,186.9 | 1,142.2 | 1,285.5 |
| Total Cost on dock Port Louis | , | 102.6 | 102.6 | 98.9 | 107.1 | 105.0 | 101.1 | 113.8 |

Table 12 - Mauritius: Economic Cost of Sugar Production (Excludes export duty and SIP premiums)

| | | Island Total | | | TYPE OF PRODU | CER BY | | |
|--------------------------------|-------------------|--------------|----------|--------------|-----------------|-----------|-------------|------------|
| | | or | Millers | | lanters by Size | | | Tenant |
| | - | Average | Planters | 100.00+ | 20 - 99.99 | 5 - 19.99 | 0.01 - 4.99 | Planters |
| Cane Production | | | | | | | | |
| Island totals | | | | | | • | | |
| Identified inputs | (Rs.Millions) | 644.8 | 384.0 | 53.3 | 32.4 | 51.1 | 110.9 | 13.1 |
| Overheads | (Rs.Millions) | 270.3 | 190.3 | <u> 17.0</u> | 9.7 | 15.6 | 33.7 | 4.0 |
| Total | (Rs.Milltons)~ | 915.1 | 574.3 | 70.3 | 42.1 | 66.7 | 144.6 | 17.1 |
| Harvested area | ('000 arpents) | 190.1 | 105.4 | 15.6 | 10.0 | 17.4 | 36.9 | 4.7 |
| Averages per arpent | | | | | | | | |
| Identified inputs | (Rs/acpent) | 3,391 | 3,643 | 3,417 | 3,240 | 2,937 | 3,005 | 2,787 |
| Overheads | (Rs/arpent) | 1,428 | 1,806 | 1,090 | 970 | 896 | 913 | <u>851</u> |
| Total | (Rs/arpent) | 4,819 | 5,449 | 4,507 | 4,210 | 3,833 | 3,918 | 3,638 |
| Cane: Total output | ('000 tons) | 6,014 | 3,710 | 478 | 267 | 446 | 1,008 | 105 |
| Yield/arpent | (t/arpent) | 31.6 | 35.2 | 30.7 | 26.7 | 25.6 | 27.3 | 22.4 |
| Averages per ton cane | | | | | | | | |
| Identified inputs | (Rs/ton cane) | 107.2 | 103.5 | 111.5 | 121.3 | 114.6 | 110.0 | 124.8 |
| Overheads | (Rs/ton cane) | 45.1 | 51.3 | 35.6 | 36.3 | 35.0 | 33.4 | 38.1 |
| Total | (Rs/ton cane) | 152.3 | 154.8 | 147.1 | 157.6 | 149.6 | 143.4 | 162.9 |
| Sugar Production | | | | | | | | |
| Sugar: Yield/ton cane | (1) | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 | 10.75 |
| Averages per ton sugar Cane | | | | | | | | |
| Identified inputs | (Rs/ton sugar) | 997.2 | 962.8 | 1,037.3 | 1,128.8 | 1,065.8 | 1,023.0 | 1,160.6 |
| Overheads | (Rs/ton sugar) | 420.0 | 477.2 | 330.8 | 337.9 | 325.6 | 311.0 | 354.4 |
| Sub-Total | (Rs/ton sugar) | 1,417.2 | 1,440.0 | 1,368.1 | 1,466.7 | 1,391.4 | 1,334.0 | 1,515.0 |
| Hilling & transport | (Ra/ton sugar) | 570.1 | 570.1 | 570.1 | 570-1 | 570.1 | 570.1 | 570.1 |
| Total Cost on dock Port Louis | (Rs/ton sugar) | 1,987.3 | 2,010.1 | 1,938.2 | 2,036.8 | 1,961.5 | 1,904.1 | 2,085.1 |
| Total Cost on dock Port Louis | (US\$/ton sugar) | 175.9 | 177.9 | 171.5 | 180.3 | 173.6 | 168.5 | 184.5 |
| Total Cost on dock Port Louis | (US cents/15 auga | r) 7.9 | 7.9 | 7.7 | 8.0 | 7.7 | 7.5 | 8.2 |

Table 13: Mauritius: Cost of Milling Sugar (Rs/ton sugar)

| | | | ign Exchange | | |
|-------------------------|----------------|-----|----------------|-----|-----------------|
| | Total | | Component | | Cost Components |
| | (Rs/ton Sugar) | (%) | (Rs/ton Sugar) | (%) | (Rs/ton Sugar) |
| Total Financial Cost | | | | | |
| Direct Expenses | 74.39 | 70 | 52.07 | 30 | 22.32 |
| Bags and Thread | 1.00 | 90 | 0.90 | 10 | 0.10 |
| Bagging and Handling | 1.43 | 10 | 0.14 | 90 | 1.29 |
| Overheads | 756.06 | 27 | 201.11 | 73 | 554.95 |
| Transport to Port Louis | 42.00 | 70 | 29.40 | 30 | 12.60 |
| | 874.88 | | 283.62 | | 591.26 |
| of Which Labor | 246.09 | | 24.61 | | 221.48 |
| Total Economic Cost | | | | | |
| of Which Labor | 24.61 | | 24.61 | | 0.0 |

Table 14 - Mauritius: Sugar Production Domestic Resource Cost

| | | Island Total | | | TYPE OF PRO | | | |
|--|------------------|---------------|---------------------|---------|--------------------------------|------------------------------|-------------|--------------------|
| | | or Average | Millers Planters | 100.00+ | Planters by S12- 20 - 99.99 | e of Holding (a 5 ~ 19.99 | 0.01 - 4.99 | Tenant Planters |
| Economic Cost on Dock Port Louis | (Rs.Millions) | 1,987.3 | 2,010.1 | 1,938.2 | 2,036.8 | 1,961.5 | 1,904.1 | 2,085.1 |
| Less: FE Cost on Dock Port Louis | (Rs.Millions) | 1,159.9 | 1,159.9 | 1,118.1 | 1,210.1 | 1,186.9 | 1,142.2 | 1,285.5 |
| Local Economic Cost on Dock Port Louis | (Rs.Millions) | 837.4 | 850.2 | 820.1 | 826.7 | 774.6 | 761.9 | 799.6 |
| FE Value of Sales on Dock Port Loius | (US\$/ton sugar) | 375.0 | 375.0 | 375.0 | 375.0 | 375.0 | 375.0 | 375.0 |
| Less: FE Component of Production Costs | (US\$/ton sugar) | 102.6 | 102.6 | 98.9 | 107.1 | 105.0 | 101.1 | 113.8 |
| Net FE Savings | (US\$/ton sugar) | 272.4 | 272.4 | 276.1 | 267.9 | 270.0 | 273.9 | 261.2 |
| Domestic Resource Cost of Sugar Production | (Ra/US\$ saved) | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 2.8 | 3.1 |
| FE Value of Sales on Dock Port Louis | (US\$/ton sugar) | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 | 135.0 |
| Less: FE Component of Production Costs | (US\$/ton sugar) | 102.6 | 102.6 | 98.9 | 107.1 | 105.0 | 101.1 | 113.8 |
| Net FE Savings | (US\$/ton sugar) | 32.4 | 32.4 | 36.1 | 27.9 | 30.0 | 33.9 | 21.2 |
| Domestic Resource Cost of Sugar Production | (Rs/US\$ saved) | 25.8 | 26.2 | 23.4 | 29.6 | 25.8 | 22.4 | 37.7 |
| FE Value of Sales on Dock Port Louis | (US\$/ton augar) | 164.2 | 165.1 | 159.2 | 167.8 | 162.0 | 157.1 | 172.6 |
| Less: FE Component of Production Costs | (US\$/ton sugar) | 102.6 | 192.6 | 98.9 | 107.1 | 105.0 | 101.1 | 113.8 |
| Net FE Savings | (US\$/ton sugar) | 61.6 | 62.5 | 60.3 | 60.7 | 57.0 | 56.0 | 58.8 |
| Domestic Resource Cost of Sugar Production | (Rs/US\$ maved) | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 | 13.6 |

Source Rigares to percentages. For 'Quantity Supplied' the percentages all across mas.

For "Mylen' and "'O'O' by' the percentages relate to the 'Cross frice (anount) to produces? and and does to colous; except for the Sersyndicess price and value which are expressed as a 2 of Averages

Frice and Fold value.

| 123/62 123/62 123/63 123/63 123/63 123/63 8471 (200) | \$\frac{\tau_1}{\tau_2}\left(\frac{\tau_1}{\tau_2}\left(\frac{\tau_1}{\tau_2}\right)\right)\right(\frac{\tau_1}{\tau_2}\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right)\right(\frac{\tau_1}{\tau_1}\right)\right)\right)\ri | () () () () () () () () () () () () | () () () () () () () () () () | () () () () () () () () () () | (0,001) (0,001 |
|---|---|--|---|---|--|
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Table 16 - Mauritius: Relationship between Actual Sugar Outturn (Y_t) and Insured Sugar (Y_t^p) (1964 - 1981)

| t —— | Y _t ('000 tons) | Y _t p ('000 tons) | Y _t /Y _t p (ratio) | $\frac{(Y_t/Y_t^p - 0.848)^2}{(\text{statisic})}$ |
|---------|-------------------------------|---------------------------------|---|---|
| 1964 | 521.280 | 678.591 | 0.769 | 0.00624 |
| 1965 | 664.290 | 688.216 | 0.966 | 0.01392 |
| 1966 | 563.813 | 687.526 | 0.821 | 0.00073 |
| 1967 | 639.227 | 657.478 | 0.947 | 0.00980 |
| 1968 | 603.967 | 677.317 | 0.892 | 0.00194 |
| 1969 | 670.562 | 661.922 | 0.987 | 0.01932 |
| 1970 | 576.243 | 685.001 | 0.142 | 0.49843 |
| 1971 | 624.855 | 676.916 | 0.934 | 0.00740 |
| 1972 | 689.753 | 693.660 | 0.995 | 0.02161 |
| 1973 | 721.380 | 709.423 | 1.017 | 0.02856 |
| 1974 | 701.338 | 717.137 | 0.978 | 0.01690 |
| 1975 | 471.747 | 725.395 | 0.651 | 0.03881 |
| 1976 | 693.988 | 735.126 | 0.945 | 0.00941 |
| 1977 | 670.212 | 726.589 | 0.923 | 0.00563 |
| 1978 | 669.542 | 735.741 | 0.911 | 0.00397 |
| 1979 | 695.128 | 737.661 | 0.943 | 0.00903 |
| 1980 | 476.981 | 730.256 | 0.654 | 0.03764 |
| 1981 | 575.800 | 728.500 | 0.790 | 0.00336 |
| | | | 15.265 | 0.73270 |
| =18) | | | | <u>.</u> |

i.e.
$$\leq \frac{T}{t=1} (Y_t/Y_t^p) = 15.265$$
 and $\leq \frac{T}{t=1} (Y_t/Y_t^p - B)^2 = 0.73270$
 $\frac{1}{T} \leq \frac{T}{t=1} (Y_t/Y_t^p) = 0.848$ $\frac{1}{T-1} \leq \frac{T}{t=1} (Y_t/Y_t^p - B)^2 = 0.043$
so that $B = 0.848$ so that $6^2 = 0.043$

Table 17 - Mauritius:

Area = P Probabilities That Given Standard Normal Variables Will Be Exceeded (Upper Tail) ~ (P) C(b) 0.09 0.00 10.0 0.02 0.03 0.04 0.05 0.06 0.07 0.08 .49601 .49202 . 48405 .48006 .47608 .47210 .46414 0.0 . 50000 .48803 .46812 .46017 .45224 .44433 .45620 .44038 . 43644 43251 42858 .42465 0.1 . 44829 .41294 .39743 .39358 .38591 .42074 .41683 .40905 .40517 .40129 .33974 0.2 .35942 .37828 .37448 . 36693 .35197 0.3 .38209 .37070 .36317 .35569 34827 0.4 . 34458 . 34090 .33724 .33360 . 32997 .32636 . 32276 .31918 .31561 .31207 .27760 .30854 .30153 .29806 .29460 .22116 .28774 .28434 0.5 .30503 . 28096 . 27425 .27093 . 26763 . 26+35 .26109 . 25785 . 25463 .25143 . 24825 .24510 .23885 .25576 .24196 .23270 .22965 . 22663 .22363 .22065 .21770 .21476 .20897 .20611 .20327 .20045 .19766 .19489 . 19215 18943 .18673 0.8 .21186 .17106 .16853 U.9 . 18406 .18141 . 17879 .17619 .17361 .16602 .16354 .16109 .14917 .14007 . 15866 .15151 .14457 1.0 .15625 . 15386 .14686 .14231 . 13786 .13567 .12924 .12507 .12302 .12100 1.1 . 13350 .13150.12714 1.11314 1.2 .11507 .11123 .10935 . 10749 . 10565 . 10383 .10204 .09510 .09342 .09176 .09012 .08351 .08691 .08534 .08379 .03226 .09680 1.3 .08076 .07927 .07780 .07636 .07493 .07353 .07215 .07078 .06944 .06811 i.5 .06681 .06552 .06+26 .06301 .06178 .06057 .05938 .05821 .05705 .05592 .04648 .03262 05050 .04947 .04846 .04746 .04551 .05480 .05370 05155. 1.6 1.7 .04457 .04363 .04272 .04182 04093 04006 .03920 .03836 .03754 .03675 .03005 .03438 .03362 .03288 .03216 .03144 .03074 .02938 .03593 .03515 1.8 .02872 .02807 .02743 .02680 .02619 .02559 .02500 .02442 .02385 .02330 2.0 .02275 .02216 .02169 .02118 .02068 -.02018 .01970 .01923 .01376_..01831 2.1 .01786 .01539 .01743 .01700 .01659 .01618 01578 .01500 .01463 .01426 2.2 .01390 .01355 .01321 .01287 .01255 .01222 01191 .01160 .01130 .01101 .01072 .01044 .01017 .00990 00764 .00939 .00914 .00889 .00866 .00842.00798 .00776 .00755 .00734 .00714 .00395 .00657 .00639 2.4 .00520 .00676 2.5 .00604 .00537 .00570 .00554 .00539 .00523 .00508 .00494 .00480 .00621 .00453 .00440 .00427 .00+15 .00÷02 .00301 .00379 .00368 .00357 .00466 7 7 .00326 .00307 .00298 .00239 .00280 .00272 .00264 .00347 .00336 .00317 .00256 ..00248 .00240 .00233 .00226 .00219 .00212 .00205 .00193 2.8 .00129 2.9 .00187 .00181 .00175 .00169 .00164 .00159 .00154 .00149 .00144 .00139 00126 .00122 00118 00114 .00111 .00107 .00104 .00100 3.0 .00135 .00131 .00074 .00097 .00094 .00090 .00087 .00084 .00082 .00079 .00076 .00071 3.1 .00064 -00052 .00050 3.2 .00069.00066 .00062 . ഗനഗംഗ .00058 .00056 .00054 .00048 .00047 UQ045 .00043.00042 .00046 .00039 .00058 00036 .00035 3.3. 3.4 00034 00032 .00031 .00030 .00029 .00028 .00027 .00026 .00025 .00024 3.5 .00023 .00022 .00022 .00021.00020 .00019 .00019 .00018 .0001700017 .00015 .00012 .000123.5 .00016 .00015 .00014 .00014 .00613 .0001300011 3.7 .00010 .00009 00009 .0000880000. 80000 .00011 .00010 .00010 00008 3.8 .00007.00007.00007.00006 .00006 .00006 .00006.00005.00005 .00005 .00005 .00005 . 20004 .00004 .00004 .00004+0000 .00004 .00003 .000003

^{*}The value of C(P) when set equal to 0.1 (the 90% confidence interval) lies between these two figures i.e. between 1.28 and 1.29. Interpolating C(P) = 1.282 (i.e. 1.2 from left hand margin + 0.08 from top of table + 0.002 by interpolation between 0.08 and 0.09 column)

Table 18 - Mauritius: Cost of Producing Maize and Potates

| | | Maize | | Potatoes |
|--|----------------|-------------|-------------|-------------|
| | | Small | Pure | |
| | FE | Holder | Stand | |
| Financial Costs | (%) | (Rs) | (Rs) | (Rs) |
| | | | | |
| Labor | 10 | 1,080 | 1,275 | 1,530 |
| Land Preparation | 70 | • | 500 | • |
| Seeds | 30/50/50 | 60 | 395 | 3,500 |
| Fertilizer | 70 | 73 | 1,775 | 511 |
| Manure | 20 | | , | 150 |
| Weedicides | 90 | | 45 | |
| Pesticides | 90 | | 276 | 400 |
| Irrigation | Ő | 100 | 160 | 50 |
| Transport | 70 | 25 | 40 | 100 |
| Total (Financial) | (Rs) | 1,338 | 4,466 | 6,241 |
| Total (Economic) | (Rs) | 337 | 3,134 | 4,500 |
| FE (Financial and Economic) | (Rs) | 195 | 2,234 | 2,720 |
| Local (Financial) | (Rs) | 1,143 | 2,232 | 3,521 |
| Local (Economic) | (Rs) | 142 | 900 | 1,780 |
| Local (Economic) | (ks) | 142 | 900 | 1,700 |
| Yield | (tons) | 0.975 | 1.6 | 3.5 |
| Financial Costs/ton | | | | |
| Total | (Rs/ton) | 1,372 | 2,791 | 1,783 |
| FE | (Rs/ton) | 200 | 1,396 | 777· |
| Local | (Rs/ton) | 1,172 | 1,395 | 1,006 |
| Local | (KS/COII) | 1,172 | 1,393 | 1,000 |
| Economic costs/ton | | | | |
| Total | (Rs/ton) | 345 | 1,959 | 1,286 |
| FE | (Rs/ton) | 200 | 1,396 | 777 |
| Local | (Rs/ton) | 145 | 563 | 509 |
| LOCAL | (KS/COII) | 147 | 202 | 203 |
| TE Value of import replacement | 1/(USS/ton) | 214 | 214 | 227 |
| Less FE Costs @ US\$1 = Rs13.6 | (US\$/ton) | 15 | 103 | 57 |
| | (,, | | | |
| Net FE Savings | (US\$/ton) | 199 | 111 | 170 |
| Domestic Resource | | | | |
| | Rs/US\$ saved) | 0.7 | 5 | 3 |
| coot of output | as, oby savea, | 0.7 | , | J |
| FE Value of Export 1/ | (US\$/ton) | 150 | 150 | 170 |
| Less FE Costs @ US\$ $\overline{1}$ = Rs13.6 | (US\$/ton) | 15 | 103 | 57 |
| TOTAL TE GOODS & GOOD NOTON | (000,0011) | | | |
| Net FE Savings | (US\$/ton) | 135 | 47 | 113 |
| | | | | |
| Domestic Resource Cost |) /TTOA | • | | , - |
| of Output (E | Rs/US\$ saved) | 1 | 12 | 4.5 |

¹/ Value on dock Port Louis.

Table 1 - Hauritius: Cost of Cane Growing per Harvested Arpent (A) of Virgin Crop and Ratoon Crop by Type of Producer and Activity
Sheet B. Activity 2: Fertilizing

I. TYPE OF PRODUCER: 100% owner planters operating 0.01-19.99 A; and 100% of area harvested by tenant planters.

| | P | Physical Inputs/A | | | | | Foreign Exchange 4/ | Skilled Labor 4/ |
|---------------------|-------------------------|-------------------|---------------|---------|---------------------------|-------------|------------------------|---------------------|
| | (Hours) (Tons) (Man day |) (Women days) | (Unspecified) | (Unite) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| Sulphate of ammonia | 0.2 | | | 0.2 | 2,570.00 1/ | | 0.70 | |
| Triple super | 0.2 | | | 0.2 | 4,050.00 $\overline{1}$ / | | 0.70 | |
| Muriate of potash | 0.1 | | | 0.1 | 2,720.00 1/ | | 0.70 | |
| Transport | | | | 0.5 | $21.19 \ \overline{2}/$ | 0.35 | ▶ 0.70 | 93.32 |
| Application | | 2.0 | | 2.0 | $17.41 \ \overline{3}/$ | | 0.10 | |

II. TYPE OF PRODUCER: 100% miller planters; 100% owner planters operating 20.00 A or more.

| | | Physical Inputs/A | | | | | Skilled Labor 4/ | Foreign Exchange 4/ | Skilled Labor 4/ |
|---------------------|----------------|-------------------|--------------|---------------|---------|-------------------------|---------------------|------------------------|---------------------|
| | (Hours) (Tons) | (Man daye) | (Women days) | (Unspecified) | (Units) | (Re/Unit) | (Component) | (Component) | (Rs/Day) |
| Sulphate of ammonia | 0.2 | | | | 0.2 | 2,570.00 1/ | | 0.70 | |
| Triple super | 0.2 | | | | 0.2 | 4,050.00 1/ | | 0.70 | |
| Murlate of potash | 0.1 | | | | 0.1 | 2,720.00 1/ | | 0.70 | |
| Transport | | | | | 0.5 | $18.61 \ \overline{2}/$ | 0.35 | 0.70 | 93.32 |
| Application | | | 2.0 | | 2.0 | 37.82 <u>3</u> / | | 0.10 | |

^{1/} Based on ex-factory prices as of April 1, 1982 plus distribution cost of about 7% plus inflation of 20% over 8 months. The ex-factory prices used were Rs2,125/ton (sulphate of ammonia); Rs2,415 (triple super) and Rs2,265 (muriate of potash).

^{2/} Cost per ton from distribution point to plantation.

^{3/} See Table 10 Sheet A footnote 2/.

^{4/} See Table 10 Sheet A footgote 3/.

^{5/} See Table 10 Sheet A footnote 4/.

japot employed by letge employers. sellids for SC. Coas of sentence deline and some as a Co. Co. and many are for some as the some sellids over it months at 101 per part gives he cold for contract of the sellids of sellids 6/ based on The industries Relations Act, 1973 Covernment Motice No. 281 of 1981 pare 3(a), Tiret Schodule Group 32 and 5% for drivers Grade 31 which quotes Rel, 193, 193, 193

.1.0 and at behalon of themogen rodal belified to men of drink insmoques 31 1.0 aved of bemass at rodal lik \tilde{L}

bossipje excebtion of cutting and loading.

yields which are intermediate relative to the 5 to 30 espent and 100 plus expent planters on the one hand and the 0.01 to 1.00 arpent group on the other the 1.00 arpent planter planter planter bally almost exclusively on family labor with an excention of recting and the 1.00 arpent planter ballo plante to rely almost exclusive and localization. optrating 5 argants or less can generally avoid hiring persastent labor by and letter to their sold state or their sold feath and to the sold the sold sold control of their states or their states and their states on the other states and their states and their states and their states and their states of the sold their states and their states are sold their states and their states and their states are sold their states and their states and their states are sold their states and their states and their states are sold their states and their states are sold their states and their states and their states are sold their 2) Planters uperacing 20 arpents or more generally have to captuy some permanent labor for which they are obliged to pay legislated levels of resunctation. Planters

> El Zetlasted as, follows e.g. 166 planters pay Radon giving total coat Saids, 600 for total digible A giving average cost of Re91.06/A. .A/dc. fffer " to 020/Afd. (ging sport sensor sand sport source sensor s

| 14 A\#1003 28416VA | Total Coat b | Nos. Planters # | \a A 1410T | Average 51se | AnthioH le sile | -1 |
|--------------------|---------------------|-----------------|------------|---------------------|-----------------------------|-----|
| 95.565 | 119,161 | 494,01 | 02.8 | A £4.0 | A 66.0 - 10.0 | |
| 11.11 | 846,244 | VIZ'EL | 115,0 | A 25.5 | A 66.4 - 00.1 | |
| 11:12 | 111,11 | 15272 | 3,020 | A 12.8 | A 66.61 - 00.8 | |
| 54.62e# | 6€1, 8∂£ = # | 961,48 | 19179 | | | |
| Average Coate/A 6/ | 1d Jaol jajoT | Non. Planter. | A IASOT | and sansak | Size of Holding | .11 |
| 40.76 | 604,201 | † 97 | 880 1 | 1 12 05 | | |
| 07.51 | 30,400 | 15 | 859"1 | 4 52.9E 4 12.516 | 20.00 - 99.99 A | |
| 91.0 | 007 3 | 1Z | 110,11 | | 100.00 + Miller Plenters | |
| (1.4 | 134'400 | 366 | (10,61 | | | |

grouped together. The transport coats about represent average per atpant (A) coats and are derived se fullows for

If Transport of tractor to and from the field in tharged for at a flet rate of Ra400. However, each farmer is charged a minimum of Ra100 when several farmers are

gociffy intron 0.4 12 99.59 40[[#13 # 1037#75 -00.011 0.1 01.0 \$6.0 16.66 Stoos bick - 1450F /E 37'23 0.8 de mint wortuit 0.1 00.616 25.66 01.0 \$6.0 gesb cip be 2.0 945,00 0.5 \$6.0 07.0 93.33 dd Tioganant 0.1 01.0 75.16 Alayuni [salayi] (Asilayuni) (atan manu) (atan) (atan) (atan) /¥ 10457) (Spanogeod) (Juanoqao3) (stablas) Exchange 3/ /(100g

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11. TYPE OF PRODUCER: 100X miller planters; 1001 owner planters aperating 29.00 A os more.

RECEPT INCLOSE 0.4 /ž 58°2E 2011032 0 2022032 -00.011 0.1 0" 1 \$5.0 01.0 25.54 Blone pick - labor 0.8 /₹ 58°EC ō.s 01.0 EULTON TOTS DE 0.£ 00.216 o. t \$6.0 ZE-64 de qin qasi 01.0 \$5.0 00.646 25.58 07.0 30 SloquestT /i tl' 65 \$5.52 01.0 (solph) (bellingend) (avab nasol) (avab nas) (sonf) (sound) (3 lou\all) (10000) (Yadal) (Cosponesc)

1. Type ny skoducygi 1001 owner plenters operating 0.01-19.99 A; and 1001 of ares hervested by tenant plenters.

Activity is Land Preparation tilvist has readered for any region of the streets and streets (A) and the street and because and becivity Activity 3: Scume Activity 4: Planting

I. TYPE OF PRODUCER: 100% owner planters operating 0.01-19.99 A; and 100% of area harvested by tenant planters.

| | | Phys | ical Inputs/A | | | Financial Cost | Skilled Labor 4/ | Poreign Exchange 4/ | Skilled Labor 5/ |
|------------------------|---------------|--------------|---------------|---------------|---------|-------------------|---------------------|------------------------|---------------------|
| | (Hours) (Tone |) (Man days) | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| Sc ums | | | | | | | | | |
| Quantity | 5.0 |) | | | 5.0 | 10.00 | | ,, | |
| Transport | 5.0 |) | | | 5.0 | 21.19 | 0.35 | ` 0.70 | 93.32 |
| Spreading | | 2.0 | | | 2.0 | 32.85 <u>1</u> / | | 0.10 | |
| Planting | | | | | | • | | | |
| Cane Setts | 4.1 | 3 | | | 4.8 | 157.00 2/ | | 0.30 | |
| Cut & load came setts | | 2.7 | | | 2.7 | 32.85 | | 0.10 | |
| Transport cane setts | 4.1 | 3 | | • | 4.8 | 21.19 | 0.35 | 0.70 | 93.32 |
| Preparation came setts | | 1.0 | | | 1.0 | 32.85 | | 0.10 | |
| Fungicide | | | | 80.0 | 80.0 | 0.31 | | 0.90 | |
| Recruit labor | | | 3.0 | | 3.0 | 17.41 3/ | | 0.10 | |
| Planting labor | | | 7.0 | | 7.0 | 17.41 3/ | | 0.10 | |

II. TYPE OF PRODUCER: 100% miller planters; 100% owner planters operating 20,00 A or more.

| | | | Phys | ical Inputs/A | | Financial · Cost | Skilled Labor 4/ | Foreign Exchange 4/ | Skilled Labor 5/ | |
|------------------------|---------|--------|------------|---------------|---------------|------------------|------------------------|------------------------|---------------------|----------|
| | (Hours) | (Tons) | (Man days) | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| Scums | | | | | | | | • | | |
| Quantity | | 5.0 | | | | 5:0 | 10.00 | | | |
| Transport | | 5.0 | | | | 5.0 | 18.61 | 0.35 | 0.70 | 93.32 |
| Spreading | | | 2.0 | | | 2.0 | 62.46 <u>1</u> / | | 0.10 | |
| Planting | | | | | | | | | | |
| Cane Setts | | 4.8 | | | | 4.8 | 176.00 2/ | | 0.30 | |
| Cut & load cane setts | | | 2.7 | | | 2.7 | 62.46 1/ | | 0.10 | |
| Transport cane setts | | 4.8 | | | | 4.8 | 18.61 | 0.35 | 0.70 | 93.32 |
| Preparation cane setts | | | 1.0 | | | 1.0 | 62.46 1/ | • | 0.10 | |
| Fungicide | | | | | 80.0 | 80.0 | 0.31 | | 0.90 | |
| Recruit labor | | | | 3.0 | | 3.0 | 32.85 3/ | | 0.10 | |
| Planting labor | | | | 7.0 | | 7.0 | 32.85 $\overline{3}$ / | | 0.10 | |

^{1/} See Table 10 Sheet A footnote 2/.

^{2/} Assumes planting material is bought standing in the field of estate, cane nursery or a planter's field. However, many planters use their own cane, but larger planters generally invest more in this input than their small holder counterpart.

^{3/} See Table 10 Sheet A footnote 2/.

^{4/} See Table 10 Sheet A footnote 3/.

^{5/} See Table 10 Sheet A footnote 4/.

Table 1 - Mauritius: Cost of Cane Growing per Harvested Arpent (A) of Virgin Crop and Ratoon Crop by Type of Producer and Activity Sheet D. Activity 5: Weeding - Virgin Crop Activity 6: Weeding - Ratoon Crop

1. TYPE OF PRODUCER: 100% owner planters operating 0.01-19.99 A; and 100% of area harvested by tenant planters.

| | | | Phys | ical Inputs/A | | | Pinancial Cost | Foreign Exchange 4/ | nge 4/ Labor | | |
|---|-------------|---------|--------------------|-------------------------------|---------------|---------|--------------------------------|------------------------------|---------------------------------------|------------------------------|--|
| ACTIVITY 5. Virgin Crop | (Hours) | (Tons) | (Man days) | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) | |
| Labor | | | | 46-00 <u>1</u> / | | 46.00 | 17.41 <u>3</u> / | | 0.1 | | |
| ACTIVITY 6. Ratoon Crop | | | | | | | | | | | |
| Labor | | | | 21.00 1/ | | 21.00 | 17.41 <u>3</u> / | | 0.1 | | |
| II. TYPE OF PRODUCER: 100% mille | r planters; | 100% os | ner planters | operating 20. | 00 A or more. | | | | | | |
| | (Hours) | (Tons) | Phys (Man days) | ical Inputs/A (Women days) | | (Units) | Pinancial Cost (Rs/Unit) | Skilled Labor 4/ (Component) | Foreign Exchange 4/ (Component) | Skilled Labor (Rs/Day) | |
| ACTIVITY 5. Virgin Crop | | | | | | | | • | • | | |
| Labor Herbicide 2/ Machinery 2/ | | | | 46.00 <u>1</u> / | | 46.00 | 37.82 <u>3</u> / | | 0.1 | | |
| ACTIVITY 6. Ratoon Crop | | | | | | | | | | | |
| Labor Herbicide 2/ Machinery <u>2</u> / | | | | 21.00 <u>1</u> / | | 21.00 | 37.82 <u>3</u> / | | 0.1 | | |

^{1/} The virgin crop requires more seeding than the ration crops. Both require about the same labor input for "ordinary" weeds namely 17 women days but for "special" weeds (Cynodon dactylon and Cyperus rotundus) the virgin crop requires about 29 women days and the ration crops about 4 women days per A.

^{2/} The estates use modern herbicides such as "Round up" but detailed costings and physical inputs are not available.

^{3/} See Table 10 Sheet A footnote 2/.

^{4/} See Table 10 Sheet A footnote 3/.

Table 1 — Nauritius; Goet of Gene Growing per Harvesetch Arpent (A) of Wirgin Grop and Macoon Grop by Type of Producer and Activity and Piting b Activity is Transformed and Loading Activity is Transport of Gene Activity 9: Transport of Cane

| /11 | (Boure) | (enoT) | Phys (Men day) | A\asuqui (acal inputa) | (mapecified) (uniten) | Internative to the section of the section (section is a section in the section is a section in the section in the section is a section in the section in the section in the section is a section in the s | 20497 70464 70464 70464 | Voreign Exchenge (Component) | 49(1/9) 49(1/9) |
|------------------------------|---|---------------|-------------------|------------------------|-----------------------|--|----------------------------------|------------------------------------|--------------------|
| #300 <u>0</u> 0 | CROP | | | | | | | | |
| liq & galdee | eqora 11A | | | 1.11 | | 15.71 | | 1.0 | |
| haof A gall! A 69,91 - 60 | Mirgin Grande Salaon | €.5€ | 10.1 | | | 28.50 | | , 0 | |
| | Virgin Petita Salson | 28.3 | 10-1 | | | 50.26 | | 1.0 | |
| | nousea sel | 5.75 | 10.1 | | | 20.50 | | 1.0 | |
| | - Puz | 3.25 | 10.1 | | | 28.50 | | 1.0 | |
| | - 616 - 414 | 0.25 | 10.1 | | | 28.56 | | 1.0 | |
| | _ 415 _ 419 | 34.6 | 10.1 | | | 20.50 | | 1.0 | |
| | _ 419 | 4.45 | 10.1 10.1 | | | 28.55 | | 1.0 | |
| | _ Jap10 | 23.6 | 10.1 | | | 28.5C 28.5E | | 1.0 | |
| 10 | - · · · · · · · · · · · · · · · · · · · | | | | | | | 1.0 | |
| ¥ 66-7 - 10 | Virgin Grande Salson | 9. AE | 10.1 | | | 28.SE | | 1.0 | |
| | Virgin Petite Salann | 5.05 | 10.1 | | | 20.50 | | tro | |
| | necsal sai | 0. es 6.1s | 10.1 10.1 | | | 28.56 | | i.o | |
| | . p16 | 9.92 | (0.1 | | | 20.5E | | 1.0 | |
| | 415 | 6.92 | 10.1 | | | 28.56 | | 1.0 | |
| | . 415 | 0.95 | 10.1 | | | 88. SC | | 1.0 | |
| | . 419 | 0.95 | 10.1 | | | 89.55 | | 1.0 | |
| | . 39910 | 3.25 | (0.1 | | | 20.55 | | 1.0 | |
| \10ens) 10 | Dasias sbesto nigity | 4.02 | 10.1 | | | ₹8.5€ | | 1.0 | |
| elentere - | Virgin Petite Sateon | 8.45 | 10.1 | | | 20.5E | | 1.0 | |
| | 14t Katoon | 8.65 | to. t | | | 28,50 | | 1.0 | |
| | 2nd | 32.4 | 10-1 | | | 20.56 | | 1.0 | |
| | - 616 - 419 | 21.9 | 10.1 | | | 28.55 | | 1.0 | |
| | - 475 | 2.15 | 10.1 10.1 | | | 28.50 | | 1.0 | |
| | " 419 | 6.15 | (0.1 | | | 20.5E 20.5C | | 1.0 | |
| | - 30pto | 8.05 | 10.1 | | | 28.5E | | 1.0 1.0 | |
| 3 10 120000 | • | | | | | | | ••• | |
| 00.01 - 00.09 | Vicgin Grands Salson | 2.50 | | | | v. 16 | | | |
| | Virgin Petite Saloon | 26.3 | | | | 61.15 | 26.0 | 7.0 | 09-67 |
| | lat Retoon | 5.15 | | | | 61.15 61.15 | 26.0 26.0 | f.0 f.0 | 08.64 |
| | _ P ^u Z | 3.25 | | | | 21.19 | 66.0 | (.0 | 08.64 |
| | . rat | 25.0 | | | | 61.15 | 25.0 | 6.0 | 08.67 |
| | . 415 . 419 | 34.45 | | | | 61.15 | 26.0 | 1.0 | 09-67 |
| | _ 439 | 34.45 | | | | 21-19 | 26.0 | 1.0 | 08.63 |
| | . Japio | 6.65 | | | | 21,19 21,19 | \$E.0 \$E.0 | 1.0 1.0 | 08.64 |
| | | | | | | | **** | 1.0 | 08.64 |
| V 66' V - 10 | Virgin Crande Saleon | 6.4E | | | | 31.19 | 26.0 | .1.0 | 08.67 |
| | Virgin Petita Salson lut Ratoon ? | 5.0£ | | | | 61.15 | \$6.0 | 1.0 | 08.63 |
| | Z Puz | (·/Z | | | | 21.19 | 26.0 | 1.0 | 08.64 |
| | . P ³ E | 9.92 | | | | 21,19 21,19 | 2E.0 2E.0 | 7.0 | 08.64 |
| | - 41 4 | £.9Z | | | | \$1.19 | 26.0 | 1.0 | 08.64 |
| | - 416 | 0.05 | | | | 21.19 | ££.0 | 1.0 | 08.64 |
| | _ **P[# _ 419 | 0.85 \$.65 | | | | 21.19 | 25.0 | 7.0 | 08.64 |
| - | | A | | | | 21.12 | 26.0 | 1.0 | 08.64 |
| 304023 \$(| Virgin Granda Salaon | 30.4 | | | | 61,15 | \$6.0 | 1.0 | 08.64 |
| . Dianteta | Wirgin Petite Saloon | 8.45 | | | | 61.15 | , se. o | 7.0 | 08.67 |
| | 0001#H 1# | 23.0 | | | | \$1.19 | 26.0 | 1.0 | 08.64 |
| | - puz | 4.52 - | | | | 81.15 | \$5.0 | į, o | 08.64 |
| | . 417 | 2.15 | | | | 21.19 | 20.0 | ۲. ₀ | 08.64 |
| | . 425 | £.12 | | | | 91.15 | 20.0 20.0 | (.a | 08.64 08.64 |
| | 419 | 2,12 | | | | 61,15 | 26.0 | 6.0 | 08-67 |

Activity 8: Cutting and Loading Activity 9: Transport of Cane

II. TYPE OF PRODUCER: 100% miller planters; 100% owner planters operating 20.00 A or more.

| | | | | | Phys | ical Inputs/A | , | | Financial Cost | Skilled Labor | Poreign Exchange | Skilled Labor |
|----|-------------------------------------|-------------------------------|---------|--------|------|---------------|---------------|---------|-------------------|------------------|---------------------|------------------|
| | | | (Hours) | (Tons) | | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Re/Day) |
| AC | TIVITY/ | | | | | | | | | | | • |
| | PRODUCER | CROP | | | | | • | | | | • | |
| 7 | Teaching (-411/ | | | | | | | | | | | |
| • | Trashing & piling/ all producers | All crops | | | | 11.7 | | | 37.82 | | 0.1 | |
| | arr producers | ALL CLOPS | | | | •••• | | | 37.02 | | 0.1 | |
| 8 | Cutting & loading | | | | | | | | | | • | |
| | 20.00 - 99.99 A | | | | | | | | | | | |
| | | | | | | | | | | | _ | |
| | Virgin | - Labor | | 33.9 | 0.65 | | | | 62.46 | | 0.1 | |
| | (Grande Saison) | | 0.1 | 33.9 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | Virgin | - Labor | | 29.5 | 0.65 | | | | 62.46 | | 0.1 | |
| | (Petite Saison) | | 0.1 | 29.5 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | lst Ratoor | - Labor | | 28.3 | 0.65 | | | | 62.46 | | 0.1 | |
| | 204 " | - Machinery | 0.1 | 28.3 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | 2nd " | - Labor | | 26.7 | 0.65 | | | | 62.46 | | 0.1 | |
| | 2-4 * | - Machinery | 0.1. | 26.7 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | 3rd " | - Labor | | 26.1 | 0.65 | | | | 62.46 | | 0.1 | |
| | | - Machinery | 0.1 | 26.1 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | 4th " | - Labor | | 25.7 | 0.65 | | | | 62.46 | | 0.1 | |
| | | - Machinery | 0.1 | 25.7 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | 5th " | - Labor | | 25.4 | 0.65 | | | | 62.46 | | 0.1 | |
| | | Machinery | 0.1 | 25.4 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | 6th " | - Labor | | 25.4 | 0.65 | | | | 62.46 | | 0.1 | |
| | | Machinery | 0.1 | 25.4 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| | Older " | - Labor | | 24.8 | 0.65 | | | | 62.46 | | 0.1 | |
| | | - Machinery | 0.1 | 24.8 | | | | | 25.00 | 0.35 | 0.7 | 93.32 |
| 9 | Transport of Cane/ | | | | | | | | | | | |
| • | 20.00 - 99.99 A | Virgin GS C.20 | 6 | 33.9 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | GS | • | 29.5 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | lst Ratoon | | 28.3 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | 2nd " | | 26.7 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | 3rd " | | 26.1 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | 4th " | | 25.7 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | 5th " | | 25.4 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | 6th " | | 25.4 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |
| | | Older " | | | | | | | | | | |
| | | orger | | 24.8 | | | | | 18.61 | 0.35 | 0.7 | 93.32 |

Note: FOR OWNER-PLANTERS OPERATING 100 A OR MORE AND ALL MILLER PLANTERS SUBSTITUTE THE FOLLOWING "PHYSICAL INPUTS/A" (tons) DATA IN THE ACTIVITY 8 AND 9 SECTIONS ABOVE.

| 01 | WINER PLANTERS OPERATING 100A OR MORE (tons) | ALL MILLER PLANTERS (tons) |
|---------------------|--|----------------------------|
| Virgin Grande Saise | on 39.0 | 44.7 |
| Virgin Petite Sais | on 33.9 | 38.9 |
| lst Ratoon | 32.6 | 37.3 |
| 2nd " | 30.7 | 35.2 |
| 3rd " | 30.0 | 34.4 |
| 4th " | 29.5 | 33.9 |
| 5th " | 29.3 | 33.5 |
| 6th " | 29.3 | 33.5 |
| Older " | 28.6 | 32.7 |

Table 1 - Mauritius: Cost of Cane Growing per Harvested Arpent (A) of Virgin Crop and Ratoon Crop by Type of Producer and Activity Sheet F. Harvesting - Activity 10: Earthing-up (Virgin Crop only) Activity 11: Road Repair (Virgin and Ratoon Crops)

I. TYPE OF PRODUCER: 100% owner planters operating 0.01-19.99 A; and 100% of area harvested by tenant planters.

| | | | Phys | ical Inputs/A | | | Pinancial Cost | Skilled Labor | Foreign Exchange | Skilled Labor |
|-----------------------------------|------------------|-----------|----------------|---------------|---------------|---------|-------------------|------------------|---------------------|------------------|
| | (H | ours) (To | | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| ACTIVITY/ PRODUCER | CROP | , , | | | | ,, | (,, | , | (555, | (,, |
| 10 Earthing~up/ All producers | Virgin crops onl | w | 7.5 | | | | 32.85 | | 0.1 | |
| | virgin crops oni | , | 7.5 | | | | 32.03 | | 0.1 | |
| ll Road repairs/ All Producers | | | | | | | | | | |
| | All crops | | 2.5 | | | | 32.85 | | 0.1 | |
| II. TYPE OF PRODUCER | | | | ical Inputs/A | | | Pinancial Cost | Skiiled Labor | Foreign Exchange | Skilled Labor |
| ACTIVITY/ | (н | ours) (To | ns) (Man days) | (Women days) | (Unspecified) | (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| PRODUCER | CROP | | | | | | | | | |
| 10 Earthing-up/ All producers | | | | | | | | | | |
| | Virgin crops onl | y | 7.5 | | | | 62.46 | | 0.1 | |
| ll Road repairs/ All producers | | | | | | | | | | |
| • | All crops | | 2.5 | | | | 62.46 | | 0.1 | |

Table 1 - Mauritius: Cost of Cane Growing per Harvested Arpent (A) of Virgin Crop and Ratoon Crop by Type of Producer and Activity Sheet G. Activity 12: Land Clearing

1. TYPE OF PRODUCER: 100% owner planters operating 0.01-19.99 A; and 100% of area harvested by tenant planters.

| | Phys (Hours) (Tons) (Han days) | olcal Inputs/A (Women days) (Unspecified) (Units) | Pinancial Cost (Rs/Unit) | Skilled Labor (Component) | Foreign Exchange (Component) | Skilled Labor 2/ (Rs/Day) |
|---------------------------------|-----------------------------------|---|--------------------------------|---------------------------------|------------------------------|---------------------------------|
| Transport D7 De-rock Cost stope | 7.0 | 1.0 | 59.72 <u>1</u> / 395.00 | 0.35 0.35 | 0.7 0.7 | 93.32 93.32 |

II. TYPE OF PRODUCER: 100% miller planters; 100% owner planters operating 20.00 A or more.

| | Physical | Inputs/A | Pinancial Cost | Skilled Labor | Foreign Exchange | Skilled Labor |
|-------------------------|--------------------------------|--------------------------------|---------------------------|------------------|---------------------|------------------|
| | (Hours) (Tons) (Man days) (Wom | en days) (Unspecified) (Units) | (Rs/Unit) | (Component) | (Component) | (Rs/Day) |
| Transport D7 De-vock | 7.0 | 1.0 | 9.73 <u>1</u> / 395.00 | 0.35_ 0.35 | 0.7 0.7 | 93.32 93.32 |
| Cost stone | ,,,, | | 372100 | 3133 | | |

^{1/} See Table 1 Sheet A footnote 1/.

 $[\]underline{2}$ / See Table 1 Sheet A footnote $\underline{4}$ /.

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

THE LIVESTOCK SUBSECTOR

I. INTRODUCTION

- 25 years ago to 40,000 in 1973 and is now less than 20,000. This has produced an increasing import bill for meat and dairy products which in 1980 amounted to US\$26 million. During the last 25 years, four types of people have engaged in milk production, sugar estates, big cow keepers (milking more than five cows) laborers at sugar estates, and small cow keepers (rural peasants with one to five milking cows and calves). In recent years the first and last of those groups have been the most important. Some of the large sugar estates have been in and out of dairying and more consistently have carried out feedlot beef production.
- 2. FAO dairy specialists reporting on the effects of World Food Program assistance which provided some free concentrate to registered cow keepers during the years 1970-71-72 showed the following yields in kilograms of milk for participating producers:

| | Sugar Estates | Big Cow Keepers | Laborers at Sugar Estates | Small Cow Keepers | Average |
|-----------------------------------|------------------|--------------------|------------------------------|----------------------|---------|
| Yield/cow/year - Yield/305 day | 2,212 | 2,306 | 1,307 | 1,755 | 1,851 |
| lactation No. of cow years | 2,496 | 2,342 | 1,523 | 1,797 | 2,050 |
| recorded | 189 | 54 | 156 | 56 | |

Forty-one cows yielded over 3,000 kg, the highest being 4,557 kg, in a lactation. Concentrate feed averaged only 1.6 kg per cow per day but the report purports to show a yield increase of about 50% by the second year of operation from cows receiving the concentrate compared to others.

- Government established a milk marketing authority in the 1960s to provide a guaranteed market for producers and a more uniform, better quality product to consumers. The small milk peddlers who have marketed smallholders' production for many years increased their farm gate price and the central marketing authority collapsed from shortage of supplies. Now some sugar estates market small amounts to urban areas but sell mostly on the estate. Other producers sell to milk peddlers or are producer/retailers. The peddlers are variously described as providing a useful service at reasonable cost or as parasites who squeeze the producer, pay him irregularly, and adulterate the milk before sale.
- 4. Farm gate milk prices vary from Rs 2.5 to Rs 3.5 per liter depending on proximity to market. Imported milk powder retails at Rs 12 per pound which will reconstitute to about 4.5 liters. The Animal Production Division of the Ministry of Agriculture (MOA) calculated the cost of production by a smallholder of one liter of milk to be Rs 5.36.

The production parameters used were lactation yield of 987 liters in 210 days with a calving interval of 15 months.

- 5. Cattle breeds found in Mauritius are:
 - Creole, a Bos taurus breed of predominantly white cattle imported originally from France to act as draft animals on sugar estates. They are large dual purpose (beef and dairy) animals.
 - breeds imported from New Zealand, Europe and Kenya either as young stock or semen over the last decade. These importations were Friesian, Hereford cross Friesian, Simmental and Sahiwal.
 - Zebus imported from the Africa mainland mainly of the Boran type. These are kept on rough grazing for meat and draft steer production.

In 1974 GOM imported 1,350 Friesian and Hereford x Friesian cattle from New Zealand, and a further 275 Friesian heifers in 1976.

- 6. Milk production in 1980 was reported to be 6 million liters from 6,000-7,000 cows and made up only about 10% of total milk supplies the balance coming from imported powder or "long life" whole milk.
- 7. The small specialist beef industry is of recent origin and mainly run by two sugar miller/planters who have some spare grassland and operate feedlots using sugar by-products. The total beef herd is about 7,500 head and 500 tons of carcase beef was marketed in 1980. About 3,800 tons of beef was imported, mainly as live cattle, during that year.
- 8. The Mauritius Meat Authority (MMA) has responsibility for price regulation which it allegedly bases on elaborate costings. In practice, the price is largely governed by the import price of cattle. Currently, slaughter stock are imported from Australia and butchers pay importers (at present there is only one) Rs 18.75 per pound carcase weight, that price includes 5% stamp duty soon to be increased to 12%. The price to butchers for locally grown carcasses is Rs 18.15 per pound. The MMA's recently updated estimated of local production cost of feedlot finished first grade animals is Rs 19.28 per kilogram liveweight. At an estimated killing out percentage of 53 that would equate to about Rs 16.5 per pound of carcase.
- 9. Sheep and Goats. About 60,000 goats are kept by smallholders with three or four head each. As in most African countries, goats are frequently slaughtered for family consumption and only about 175 tons of goat meat is marketed annually against an imported volume of 2,000 tons. Goats are not milked despite MOA's imported Anglo-nubian breed, which is dual purpose, being very much in demand. A very few small African sheep are kept.
- 10. Pigs. A modern pig industry has grown up facilitated, like the poultry industry, by the availability of balanced rations using mostly imported ingredients. About 10,000 pigs are slaughtered annually to produce 600-700 tons of pig meat. Pork based manufactured products are still imported but funding has been agreed upon to install a factory from France to undertake local production of these products.

ANNEX 3 Page 3

- Poultry. Modern commercial broiler production is dominated by two large units and amounted to 5,500 tons in 1980. Egg production is practiced much more widely with 10,000-15,000 families keeping some poultry. About 4,000 tons of eggs are marketed annually making the country self sufficient in eggs, as it is in poultry meat.
- 12. Deer. Introduced from Java, the Sambur deer has adapted well to the mountains in Mauritius. There are an estimated 30,000 animals kept primarily for hunting but about 220 tons of venison was marketed on the island in 1980. Several estates are now attempting either deer feedlot fattening, or farming herds on fenced planted pastures. Two year carcase weights off pasture average 40 kg and producers hope to enter the European venison market soon. The island's freedom from epidemic bovine disease would make such trade possible.

II. SERVICES TO THE LIVESTOCK SUBSECTOR

- 13. Division of Veterinary Services. One Chief Veterinary Officer, eleven veterinary officers and thirty technical assistants operate the administration at Raduit which includes a diagnostic laboratory, vaccine production (Newcastle disease and fowl pox) and the artificial insemination service bull stud, and provide services from 16 subcenters throughout the island. About 7,000 inseminations are made annually using 4,000 doses of imported semen and 3,000 doses of local semen. The Chief Veterinary Officer claim the A.I. Service has 75% conception on first service to frozen semen and 60% to fresh semen. Some users reported conception rates being very low, even down to 25%, and it was clear that a major constraint of small cow keepers is long calving intervals. The island is free of the common Eastern Africa epidemic diseases, rinderpest, contagious bovine pleuropneumonia, foot and mouth disease and rabies and there has been no recorded case of anthrax, blackquarter or haemorrhagic septicaemia. Anaplasmosis and heartwater are present and cause no great problem, but could be a danger to introduced susceptible stock. Bovine tuberculosis has been diagnosed in two feedlots and an attempt is being made to eradicate the disease. Brucella abortus has not been diagnosed. Owners are charged Rs 0.05 per dose for poultry vaccines. Drugs are provided free to smallholders. The A.I. service is also heavily subsidized. However, the drug fund was reduced two years ago from Rs 200,000 to Rs 100,000. The Chief Veterinary Officer says his biggest problem is lack of transport and transport operating funds.
- 14. The MOA Livestock Breeding Stations. The cattle imported in 1974 and 1976 went to the stations at Palmar and Richlieu.
- A. (i) Palmar Station extends to 300 arpents and carries about 525 head of cattle of which 325 are mixed zebu breeds kept to produce working oxen, and 200 are dairy animals mostly Friesian. From 100 milking cows, about 60 were in milk at the time of the mission's visit.
- (ii) A flock of 120 breeding goats are Anglo-nubian and others. The pig unit of 75 sows has evidence of several breeds but is mostly Large White Yorkshires. Production from the goat and pig unit appeared satisfactory. The Head of the Animal Production Division stated that the Division intends to increase production of both species and concrete.

foundations for a new pig house had been laid. While goats are sold mostly for breeding, weaner pigs are mainly sold to a cooperative society whose members fatten the weaners bought from Palmar.

- (iii) Young cattle are sold to small cowkeepers at Rs 12 per kg liveweight. The market price is Rs 20-25/kg. Young goats are sold at Rs 13-15 per kilo liveweight which is close to market price. Goat meat retails at Rs 18.20 per pound, well below beef at Rs 26-30 per pound. Weaner pigs from the station sell at Rs 350 each, which is close to commercial value.
- (iv) The station has 15 arpents of leucena leucocephala and 10 arpents elephant grass. In addition to these, cows are fed sugarcane tops in season and 4 kg cow feed (concentrate) per day aiming at an average yield of 8 kg milk per day. The dairy herd were housed continuously on slotted floor concrete pens and looked miserable. In the mission's opinion, management of the cattle is poor as milk yields indicate. Many cattle had lost udder quarters, some were badly grown and poorly developed for milk production. Newly calved cows had udders which showed good yield potential, but that potential was quickly lost.
- (v) There are 300 men on the staff of the station and annual expenditure reported to be several times annual revenue.
- B. (i) Richlieu Station is only 40 arpents in area of which 15 arpents is planted to leucena leucocephala and 11 arpents to sugarcane. It was a crop research station prior to 1974, then housed some of the 1974 importation of cattle from New Zealand. No animals other than cattle are kept at Richlieu. The Ministry's dairy chemistry laboratory is located on the station. At the time of the mission's visit, 430 cattle were carried, of which 234 were breeding cows. The cattle are Creole x Friesian, Creole x Simmental, Friesian and Sahiwal. All are permanently housed in open-sided pens and fed sugarcane tops, elephant grass, leucena, molasses and cow feed.
- (ii) The station sells weaners (140 in 1981) for breeding to small cow keepers at Rs 12.5 per kg liveweight. There is accommodation for a feedlot fattening operation but this is not used as all surplus stock are sold as weaners. Milk yields are again low and the mission thought management was poor. Cattle were hungry and hollow bellied at 9:30 in the morning. They were seriously distressed by biting flies. Again, many had blind udder quarters and displayed uneven growth and development. Employees number about 125, expenditure is estimated to be Rs 4 million and revenue Rs 0.85 million.
- (iii) Research under the guidance of the Animal Production Division is measuring breed diferences in yield, and yield responses to various rations. In the mission's opinion, this work is of little value because yields are below commercial levels, and yield variance attributable to individual abnormalities.
- C. (i) <u>Curepipe Station</u> is the oldest animal breeding unit, built to accommodate cattle in fly-proof byres. Cattle at this station are the country's only pure bred Creole herd, totalling 150 animals of which 72 are

milking cows. Bulk feed is obtained from the Agronomy Division as the station has no land for forage production. Sugarcane tops are fed for four months but Setaria grass forms the main bulk feed. Cow feed concentrate is fed at the rate of one pound per kilogram of milk produced. Average milk yield is 2,100 liters per lactation. Calves on this station are bucket fed; on Palmar and Richlieu, they suckle. Curepipe Station is better managed, cows look well and being free of biting flies, are more contented and produce more milk.

- 15. The MOA Animal Production Division's work includes:
 - performance testing of bulls (growth rate) for subsequent use at the A.I. Station.
 - research into applied nutrition at the animal breeding stations. The work includes use of sugar industry by-products, protein forages such as leucena leucocephala and poultry litter in diets of growing and lactating cattle.
 - advice to the livestock breeding station on livestock husbandry practices.
 - formulation of rations at the Government Livestock Feed Factory.

The Government Livestock Feed Factory is one of three, the others being privately owned. It manufactured 3,500 tons of feed in 1981 of which 1,900 tons was cattle feed, 300 tons pig feed and 1,300 tons poultry feed. The private factories manufacture together about 17,000 tons of feed. The Government factory has 25 distribution points throughout the island and supplies feed to Rodrigues. Their cow feed which includes 30% mollases, 20% maize, 20% bran and 23% cottonseed cake is sold at Rs 2,250 per ton to registered small cow keepers. That item is subsidized by about Rs 500 per ton. Overall, the factory makes a small annual profit or breaks even.

- 16. Performance in the Private Sector. As growth rates and conversion ratios in feedlots are much more satisfactory than milk yields, and the reduction in numbers of dairy cows kept by smallholders is MOA's major concern, the mission visited one large and five small milk producers.
- 17. (i) A dairy unit was started late in 1979 on the miller/planter sugar estate of the Union S.E. Co., Ltd., Riviere des Anguilles. The enterprise had a negative cash flow (or investment) of Rs 1.0 million in 1980, Rs 0.8 million in 1981 and management anticipates a negative flow of Rs 0.5 million in 1982. Cattle, of very mixed genetic make-up, were purchased from smallholders and from Government stations. Many cattle purchased were culls so early yields were expected to be low. By use of imported A.I. the milk potential of the next generation will be much higher. In 1981 lactations averaged 1,500 liters with a calving interval of 12-1/2 months, and 1,700 liters is foreseen for 1982. Milking cows will reach 300 in number this year and steer calves will be fattened. All stock are kept in yards year round and cows milked in an adjacent bail. Calves are bucket fed and calf mortality reduced this year from 20% to 4%.

- (ii) Bulk feed is from sugarcane tops, maize green chop, some grass and poultry litter. Concentrate costing Rs 3,000 per ton is fed at the rate of 1 kg per 2 kg of milk plus 1 kg per cow per day towards maintenance. Cows are yarded according to yield and concentrate is pen fed. Cattle were in only fair condition and at the time of the visit, severely distressed by biting flies. Milk is cooled and packaged in plastic bags, some sold on the estate and 500 liters per day from a retail outlet in Curepipe. Milk is sold at Rs 3.5 per liter, demand was originally weak but is now very strong.
- (iii) The mission feels that only if bulk feed will produce maintenance and 2 kg of milk per cow per day, and annual production per cow reach 4,000 liters would this operation become profitable.
- 18. The five smallholder cow keepers all pressented a similar operation, with one to three cows each, all kept in small houses darkened to discourage biting flies. All marketed milk to their neighbors at prices of Rs 2.0 to 2.5 per liter. Sugarcane tops alone are fed for four months and grass collected from roadsides, waste ground and mountainsides for the rest of the year. They said cow feed is given to newly calved cows but none was seen. All used the A.I. service and said it was sastisfactory, but as the mission was travelling with the Head of the A.I. service that sentiment may not be felt. Their cattle were Friesian or Friesian grades, the owners of four units old women and of the other (the biggest) two sisters aged about 20. Animals were all in good condition and the owners claimed yields of 10-15 liters per day from from the calved cows.

III. MINISTRY OF AGRICULTURE PROPOSALS

- 19. Mr. B. Hulman, Head of the Animal Production Division and his staff see their most urgent task as stopping the decline in national herd numbers. They attribute the declining interest by smallholders to the social unacceptability to young people of cow keeping, and to the low price of imported milk powder forcing the price of fresh milk below the cost of production. They proposed a levy of Rs 1.0 per kg on imported milk powder. That levy would help pay for a suggested subsidy to small cow keepers of Rs 75 per milking cow per month, plus Rs 300 for each calf weaned.
- 20. Senior staff opinions varied on the need for a milk marketing organization. All saw the difficulty in getting sufficient volume of milk to support collection throughout the island in the light of the failure of the scheme started 15 years ago when cow numbers were several times present-day numbers.
- 21. In an attempt to reduce operating losses at the MOA Livestock Breeding Stations, GOM has caused MOA to reduce cattle numbers by 50% recently. The three stations sold 290 weaner calves in 1981 and had a demand for 1,600 but what proportion of this demand is for breeding stock as opposed to slaughter stock, it is not possible to say.

IV. THE MISSION'S PROPOSALS

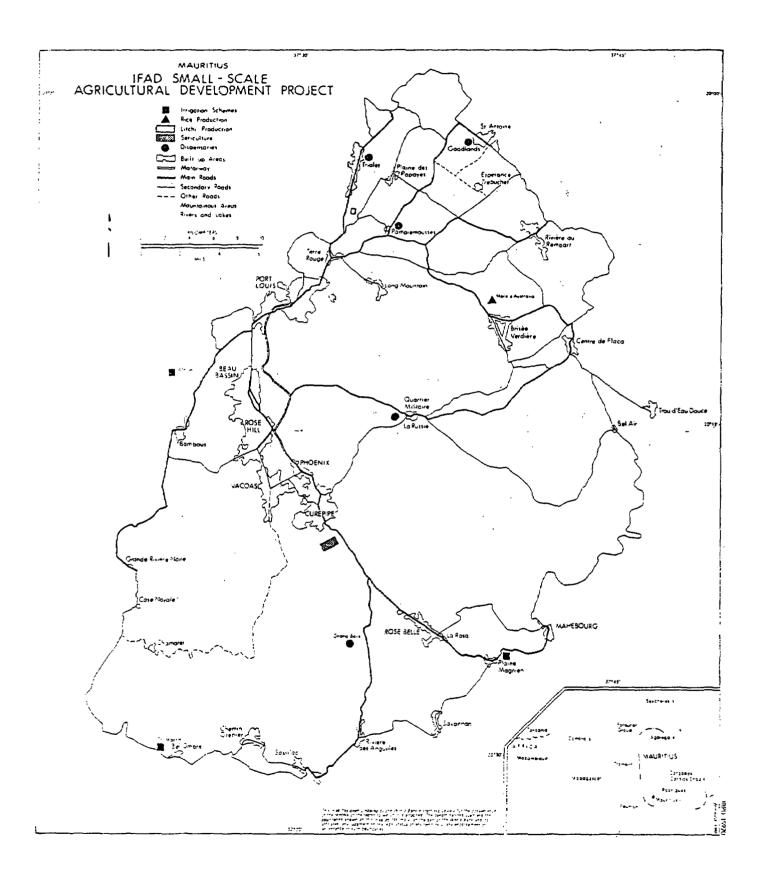
- 22. Because land for livestock is very limited and therefore forage, other than seasonal cane tops, at a premium and most livestock products are imported, livestock production systems with high yields are likely to be most profitable. Similarly, dual purpose breeds of cattle having cows capable of high milk yields under good management are most likely to succeed. All three main cattle breeds on the island, the Creole, the Friesian and the Simmental are very good genetic material with which to pursue such a development strategy, which is no doubt why those breeds were originally imported. The mission believes that average milk yields of 4,000-5,000 liters per cow per annum are obtainable. Only with those yields would cattle keeping in small or large units be economically and financially viable, and limited use of land for forage production be warranted.
- 23. The main constraints to high milk yields are:
 - poor herd mangement and particularly inefficient daily husbandry routine.
 - the extension service has no staff trained in commercial animal husbandry, as no diploma level training is available.
 - presence of high populations of biting flies in the cattle environment.
 - Inadequate knowledge of use of sugar industry by-products in rations for dairy cows.
 - inadequate milk marketing system.
 - unreliable year round cattle food supply.
 - variable A.I. service.

The mission was told that the concentrate feed supply and the A.I. service have frequently been efficient but have not been reliably so over time.

- 24. These constraints would be alleviated by the following actions:
 - students to be trained by working on intensive dairy production farms overseas, e.g., in southeastern USA. Such practical work should be for two years and be an essential precursor to any animal production degree or diploma course overseas.
 - the biting fly problem would receive research priority, the aim being to rid Mauritius of the species. Part of the flies' life

cycle is spent in rotting sugarcane vegetation and this research would be undertaken by the Mauritius Sugar Research Institute (MSIRI).

- the biting fly infestations of livestock herds would be reduced in the short term by use of insecticides. Eartags impregnated with a synthetic pyrethroid and which last for four months have recently been developed in Europe.
- research into use of sugar industry by-products as livestock feed could also be done by MSIRI to take the financial burden off GOM. The work would need an experienced animal nutritionist, and a prerequisite would be a high yielding dairy herd fed on conventional rations.
- the need for a central milk marketing organization and improvements to the reliability of cattle feed supply and A.I. services would be established by a study to be undertaken by consultants. The study would include a review of the role played by the MOA livestock breeding stations and suggest how they can more effectively serve the industry and how they can operate at less cost to GOM.



MAURITIUS AGRICULTURE SECTOR MEMORANDUM

THE TEA INDUSTRY

- Tea planting in Mauritius started in the late 19th century supported by a Government experimental station established in 1895 and by 1920 about 310 Arpents (A) had been planted. A lull followed due to escalating labor costs in the post World War I period but planting was later resumed and by 1950 there were 2,000 A under tea comprising factory estates and small private planters. In 1955, Government initiated a program to encourage further expansion providing crown land leaseholds and subsidies to a group of fifteen medium size farmers (called "project planters") whereby about 3,800 A were planted by 1970. A tea division in the Ministry of Agriculture (MOA) was created in 1964 to assist in the implementation of this project.
- To process the smallholder tea which was being planted Government arranged for two new factories to be built. Chartreuse Factory was built in 1958/59 by the Nuwara Eliya Tea Estates Company Limited of Sri Lanka to process the leaf produced by the "project planters". The factory was sold in 1963 to the "project planters" cooperative, the La Chartreuse Tea Manufacturing Cooperative Society Ltd. The sugar industry decided to help Government with the development of the tea industry and built Dubreuil Factory in 1967 by a newly formed company the Tea Manufacture (Sugar Millers) Ltd. (TM(SM)). The company would process smallholders tea at cost which would include depreciation and interest charges.
- 3. By 1968 Government's targets were in excess of the MOA Tea Division's capacity and Government prepared a plan in 1969 for a Phase II smallholder program and looked to the Bank for finance. At this time there were 8,100 A under tea comprising 1700 A with "project planters", 1200 A with cooperative smallholders, 2,200 A immature tea (maintained by MOA Tea Division) and 3,000 A with six private factory estates and hundreds of small private planters. The Government program at the time of Bank appraisal was to plant a further 13,000 A of tea on crown land between 1971-76 starting with a three year Project to be financed by the Bank.
- The Project was appraised in March 1971 under which a parastatal organization (Tea Development Authority (TDA)) was to be established, 5600 A tea were to be planted to be leased to 3,730 smallholders after a 42 month training period during which they would work for TDA as field laborers and two factories would be constructed to process the green leaf. TDA would be responsible for project implementation and leasing the plots to the trainee smallholders. The Government would construct roads and tea villages in the planting area. The Project became effective on July 2, 1971 was scheduled for completion by June 1977 at a total cost of US\$7 million of which US\$5.2 million would be financed by IDA Credit 239-MAS.
- 5. Project implementation encountered serious difficulties and delays due to shortcomings in project design, deterioration of the economic situation of the tea industry, increase in daily wage coupled with low output and labor disorders, poor accounting procedures and generally poor

management of TDA which brought about political and bureaucratic interference. As a result there was a cost overrun of 300%, the field achievement was only 2572 A instead of 5600 A, only one factory was built and even these lower achievements were not completed until March 1979. Efforts were made to improve matters throughout 1979 and early 1980 but the project was finally closed in July 1980. The Government's commitment to construct roads was only partly achieved (25km out of 60km) and the construction of tea villages was never commenced.

- In June 1974 Government set up a Study Group to examine the 6. estate of the tea industry and to make recommendations. The Group included two representatives from the Bank. The terms of reference were wide including the overall aims of the industry with reference to employment including self employment, diversification, planted areas, output, export earnings, income distribution, world outlook etc. The Group was also to examine the structure of the industry including the functions and relationships of the MOA, the Tea Board, the Cooperatives, the TDA smallholders, project planters and the private sector. The report of the Study Group which was produced in December 1974 emphasized that although because of high wage rates Mauritius was a high cost producer tea was one of the largest foreign exchange earners after sugar and molasses. The principal elements of a short term action program included consolidation of the area under tea, improved cultural practices and higher productivity, intensified extension, plantation rehabilitation and research. The Study Group suggested that the tea industry required the services of two or three Consultants to assist not only TDA but other producers in a systematic review of their problems and in drawing up a program aimed at their resolution. The Study Group did not carry out an economic analysis of the tea industry and nothing in this connection having been done there are still doubts as to exactly what part tea plays in the economic welfare of Mauritius.
- Apart from the problems encountered in the implementation of the TDA project the resultant yields were low, South Africa which bought a large quantity of Mauritius tea at a premium withdrew its support, trainees were not willing to give up their secure jobs with TDA and take over plots and a large number of MOA, DWC and casual workers were now on TDA payroll. The "project planters" finding tea unremunerative due to high labor costs handed back their lands to Government who in turn gave the responsibility to TDA who found itself faced with the problem of rehabilitating abandoned tea and having to run the entire enterprise on an estate basis. With low yields, a costly, undisciplined and low productive labor force, relatively weak management, and low tea prices the inevitable result was a massive drain on government resources amounting to about Rs.60 million per annum. Government set up the Pillay Commission in 1980 to investigate TDA's management, labor and financial problems and propose ways and means of solving them. That commission proposed inter alia the restructuring of management, introduction of accounting and cost control systems, the running of 840 A of TDA tea as a "model" estate which would be mechanized to reduce labor, abandoning unproductive tea areas, merely maintaining the balance with the minimum of inputs and redeploying as much excess labor and staff as possible. The implementation of these recommendations were built into Structural Adjustment Loan I (SAL I).

- The overall achievement of these recommendations has been disappointing for numerous reasons although MOA did manage to redeploy 1318 labor and there was a drop in TDA of 235 due to general wastage. The problem of excess labor, low yields and high operational costs still remains and the new government which came into office in 1982 has again addressed the problem fully appreciating that it cannot continue to subsidize TDA to the extent of Rs.60 million per annum. After discussion within numerous committees Government has decided to move away from the concept of an estate and to restructure TDA along the lines of smallholders as contained in the original Bank project. About 2895 A of tea will be leased to 1500 smallholders over three years. The smallholders will, it is hoped, comprise 1147 TDA employees (trainees and pluckers who are not permanent pensionable employees) plus others who would in any case have to be redeployed plus some outsiders who have applied for plots. Management has been decentralized by moving senior staff to Chartreuse and Belle Rive factories from where they will supervise the relevant smallholder groups attached to each factory unit. Government has appointed a new Mauritian Executive Chairman to control the existing operations and administer the redeployment of labor and staff. The former expatriate Chairman will be offered an advisory appointment (funded under the TA Project) to concentrate on the technical aspects of smallholders, new leaf collection methods, the factory extension program and manufacture with a view to reducing costs and improving standards. Because of the social and political implications the task is by no means easy but it is encouraging that Government is committed to making a meaningful effort and the program has been icluded as a component of SAL II.
- 9. Emphasis is usually placed on TDA when discussing tea production in Mauritius and the private sector, together with a factory run by the Ministry of Cooperatives, is almost overlooked. The green leaf producers comprise private sector plantations, private smallholders, metayers who lease land from Government or TDA. Manufacture or processing is carried out by 4 privately owned factories, 1 owned by the Ministry of Cooperatives (MoCoop), 2 owned by TDA and 1 owned by TM(SM) which processes leaf on behalf of KTDA. The general picture of green leaf production and distribution in calendar year 1982 was:

GREEN LEAF '000 KG

| | | Even | From Metayers | % | ø/ |
|---|--|-----------------------------------|--------------------------------------|-----------------------|------------------------|
| Factory | Throughput | From Estate | and Smallholders | EST | % SHS. |
| Private (30%) | | | | | |
| Bois Cheri Corson La Flora Pont Colville | 4,541.2 1,351.9 1,468.1 661.0 | 2,260.4 99.7 701.9 190.3 | 2,280.8 1,252.2 766.2 470.7 | 50 7.4 48 29 | 50 92.6 52 71 |
| Coop (14%) Nouvelle France | 3,634.0 | - | 3,634.0 | - | 100 |
| TDA (56%) Belle Rive Chartreuse Dubreuil | 1,385.1 5,157.1 8,366.9 | 1,521.9 | 13,287.2 | 10 | 90 |
| | 26,565.3 | 4,774.2 | 21,791.1 | 18 | 82 |

- (a) The Private Companies produced 30% of the country's tea using 40.5% of their own leaf and 59.5% smallholders/Metayer leaf.
- (b) The Cooperative Factory Company produced 14% of the country's tea using 100% smallholder leaf.
- (c) TDA produced 56% of the country's tea using 10% TDA estate leaf and 90% smallholder leaf.
- (d) It is anticipated that within 3 years TDA production will rise by 66%, their share of the country's production will be 68% using 100% smallholder leaf.
- 10. Government support to the tea subsector has been limited to the public sector i.e. to TDA through MOA and to Nouvelle France through MoCoop. This is understandable because these two sources produced 70% of the country's tea using almost 100% smallholder leaf. If the TDA improvement plan succeeds Government production will rise to 80% of the total assuming the private sector production to remain static. The cost, however, has been extremely high, Government having injected into TDA about Rs.268 million up to 1979 and a further Rs.226 million up to FY 1982/83. The Government's plan drawn up under SAL II aims at reducing these heavy annual subventions from about Rs.65 million to Rs.24 million while at the same time increasing gross foreign exchange earnings from Rs.47 million to Rs.89 million in a 3-year period. The position can be further improved over the succeeding five years by increasing yields, lowering manufacturing costs and improving the standard of the finished product.

- 11. The Government injections to Nouvelle France factory through MoCoop since the estate and factory were purchased in 1973 have also been considerable. Nouvelle France has loans from Government and MCCB of Rs.10.16m and Rs.1.15m respectively. The Government loan is repayable over 15 years, about half being interest free and the other half carrying 5% p.a. The MCCB loan is for 5 years at 15 1/2% p.a. There is an overdraft of SCB of Rs. 3.6m and at MCCB of Rs.1 m each carrying 17 1/2% interest. The loss in 1980/81 was Rs.2.5m bringing the accumulated losses to Rs.7.2m and similar loss is anticipated for FY 1981/82 bringing the accumulated losses to about Rs. 10m. Although the position has now been reached where Nouvelle France cannot service its debts it is endeavoring to negotiate a loan of Rs. 10m with the KFW Bank of Germany to finance the extension of the factory and installation of more machinery.
- 12. The private manufacturers complain that they endeavor to assist the Mauritian economy by tea production but are now incurring losses for which they get no assistance from Government while the inefficient public sector of the tea industry is heavily subsidized. Not all the private sector is highly efficient however, and in some instances they require guidance. The factory companies have complained for some years that the formula established in 1978 whereby the proceeds from tea sales are apportioned in the ratio of 66% to the grower and 34% to the manufacturer or processor no longer holds good. They allege that losses in 1979/80 were Rs. 6.23 million but the Tea Board after reviewing the matter in 1980 decided to retain the ratio. In 1981/82 despite better selling prices the 4 private factories allege they incurred losses of Rs. 4.6 million while Nouvelle France lost Rs. 2.6m. TDA accounts indicate that their two factories plus Dubreuil lost Rs 12.9 million but this loss was of course subsidized by Government.
- The quality of Mauritius tea is limited by environmental factors and while efforts are continuously being made to improve the end product there is a limit to the price which Mauritius teas will fetch in the export market. The cost of green leaf is controlled by the formula mentioned in the preceeding paragraph but in fixing the formula it has been assumed that any smallholder or metayer must earn from his tea a wage similar to that which he would earn if he was in full employment. The residual 34% is allocated to factories which all unanimously state is insufficient. The cost of green leaf production and factory processing requires detailed examination. In financial terms it does appear that in the Mauritius context where the sales revenue from the end product is inevitably limited and the cost of the raw material, because of social factors, is relatively high the tea industry can never be profitable and may always require a Government subsidy. The tea industry may always show a negative financial return although it is a valuable foreign exchange earner. The foreign exchange costs required to keep the industry going will have to be assessed after which it will have to be determined whether the ratio between the economic cost of resources consumed and the net foreign exchange proceeds is greater or less than 1. The internal taxes and labor opportunities generated by the industry will also hae to be reviewed to assess the economic benefits to the country.
- 14. The new Government appreciates in broad terms the problems of the tea industry and has decided to set up yet another Study Group under the

Chairmanship of the former Chief Agricultural Officer comprising representatives of the Ministries of Finance, Agriculture, Economic Planning, the TDA and the Tea Board. The SAL II appraisal mission when dealing with the tea sector advised the Ministry of Agriculture, Fisheries and Natural Resources that proposed TOR were not sufficiently specific to deal with the numerous problems facing each section of the tea industry. The various studies and commissions which have taken place from time to time, including the PCR and Audit Report of the Bank Project, have commented on the high costs of production relatively low selling prices and asked whether Mauritius can really afford a tea industry. No in-depth economic analysis of the tea industry as a whole appears, however, to have taken place. The new study whou'dl address all the issues leading to the current problems and finally assess the short and long term economic and financial viability of the tea industry in Mauritius. Guidelines were given to the Permanent Secretary of MOA and the Bank was assured that they would be used when briefing the Study Group. Government has accepted that the study is vitally necessary and the Bank has indicated to the MOA that consultancy services could be made available under the Technical Assistance Loan if a request were received.

MAURITIUS

AGRICULTURE SECTOR MEMORANDUM

WATER RESOURCES AND IRRIGATION DEVELOPMENT

I. WATER RESOURCES

Rainfall

- 1. Mauritius receives an abundance of rainfall 1 /, in an average year about 2,000 mm or almost 4,000 million m 3 . But because of the topography of the island and its geographic location there are unusually great variations of the precipitation. The exposure of the mountainous island to southeastern winds leads to much higher rainfall on the southern and eastern slops reaching peak values of 5,000 mm annually, while the eastern and northern coastal lowlands receive only about 1,000 mm (Annex 2, Fig. 1 and 2).
- The frequent cyclones cause an even greater variation of rainfall. While the average data indicate that the island is "well watered", heavy rainstorms alternate with dry periods as exemplified by the rainfall records shown in Table 1. The rainfall measuring station, established by the Northern Plains Irrigation Pilot Project shows that during a seven-year period the annual rainfall varied from a low of 853 mm to a high of 2,689 mm. The differences between the monthly records are exceptionally high. The greatest variations appear in October, with a ratio of 1 to 51 for the driest to the wettest month of October. In December and January this ratio is 14, in June and September only about 2.

Run-Off and Aquifer Recharge

- Large quantities of water run off quickly into the ocean because of the nature of heavy rainstorms, the steep slopes and the short distance to the coastline. On the other hand, generally porous soils permit a quick infiltration which recharges the aquifers. In recent reports and studies of the water resources of Mauritius, the total run-off and recharge of the aquifers have not been reviewed. However, the data given indicate the order of magnitude of the water available.
- 4. The average yearly rainfall has been estimated at 3,962 million m^{32} /. The total surface run-off has not been established, but if we consider the presently utilized surface flows (305.6 million m^3 annually) and the potential for additional surface water development (estimated at about 200 million m^3), we may assume that this represents about half of the

NORTHERN PLAINS IRRIGATION PILOT PROJECT — RAINFALL RECORDS 1973-1980

SCHEDULE 1

| Month | | 1973/74 | 1974/75 | 1975/76 | 1976/77 | 1977/78 | 1978/79 | 1979/80 | Total | Mean | Median |
|-----------|-----|---------|---------|---------|---------|---------|-------------|----------|--------|--------|--------|
| October | | 23.6 | 10.6 | 7.3 | 26.4 | 19.0 | 76.8 | 1.5 | 165.2 | 23.6 | 19 |
| November | | 13.2 | 27.3 | 74.9 | 4612 | 37.2 | 68.7 | 73.2 | 340.7 | 48.7 | 46 |
| December | | 76.8 | 95.3 | 44.0 | 26.9 | 120.0 | 51.9 | 384.5 | 799.4 | 114.2 | 77 |
| January | | 187.2 | 72.6 | 157,7 | 210.0 | 94.9 | 317.6 | 1024.7 | 2064.7 | 295.0 | 187 |
| February | | 160.3 | 143.6 | 262.6 | 229.2 | 57.3 | 226.2 | 47.2 | 1126.4 | 160.9 | 160 |
| March | | 136.3 | 115.0 | 157.3 | 73.0 | 106.5 | 138.3 | 430.8 | 1157.2 | 165.3 | 136 |
| April | | 49.4 | 95.8 | 171.0 | 166.8 | 300.0 | 106.0 | 397.8 | 1285.8 | 183.7 | 167 |
| Мау | | 69.2 | 100.6 | 181.8 | 177.9 | 44.7 | 79.1 | 148.7 | 793.0 | 113.3 | 101 |
| June | | 84.2 | 58.3 | 111.1 | 73.4 | 63,7 | 58.0 | 58.9 | 507.6 | 72.5 | 64 |
| July | | 76.0 | 29.1 | 42.8 | 118.8 | 165.6 | 17.6 | 52.7 | 502.6 | 71.8 | 53 |
| August | ••• | 63.7 | 54.2 | 134.2 | 27.6 | 66.1 | 133.3 | 27.1 | 50ó.2 | 72.3 | 64 |
| September | ••• | 39.1 | 51.0 | 53.9 | 34.7 | 35.5 | 23.4 | 41.6 | 279.2 | 39.9 | 42 |
| TOTAL | | 979.0 | 853.4 | 1398.6 | 1210.9 | 1110.5 | 1286.9 | . 2688.7 | 9528.0 | 1361.2 | 1116 |

existing run-off which may therefore total about 1,000 million m³ per year or 25% of the precipitation. In addition, we know an estimate of the available groundwater potential in Mauritius which could safely be utilized. It amounts to about 12 million m³ annually. Since this estimate main water demand centers, we can safely assume that the total existent aquifer recharge exceeds the estimate several times.

5. With an annual evapotranspiration estimated at 2,300 million m^3 , a rainfall of 4,000 million m^3 and a run-off volume of 1,000 million m^3 , we may conclude that the annual aquifer recharge is about 600 million m^3 , of which, of course, only a part is economically exploitable because of its location and since large volumes probably enter the ocean rather quickly through the permeable coastal soils.

River Basins

- 6. All river basins are quite small. The largest is the basin of the Grand River Southeast covering 166 km 2 , followed by the Grand River Northwest with 116 km 2 (see map).
- 7. Most rivers have flows which average less than $1 \text{ m}^3/\text{s}$ over most of the time. However, sudden increases due to heavy rainstorms occur frequently but very irregularly.
- 8. The total flow of the rivers is difficult to establish because of numerous diversions and tributaries over the whole course of the rivers. Data for some of the main rivers are given in tables included in the Appendix.

^{3/} The Water Resources Development of Mauritius, A Master Plan, June 1981.

9. The water resources which could be developed from surface water have been estimated by SIGMA and SOGREAH 4 / as follows:

Table 2

| River Basin | Average Flow (million m ³ /year) | | |
|---------------------------|---|--|--|
| Grand River Northwest | 97.0 | | |
| Mare-aux-Vacoas | 37.5 | | |
| River du Rempart (West) | 12.7 | | |
| River Tamarin | 25.8 | | |
| Black River | 19.0 | | |
| Chamarel River | 13.0 | | |
| River du Poste | 20.5 | | |
| River La Chaux | 30.5 | | |
| River des Creoles | 96.6 | | |
| Grand River Southeast | 146.4 | | |
| Piton du Milieu Reservoir | 7.3 | | |
| Nicoliere | 4.8 | | |
| River Tombeau | 18.5 | | |
| Springs on Western Coast | 23.5 | | |
| Total | 553.1 | | |

Storage Development

- 10. Surface water storage reservoirs exist mainly in natural basins in the center of the island. The largest reservoir is the Mare-aux-Vacoas which has a capacity of 28 million m^3 serving domestic and industrial water systems and supplying water to the Tamarin Falls and Magenta hydroelectric power stations from where water is channelled to the irrigation schemes in the western coastal area. Additional reservoirs serving the western coastal region are the Mare Longue with 6 million m^3 and the Tamarin Falls reservoir with 2 million m^3 capacity as well as the La Ferme reservoir (12 million m^3).
- 11. The northern region is served by the Nicoliere reservoir (6 million m^3) which receives water from the Grand River Southeast through a canal of about 27 km. The Nicoliere reservoir supplies water to domestic users and the Northern Plains irrigation schemes. Domestic water is also supplied by the Piton du Milieu reservoir (3 million m^3) in the Central Plateau. The adjacent Eau Bleue reservoir (6 million m^3) is serving the

^{4/} Source as in above footnote.

Ferney power station and some small irrigation schemes. In 1928, the construction of the Midlands reservoir was started but later abandoned. If completed, it could supplement the water supply to the Nicoliere reservoir serving the Northern Plains. Also several small private reservoirs have been built, the largest of which are Valetta (2 million m^3) and La Dagotiere (0.25 million m^3).

12. The total storage capacity of these reservoirs amounts to about 65 million $\ensuremath{\text{m}}^3.$

II. WATER DEMAND

Domestic and Industrial Water

13. The water requirements for the various water supply systems have been estimated by SIGMA and SOGREAH (see Table 3), for 1980, 1992 and 2030 under different assumptions for the efficiency of the systems. The Bank's Mauritius Water Supply Project, appraised in October 1981, shows different requirements with about 50 million m^3 in 1980 rising to 62 million m^3 in 1990. In comparison with the irrigation requirements, the present domestic and industrial demand is, however, relatively small. No attempt has, therefore, been made to analyze these different data.

Table 3
Water Requirements of Townships

| | | (mm ³ /year) | |
|---------------------|------|-------------------------|------------------|
| | | | at latest |
| | 1980 | 1992 | (2030) |
| | | 32.85 | 43.2 |
| | | with 75% efficiency | (efficiency 75%) |
| Port Louis | 20 | 40 | |
| | | with 65% efficiency | |
| | | 61.2 | 80.3 |
| | | with 70% efficiency | (efficiency 70%) |
| Mare-aux-Vacoas | 49.6 | 71.4 | , |
| | | with 60% efficiency | |
| Districts: | | | |
| . Southern network* | - | 2.7 | 7 |
| • Southeast | 5.4 | 11.5 | 28.7 |
| . East | 5.2 | 11.2 to 16.6 | 28.8 to 37.5 |
| . Northeast | 1.6 | 3.4 to 5.7 | 8.5 to 12.8 |
| . North | 6.0 | 12.8 | 32.6 |
| TOTAL | 87.8 | 135.6 to 160.7 | 229.1 to 242.1 |

*Mont Blanc network

Irrigation Water

14. Irrigation has been developed in Mauritius over an area of about 16,000 ha as reported by the Irrigation Authority (see Table 4 and 5). Since the requirements differ from year to year, and since the pumping costs have increased in the recent past, the total area irrigated varied substantially over the last few years.

Table 4

MSIRI Survey of Irrigated Cane Lands of Large Planters

Table 5

IA Assessment of Areas Irrigated in Mauritius 1979 (ha)

15. The total area which could be irrigated has been estimated by SIGMA and SOGREAH to reach 21,500 ha (see Table 6).

Table 6
Possible Irrigation Schemes

| Zone | Scheme | Maximum Area | Maximum Requirements (mm/year) | | |
|------------------|-----------------------|-----------------|--------------------------------|----------|--|
| | | (ha) | Runoff | Overhead | |
| | Phase 2 | 2,500 | 53 | 20.6 | |
| Northern | Phase 3 | 1,100 | 23.3 | 9.1 | |
| | Mont Piton | 5,000 | 106 | 41.2 | |
| | River Francoise | 1,200 | 21.6 | 8.4 | |
| Eastern | R. Coignard, R. Seche | 3,500 | 63 | 24.5 | |
| | Plaine Magnien | 1,600 | 28.8 | 11.2 | |
| Upper Western | La Chaumiere | 926 | 22.6 | 8.8 | |
| | La Ferme | 1,220 | 32.1 | 12.5 | |
| | Saint Pierre | 1,220 | 32.1 | 12.5 | |
| Lower | Magenta right bank | 1,330 | 35 | 13.6 | |
| Western | Magenta left bank | 760 | 20 | 7 8 | |
| | Case Noyale | 1,18 <u>5</u> | 31.2 | 12.1 | |
| TOTAL | | 21,541 | 468.7 | 182.3 | |

16. Based on the characteristics of the main regions of Mauritius, irrigation requirements have been calculated relative to incremental yields which are given in Table 7. If these requirements are fully satisfied, the yield in sugarcane, the main crop, is expected to reach 100 tons/ha under overhead irrigation and 88 tons/ha under furrow irrigation.

Table 7
Characteristics of Irrigation Zones

| Zones | Yearly (mm/year) | Peak Months (mm/month) | Rise in Yield (tons/ha) |
|-----------------|---------------------|------------------------|----------------------------|
| Northern Plains | 825 | 125 | 34 |
| Eastern | 700 | 100 | 23.7 |
| Upper Western | 950 | 125 | 41.5 |
| Lower Western | 1,025 | 150 | 44.6 |

17. The total water requirements for irrigation, if all irrigable lands would be watered, are given in Table 6; they would amount to 470 million m³ per year under furrow irrigation and 180 million m³ under overhead irrigation. Because of localized water shortages and the recent progress in developing drip irrigation, the volume of water given for furrow irrigation is a purely theoretical figure. It appears to be more realistic to assume a total demand of less than 180 million m³ per year to meet all irrigation water requirements.

Hydropower

18. Generally, the water demand for the hydroelectric power stations does not conflict with the water demand by municipal systems and irrigation schemes since most stations are located in such places that water can be re-utilized for domestic and irrigation supply after generating power. The La Champagne power station, presently under construction in the southeastern part of Mauritius, would, however, need water from the Grand River Southeast which is until now supplying water to the Nicoliere reservoir. Consultants are now evaluating the optimal distribution between power generation and irrigation, and a decision should be made shortly by the authorities concerned (Central Water Authority in consultation with the Irrigation Authority, and the Ministry of Energy).

III. WATER BALANCES

- Reviewing the data given above, we can see that the present annual demand for irrigation water (about 120 million m³) exceeds the demand of the domestic and industrial sector (about 70 million m³). In comparison with the available water resources, even if we consider only the potential of surface water development (550 million m³) without groundwater development, the total demand could easily be satisfied. Within the next 50 years, however, the domestic and industrial water demand (230 million m³ in the year 2030) will surpass the irrigation water requirements (probably less than 180 million m³ total demand for all irrigable lands). The total demand of both sectors will, however, not exceed the potential surface water development.
- 20. The overall data indicate that Mauritius does not have to fear any serious water shortages. However, they do not show the regional imbalances and the problems which are likely to arise in some areas with less access to water, and where conflicts are apparent and will appear as in the case of the La Champagne power stations, referred to in paragraph 18 above.
- 21. Unfortunately, the available information does not allow to calculate regional water balances. Because of the heavy concentration of the population in the urban areas, the likely population growth and the increasing water demand, such balances would be highly desirable as an important planning instrument. They could also be included in automated geographic information (AGI) systems, presently under consideration as a planning tool for Mauritius.

IV. IRRIGATION DEVELOPMENT

Present Irrigated Area

- The uneven distribution and irregularity of rainfall has lead to the construction of irrigation schemes by private planters to increase sugarcane yields. Of the total cultivated land area of almost 100,000 ha about 16,000 ha are presently under irrigation. No complete survey data are available. The Mauritius Sugar Industry Research Institute (MSIRI) publishes annual surveys or irrigation by large cane planters (with over 25 arpent each) which represents about 90% of the irrigated area (see Table 4). The Irrigation Authority (IA) estimated that in 1979, a total of 16,117 ha were irrigated (Table 5).
- 23. Private irrigation development consists usually of river diversions for which cane planters obtained water rights. Canals, frequently in need of repairs, feed small reservoirs for overnight storage. Most schemes depend, therefore, on river base flows supplemented by some stored water.
- Public irrigation schemes utilize water from the larger storage reservoirs La Nicoliere, La Ferme and Magenta which are connected to river diversions and other reservoirs through relatively long feeder canals. High infiltration losses along these canals are one of the major problems of the systems.

Potential Irrigation Development

- 25. According to the 1975 FAU Land Resources Survey, the land area classified as highly or moderately suitable for sugarcane is 44% of the total amount of suitable land. With irrigation this amount could be raised to 52%. The FAO Survey estimated that "28,000 ha are eminently suitable for full development to irrigated cropping land", including much of the land in the Western Coastal and Northern Plains irrigation schemes.
- 26. SIGMA and SOGREAH, however, assumed for their Water Master Plar (October 1981) that a maximum area of 21,500 ha could be irrigated (see Table 6). If we accept this latest review, we can conclude that in addition to the present 16,000 ha irrigated, about 5,500 ha could be brought under irrigation.

Irrigation Systems

27. Sugarcane is the principle crop under irrigation in Mauritius. In order to reach a target production of 100 tons of cane per hectare, irrigation of various intensities is needed, especially in the northern and western regions. SIGMA and SOGREAH estimated the irrigation water requirements and the rise in yields through irrigation. The results of their studies are given in Table 7.

- 28. The yield increases shown in Table 7 refer to unirrigated crops. A comparison of water requirements for gravity and overhead (sprinkler) irrigation by the same authors is given in Table 6 above. The unusually large differences between the water requirements for the two methods result from the high permeabilities of the volcanic soils which lead to very high infiltration of irrigation water.
- 29. Recently drip irrigation systems have been introduced in Mauritius. While the claims of their success seem to be almost too good to be true, this system appears to be very promising because of potential water savings and easy operation. SIGMA reported on yields in the western region under several systems, stating that 25 to 30 tons/arpent (about 66 tons/ha) could be obtained without irrigation from the 4th ratoon, with overhead irrigation the yield was 42-43 tons/arp (about 102 tons/ha) from the 4th ratoon and 48 tons/arp (115 tons/ha) average over 7 to 8 ratoons. With drip irrigation the yield was reported to have reached over 50 tons/arp (over 120 tons/ha) during the first year and over 55 tons/arp (over 132 tons/ha) during the following years. The water consumption was reported as about equal to the consumption under overhead irrigation.
- 30. Of the total irrigated area of about 16,000 ha about 60% are under overhead irrigation, a percentage which rose gradually while the area under surface irrigation was reduced (see Table 4). The reduction of irrigation in general during the past few years has been mainly attributed to the rising cost of energy. Drip irrigation has been introduced on only several hundred arpent so far, but many planters are reportedly interested in converting parts of their irrigation schemes to drip systems.
- 31. The MSIRI recently entered into an agreement with ODA for a detailed long-term study of the soil-plant-water relationship under drip irrigation. SIGMA designed the drip system for the trial plots.

Costs of Irrigation

32. For most irrigation schemes, the water development and conveyance system (diversion, reservoir, canals or pipelines) represents a major cost element. The difficult topography of Mauritius contributes to the high cost of water development as evidenced by the Northern Plains Irrigation system. Since these works differ considerably from scheme to scheme, they do not lend themselves to cost comparisons. Therefore, cost data as obtained recently are presented only for the field development of various irrigation systems:

| System | Cost (Rs per arpent) |
|---------------------|-------------------------------------|
| Furrow Irrigation | 40,000 |
| Overhead Irrigation | 54,000 (45,000 for field equipment) |
| Drip Irrigation | 18,000 (25,000) |

The costs are for the installation of the various systems, assuming that the fields had been cultivated or prepared for cultivation (1982). The low cost for drip irrigation is quoted from a recent bid by a new company, previous prices were about Rs 25,000 per arpent.

- 33. Operational costs vary considerably, depending primarily on the need for pumping. While several systems utilize gravity pressure for sprinklers, most need to purchase electricity for running their overhead schemes. The cost of some pump systems have been reported to reach about Rs 635 per arpent per year.
- 34. In the absence of a detailed survey, we may thus assume average costs for operation and maintenance of irrigation systems, e.g. labor requirements of about 1 hour per ha and cm of irrigation and depreciation periods of 15 years for sprinkler systems. For drip systems, a useful life of about 5 to 6 years is presently assumed in Mauritius; the labor cost for drip irrigation systems may be about half an hour per hectare per irrigation.

V. ORGANIZATIONAL ARRANGEMENTS

Government Organizations

- 35. The overall control, development and distribution of the island's water resources is the responsibility of the Central Water Authority (CWA). In addition to supplying water throughout the country, CWA also grants rights for the use of water and operates water development works which deliver water to various users, including irrigation districts.
- 36. The Irrigation Authority (IA) was established by the Irrigation Authority Act No. 39 of 1976. As defined in the Act, the objectives of the authority are: (a) to study the development of irrigation and to make proposals to the Central Water Authority for the preparation of schemes for the irrigation of specific areas; (b) to implement and manage irrigation projects in every irrigation area and to do all other acts incidental thereto; and (c) to undertake research into the optimum use of water made available by the Central Water Authority for irrigation.

37. Responsibility for the management of the IA is vested in a board whose members are appointed in accordance with the Act. The IA is composed of head office staff and project staff who are concerned with general management and project implementation and management. The staff is headed by a general manager, seconded from the Commonwealth Development Corporation and entrusted by the board with control of project implementation and of the irrigation schemes' operation and maintenance.

Water Rights

- 38. All surface and groundwater is state-owned. Rights to use water are controlled by a department of the CWA, created under the CWA Water Act in 1971. In some areas water was developed by large planters in the past who claim the right to use existing flows. Subsequently, conflicts arose about water rights among large water users such as sugarcane plantations, sugar mills and hydropower stations. However, existing conflicts do not involve potable water supply.
- 39. All matters relating to water, including investigations of resources, allocation of water development and operation of supply systems for domestic, industrial, commercial and irrigation purposes are the responsibility of CWA, but CWA's management does not fully exercise the authority delegated to it. The CWA Board (the Central Water Board) is under the Ministry of Power, Fuel, and Energy, but in fact, authority and responsibility are not delegated from the Ministry to the Board as is normally done for a parastatal utility. Therefore, decisions on water allocations and rights are reviewed by CWA and then referred to the Ministry for final decision.
- 40. A new water law, drafted in 1982, would strengthen the authority of CWA and consolidate existing fragmentary legislation.

VI. CONCLUSIONS

Water Resources Planning

41. Present data indicate that Mauritius will have sufficient water to satisfy all requirements in the foreseeable future. However, regional imbalances will become more and more apparent which will require water transfers from surplus to deficit regions. Therefore, detailed regional (basin) analyses should be carried out including more detailed investigations of water availability and water needs and the calculation of regional water balances.

The requirements for domestic and industrial water use are presently much less than the water demand for irrigation. Within the coming decades, this relation is likely to be reversed, because of the increasing water demand by industry and the growing population. Consequently, the main focus for water development is expected to be on domestic and industrial supplies. Irrigation water requirements will, therefore, in the future only be satisfied if the main new water development works (diversions, reservoirs and water transfer schemes) are planned with due consideration of these needs.

Water Rights and Charges

- 43. The water legislation needs to consolidate existing fragmentary laws and to strengthen the authority of CWA. This should include the process of allocating water rights to the various users.
- 44. In view of local conflicts over the use of water, a thorough review of existing tariffs and charges is recommended to establish a system of water charges for all users, considering the cost of water development, operation of systems, the value of water to the various users and their ability to pay.

Irrigation Development

- 45. Because of the high cost of water development works, they should be planned and implemented as multipurpose works wherever feasible.
- 46. In the construction of water distribution systems, a trend to drip irrigation is apparent. Although recent cost estimates show an advantage of this system over others, investigations still need to be carried out to establish the competitiveness and best technical criteria for this method or irrigation in Mauritius. MSIRI is just now starting with a major research effort in this field.
- 47. Because of local water shortages and the high cost of pumping, water conservation methods (which may include the conversion of existing schemes to drip systems) deserve priority consideration.

TABLE 2

SIGMA Societe d'Ingenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENSUEL DE LA TOTALE GRANDE RIVIERE SUD EST (EZA)

UNITE=million de m3

MINEE CIVILE

| U | AL | Ł. | , | Q | S | F | S | T | t | н | F | Ł. | S |
|---|----|----|---|---|---|---|---|---|---|---|---|----|---|
| | | | | | | | | | | | | | |

| ANNEE | JĄN | FEV | MAR | AVR | HA1 | JU | JUI | AOU | SEP | OCT | NOV | DEC | TOTAL |
|------------|--------|--------|---------|--------|--------|----------|--------|---------------|---------|---------|-------|--------|----------------|
| 1953 | 10.056 | 3.355 | 4.969 | 3.316 | 11.697 | 12.122 | 11.375 | 7.886 | 2.327 | 3.436 | 2.988 | 7.802 | 83,329 |
| 1954 | 6.757 | 3.212 | 9.875 | 5.660 | 7.143 | 6.223 | 4.459 | 5.702 | 3.708 | 1.396 | 2.520 | 2.493 | 59.229 |
| 1955 | 1.846 | 5.096 | 15.666 | 5.551 | 6.451 | ម. ៦៤០ | 4.551 | 3.615 | 1.827 | 1.656 | 1.072 | 7.711 | 63.607 |
| 1954 | 9.204 | 12.253 | 9.167 | 3.067 | 4.603 | 5,444 | 1.966 | 2.306 | 1.836 | .772 | .480 | 3.800 | 54.980 |
| 1957 | 5.840 | 6.731 | 5.327 | 10.357 | 5.795 | 3.317 | 2.655 | 1.394 | 2.138 | .716 | . 854 | 1.994 | 47.121 |
| 1958 | 4.089 | 10.602 | 25.330 | 11.450 | 5.143 | 2.462 | 4.466 | 5.644 | 2.726 | 2,554 | .912 | .561 | 75,93 9 |
| 1959 | 4.230 | 10.107 | 10.302 | 2.502 | 1.230 | . 300 | 1.102 | 3.591 | 1.399 | 1.602 | 4.607 | 2.308 | 43,448 |
| 1960 | 14.868 | 31.122 | 12,442 | 2.954 | .805 | 2.037 | 1.493 | . ย Ӡษ | 3.850 | 1.307 | .836 | . 375 | 72.928 |
| 1961 | 2.092 | . 793 | 4,355 | 3.778 | 2.176 | 4,767 | 5.342 | 5.075 | 2.770 | 1.587 | 1.147 | 19.778 | 53,459 |
| 1962 | 6.294 | 8.763 | 14.162 | 5.532 | 2.813 | . 5. 010 | 1.877 | 2.810 | 4.402 | 6.879 | 6.015 | 2.010 | 67.376 |
| 1963 | 2.996 | 8.480 | 5.600 | 7.475 | 5.625 | 3,069 | 3.978 | 1.824 | . 790 | 1.722 | 7.595 | 2.762 | 51,775 |
| 1964 | 20.327 | 6.556 | 9.074 | 5,342 | 5.240 | 3.432 | 3.475 | 2.808 | 3.953 | 6.396 | .937 | 1.823 | 69.382 |
| 1965 | 9.750 | 5.088 | 8.906 | 9.439 | 5.419 | 2.300 | 6.787 | 6.074 | 4.163 | 3.799 | 5.645 | 1.845 | 70.021 |
| 1966 | 8.984 | 3.259 | 6.148 | 1.809 | .506 | 4.857 | 4.559 | 3.513 | 3,120 | 1.038 | 1.036 | 8.985 | 47.905 |
| 1967 | 12,045 | 3.201 | 4.755 | 5.435 | 4.708 | 4.315 | 6.821 | 6.046 | 3.846 | 6,126 | 7.797 | 4.218 | 71.395 |
| 1968 | 2.826 | 11.859 | 8.767 | 1,303 | 2.125 | 3.291 | 4.131 | 3.458 | 3.877 | 1.458 | 1.484 | 1.942 | 46.722 |
| 1469 | 1.151 | 5.830 | 3.366 | 10.413 | 6.073 | 1.546 | 5.395 | 5.164 | 2.926 | 1.025 | .646 | 5.901 | 49.404 |
| 1970 | 11.170 | 7.972 | 14.895 | 7.464 | 4.475 | 4.185 | 6.255 | 6.353 | 2.332 | 1.190 | 1.575 | 1.345 | 21.214 |
| 1971 | 1.703 | 11.668 | 3.017 | 7.813 | 4.335 | 3.525 | 5.221 | 3.719 | 1.898 | 1.077 | 1.654 | 1.145 | 42.574 |
| 1972 | 3.215 | 10.916 | 4.441 | 6.732 | 4.096 | 6.625 | 4.351 | 11.073 | 1.828 | 3.919 | 6.753 | 4.664 | 6H.613 |
| 1973 | 9.320 | 11.770 | 11.167 | 4.243 | 4.378 | 5.671 | 5,243 | 7.186 | 4.230 | 1.479 | .601 | 1.236 | 66.551 |
| 1974 | 3.616 | 0.542 | 7.273 | 3.075 | 3.197 | 4.501 | 6.872 | 8,130 | 2.207 | 1,112 | , 557 | . 993 | 49.477 |
| 1975 | 4.853 | 17.453 | 7.837 | 4.452 | 15.630 | 4.744 | 4.422 | 2.070 | 6.355 | 1.270 . | 1.796 | 1.218 | 73.400 |
| 1976 | 3.110 | 14.112 | 5.564 | 6.419 | 7.700 | 7.269 | 3.962 | 4,524 | 3.451 | 2,540 | 1.501 | 2.150 | 62.302 |
| 1977 | 7,065 | 9.201 | 3.050 | 8.781 | 5.265 | 3.092 | 3.205 | 3.005 | 1.654 | 2.169 | .071 | 7.251 | 55.469 |
| 1978 | 9.735 | 3.491 | 9.577 | 14,410 | 4.127 | 4.393 | 4.550 | 4.800 | 1. មួយប | 1.390 | 1,404 | 1.156 | 61.000 |
| 1979 | 5.627 | 12.553 | 10. 478 | 4.436 | 4.480 | 5.200 | 2.673 | 6.297 | 2.654 | 1.160 | . 408 | 12.106 | 60.551 |
| HDYENNE | 6.747 | 9.037 | 6.029 | 6.040 | 5.013 | 4.610 | 4.486 | 4.699 | 2.895 | 2.299 | 2.377 | 4.160 | 61.199 |
| ECART-TYPE | 4.538 | 5,460 | 4.810 | 3.198 | 3.124 | 2.366 | 2.086 | 2,334 | 1.209 | 1.720 | 2.325 | 4.335 | 10.934 |

TABLE 3

SIGMA Societe d'Ingenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENGUEL DU RUISSEAU CHEVRETTES A BOIS CLAIR (E17A) UNITE-million de m3

ANNEE CIVILE

VALEURS ESTIMEES POUR LA PERIODE 1953-1973

| ANNEE | HAE | FEV | HAR | AUR | HAI | , in | וחנ | UGA | SEP | OCT | ИOV | DEC | TOTAL |
|------------|-------|-------|-------|-------|----------|-------|-------|-------|-------|--------|-------|---------------|---------|
| 1953 | 1.063 | . 469 | .803 | .470 | 1.159 | 1.145 | 1.085 | .907 | . 336 | . 437 | .399 | .854 | 9.129 |
| 1954 | .678 | . 432 | 1.043 | .708 | .826 | .756 | . 557 | , 648 | .488 | .209 | .344 | .335 | 7.076 |
| 1955 | . 263 | , 575 | 1.475 | .654 | .661 | .957 | . 598 | .493 | . 268 | . 243 | 154 | .855 - 855 | 7,195 |
| 1956 | 1.038 | 1.262 | .988 | . 432 | .506 | .687 | .279 | .334 | . 259 | .115 | .072 | .446 | 6.499 |
| 1957 | . 689 | .797 | . 673 | 1.021 | .706 | . 442 | . 356 | .202 | . 292 | . 107 | .127 | .264 | 5.675 |
| 1958 | .522 | 1.006 | 1,850 | 1.142 | . 651 | , 357 | .503 | .713 | . 376 | 350 | . 137 | . C 0 4 | . 7.729 |
| 1959 | . 475 | .647 | 1.070 | . 364 | . 186 | . 857 | 165 | . 459 | .210 | .230 | ,539 | .334 | 4,935 |
| 1960 | 1.216 | 1.650 | 1.205 | . 381 | .121 | . 302 | .224 | .126 | . 497 | .196 | .125 | .056 | 6.100 |
| 1761 | . 283 | .117 | .553 | . 462 | .301 | .633 | .684 | . 659 | .385 | . 227 | .166 | 1.610 | 6.081 |
| 1762 | .774 | .918 | 1.400 | , 667 | . 367 | .580 | .265 | .370 | .548 | .693 | . 569 | . 375 | 7.525 |
| 1763 | . 384 | .733 | . 678 | .842 | .637 | . 432 | .531 | . 257 | . 115 | .243 | .763 | , 369 | 6.005 |
| 1964 | 1.265 | .701 | 1.041 | . 657 | . 653 | .460 | . 452 | .390 | .518 | .703 | .141 | .254 | 7.232 |
| 1965 | 1.036 | . 448 | ,772 | 1.025 | .654 | . 324 | .789 | . 789 | . 537 | .532 | .695 | .270 | 0.082 |
| 1966 | .718 | . 437 | .755 | .275 | .076 | 593 | .611 | , 485 | . 403 | .154 | . 150 | .854 | 5.510 |
| 1967 | 1.001 | 431 | .615 | . 691 | .572 | 1,572 | .621 | .760 | .532 | . 609 | .870 | .756 | B.311 |
| 1968 | . 382 | 1.149 | .901 | . 191 | .247 | .417 | .555 | .500 | : 498 | .210 | .211 | . 276 | 5.538 |
| 1969 | . 168 | . 674 | . 464 | 1.121 | .749 | .230 | . 682 | . 677 | . 413 | . t 53 | .096 | . 675 | 6,102 |
| 1970 | 1.146 | .876 | 1.522 | . 678 | .574 | .764 | . 782 | . 794 | . 336 | .174 | .229 | . 198 | 8.274 |
| 1971 | . 239 | 1.092 | . 413 | .752 | .543 | . 469 | . 654 | .520 | . 273 | . 245 | .238 | .168 | 5.645 |
| 1972 | . 426 | 1.120 | , 569 | , 739 | .536 | . 787 | . 582 | 1.174 | . 271 | . 463 | .744 | . ፊቦΒ | 7.979 |
| 1973 | 1.022 | 1.195 | 1.131 | .550 | .579 | .719 | . 604 | . 965 | . 542 | . 219 | .070 | . 186 | 7.790 |
| 1974 | . 197 | .962 | 1.056 | ,725 | .446 | . 443 | . 608 | 1.10년 | . 443 | .171 | .112 | .107 | 6.379 |
| 1975 | .432 | 1.341 | .936 | .701 | 1.211 | . 644 | .702 | . 450 | . 259 | .237 | .169 | .143 | 7.777 |
| 1976 | .328 | 1.545 | . 696 | .802 | 1.231 | 1.134 | . 554 | , 238 | . 615 | .380 | . 299 | ,276 | 8.796 |
| 1977 | 1.091 | 1.023 | . 340 | 1.214 | 1.041 | .569 | .623 | . 532 | . 369 | .323 | .152 | .875 | B 153 |
| 1978 | 1.124 | 056. | 1.550 | 1.741 | .522 | .536 | . 671 | .744 | . 372 | .215 | . 193 | ,258 | 8.547 |
| 1979 | . 499 | 2.665 | 1.424 | . 545 | .645 | . 939 | . 379 | .570 | .300 | .220 | .189 | 1.311 | 9.705 |
| MOYENNE | . 684 | .936 | . 961 | .732 | .611 | . 593 | .524 | .612 | , 404 | 302 | . 294 | . 474 | 7.178 |
| ECART-TYPE | . 161 | . 499 | . 370 | . 351 | 4 11 ك - | .259 | .201 | .261 | . 141 | . 175 | , 234 | . 306 | 1.270 |

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TABLE 5

SIGMA Societe d'Ingenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENSUEL DE LA RIVIERE DES CREOLES A RICHE EN EAU (G9) UNITE MILLION de M3

ANNEE CIVILE

| ANNEE | MAL | FEV | MAR | AVR | HAI | , JU | ĮUĮ | AUU | SEP | OCT | NOV | DEC | TOTAL |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| 1955 | 3.937 | 10.304 | 24.906 | 12.658 | 10.239 | 14.376 | 10.030 | 9,294 | 6.185 | 4,192 | 2.328 | 11.885 | 120.334 |
| 1956 | 15.269 | 19,752 | 18.045 | 9.170 | 9.708 | 9.656 | 5.373 | 5.291 | 3.853 | 2.008 | 1.304 | 7.013 | 105.442 |
| 1957 | 18.641 | 11.015 | 14.143 | 16.602 | 10.076 | 7,548 | 4.709 | 3,947 | 4.061 | 2,506 | 0.000 | 6.184 | 91.517 |
| 1950 | 13.301 | 16.240 | 26.186 | 22.243 | 12.240 | 6.940 | 10.879 | 7.546 | 5.708 | 4.800 | 2.562 | 1.648 | 132.293 |
| 1959 | 9.913 | 15,643 | 16.717 | 9.504 | 6.169 | 2.851 | 3,752 | 10,932 | 8.574 | 9.373 | 17.743 | 11.732 | 122.923 |
| 1960 | 22.308 | 19.299 | 31.249 | 10.5% | 4.384 | 9.062 | 6.322 | 4.766 | 11.153 | 7.534 | 4.316 | 2.951 | 133.899 |
| 1961 | 4.458 | 2.443 | 4.471 | 6.663 | 3.463 | 5.409 | 8.750 | 11.224 | 7.337 | 5.445 | 3.122 | 34.150 | 97.935 |
| 1962 | 19.566 | 19.448 | 23.016 | 14.783 | 8.799 | 9,664 | 4.771 | 5.727 | 8.647 | 11.140 | 10.136 | 7.446 | 143.144 |
| 1963 | 9.851 | 10.661 | 16.034 | 15.878 | 10.017 | 11.172 | 11.860 | 4.971 | 2.705 | 2.946 | 16.443 | 6.228 | 119.566 |
| 1964 | 12.579 | B.277 | 12.264 | 8.271 | 9.254 | 7.039 | 4.358 | 4.854 | 4.941 | 5.416 | 3.847 | 2.806 | 83.907 |
| 1965 | 7.320 | 7.869 | 7.687 | 20.727 | 8.829 | á.471 | 5.664 | 9.390 | 6.627 | 5.813 | 7.123 | 3.308 | 98.927 |
| HOYENNE | 11.740 | 12.014 | 17.863 | 13.369 | 8.453 | 8.292 | 6.959 | 7.268 | 6.345 | 5.563 | 6.266 | 8.476 | 113.626 |
| ECART-TYPE | 5.745 | 5.443 | 7.878 | 5.134 | 2.709 | 3.000 | 2.884 | 2.705 | 2.481 | 2.842 | A.030 | 9.108 | /19.232 |

TABLE 6

SIGMA Societe d'Ingenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENSUEL DE LA RIVIERE DES CREOLES A RICHE EN EAU (G9) UNITE-million de m3

ANNEE CIVILE

| ANNEE | HAL | FEV | HAR | AVR | HĄI | JU | JUI | AUU | SEP | OCT | NOV | DEC | TOTAL |
|-----------------------|----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------------|
| 1974 | 4.878 | 15.092 | 13.817 | 5.723 | 0.000 | 0.000 | 10.231 | 10.536 | 6.595 | 2.511 | 1.339 | 1.188 | 71.910 |
| 1975 | 5.685 | 18.507 | 17.631 | 13.262 | 18,554 | 12.668 | 8.977 | 5 .358 | 7.390 | 5.225 | 3.985 | 3.305 | 120.547 |
| 1976 | 4.403 | 20.891 | 13.618 | 12.681 | 16.067 | 16.253 | 9.391 | 0.660 | 6.794 | 4.870 | 3.534 | 3.698 | 122.160 |
| 1977 | 12.990 | 15.403 | 7.265 | 14.584 | 14.444 | 9.211 | 5.276 | 5.368 | 3.653 | 3.956 | 1.967 | 6.638 | 100.755 |
| 1978 | 13.531 | 9,434 | 13.180 | 19.283 | 10.696 | 5.651 | 4.279 | 9.785 | 5.708 | 2.924 | 845.5 | 2.450 | 105.389 |
| 1979 | 10.843 | 16.258 | 18.241 | 13.066 | 11.942 | 12.740 | 6.375 | 8.760 | 8.237 | 2.458 | 2.167 | 13.578 | 124.665 |
| MOYENNE ECART-TYPE | 6.722 4.207 | 15,931 3,851 | 13.959 3.934 | 13.100 4.360 | 12.084 6.607 | 9,507 5,737 | 8 342 2.028 | 8.078 2.214 | 6.410 1.529 | 3.657 1.209 | 2.560 1.001 | 5.143 4.511 | 107.571 19.982 |

TABLE 7

SIGMA Societe d'Ingenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENSUEL DE LA RIVIERE DU POSTE A LA FLORA (J4)

UNITE=million de m3

| ANKEE CIVIL | LI | Iι | V | ţ | I | : | | E | ε | ₹ | ì | Н | A | |
|-------------|----|----|---|---|---|---|--|---|---|---|---|---|---|--|
|-------------|----|----|---|---|---|---|--|---|---|---|---|---|---|--|

| ANNEE | JAH | FEV | HAR | AUR | HA1 | 10 | JUI | AUU | SEP | OCT | שמא | DEC | TOTAL |
|------------|-------|--------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|--------|
| 1955 | . 402 | 8.038 | 9.359 | 4.524 | 5.583 | 10.454 | 3.107 | 2.934 | 1.262 | . 441 | ,236 | 3.110 | 49.530 |
| 1956 | 9.148 | 11.283 | 7.907 | 1.781 | 1.585 | 1.993 | . 658 | . 658 | .446 | .141 | .098 | 1.608 | 36.326 |
| 1957 | A.354 | 2.934 | 1.221 | 4.603 | 1.104 | . 829 | . 875 | . 491 | .501 | , 190 | ,203 | .707 | 18.212 |
| 1958 | 2.584 | 6.100 | 9.160 | 6.714 | 1.047 | . 725 | 2.476 | 1.580 | .502 | .942 | .410 | . 178 | 32.418 |
| 1959 | . 654 | 1.785 | 4.397 | 1.379 | . 789 | .350 | 1.011 | 3.958 | 1.400 | 4,423 | 2.513 | 2.133 | 24.992 |
| 1960 | 7.149 | 3.674 | 8.237 | 2.700 | .789 | 2.116 | 1.704 | .019 | 2,501 | .765 | , 473 | .224 | 31.222 |
| HOYENNE | 3.930 | 5.636 | 6.714 | 3.617 | 1.050 | 2,745 | 1.639 | 1.740 | 1.115 | 1.150 | . 456 | 1.327 | 32.117 |
| ECART-TYPE | 3.250 | 3.574 | 3.233 | 2.030 | 1.648 | 3.844 | . 900 | 1.411 | .831 | 1.634 | ,920 | 1.169 | 10.639 |

TABLE 8

SIGMA Societe d'Engenieurs Conseils

SCHEMA DIRECTEUR D'AMENAGEMENT DES EAUX

VOLUME MENSUEL DE LA RIVIERE DU POSTE A LA FLORA (J4)

UNITE-million de m3

ANNEE CIVILE

| ANNEE | JAN | FEV | HAR | AUR | HAI | Ju | Jul | AOU | SLP | OCT | NOV | DEC | TOTAL |
|------------|------------|---------|-------|-------|--------|---------|-------------|-------|--------|--------|-------|-------|--------|
| 1968 | 1.774 | 6,067 | 4.290 | 1.023 | 354 | 1.158 | 2.476 | 1.088 | 1.862 | . 188 | ,286 | .613 | 23,179 |
| 1969 | ,233 | 2.135 | . 699 | 2,318 | 1.424 | .746 | 2.871 | 1.376 | 1.177 | ,209 | .050 | 1.173 | 14.409 |
| 1970 | 5.590 | 3.506 | 5.851 | 4.200 | 1.632 | 1,985 | 2,134 | 2.670 | . 758 | . 159 | .187 | .150 | 29.021 |
| 1971 | 1.343 | 4.482 | 1.604 | 3.130 | 1.110 | 1.190 | 2.441 | 1.143 | . 475 | .297 | .438 | .120 | 17.773 |
| 1972 | .774 | 3.169 | 2.449 | 3.791 | 1.294 | 2.798 | 1.276 | 3.924 | .339 | . 785 | 3.074 | 2,260 | 25.931 |
| 1973 | 5.353 | 4.305 | 4.535 | 1.930 | 1,763 | 2:064 | 1.905 | 2.785 | 1.472 | ,291 | .043 | . 059 | 28.512 |
| 1974 | .597 | 2,723 | 2.279 | .350 | .576 | 1.336 | 1.056 | 3.013 | . 539 | . 106 | .033 | .084 | 13.501 |
| 1975 | . 688 | 6.963 | 2.611 | 1,410 | 4.533 | 1.303 | .875 | 1.041 | 1.651 | .298 | .663 | .198 | 22.243 |
| 1976 | , 552 | 4.775 | 1.008 | 2.975 | 3.394 | 3,220 | 1.349 | 1,885 | .590 | . 436 | . 137 | 1.006 | 21,408 |
| 1977 | 2.609 | 2.202 | .923 | 3.241 | 2.542 | 1,218 | 1.234 | 1.091 | . 365 | ,556 | . 160 | 2.259 | 18.400 |
| 1979 | 3.854 | **5.012 | 2.930 | 3.670 | 1.00.0 | 1.176 | 1.521 | 1.712 | . 531 | . 260 | .221 | .163 | 18.354 |
| 1979 | 1.200 | 4.079 | 3,943 | 1.470 | 2.040 | 2.050 | , 925 | 2.402 | . 9110 | , 196 | , 144 | 3.238 | 22.864 |
| 1,,, | 1 . 2. 017 | 7.077 | 3,743 | 1.30 | 2.00 | 2.000 | , , , , , , | C | | , | | | |
| HUYENNE | 2.054 | 3,954 | 2.933 | 2.479 | 1.010 | - 1.689 | 1.739 | 2.017 | .911 | .315 | 453 | .944 | 21.300 |
| ECART-TYPE | 1,090 | 1.843 | 1.867 | 1.245 | 1.193 | .745 | . 646 | . 945 | . 526 | . 1.92 | .845 | 1.082 | 5.025 |

