

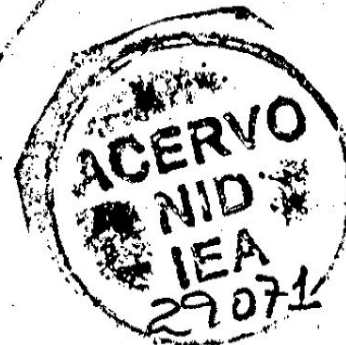
THESIS

INDUSTRIAL MONOCULTURE
VERSUS FOOD CROPS

SOME ECONOMIC OBSTACLES TO THE
PRODUCTION OF FOOD CROPS IN THE
PIRACICABA ZONE, SAO PAULO, BRAZIL

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INDUSTRIAL MONOCULTURE VERSUS FOOD CROPS

Some Economic Obstacles to the Production of Food Crops
in the Piracicaba Zone, Sao Paulo, Brazil

A Thesis

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To my parents

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I

INTRODUCTION

Introduction

The commercial sector of Brazilian agriculture was developed largely through the expansion of one or two crops which had their major markets outside of Brazil. These crops were first sugar and later coffee; most of the agricultural infrastructure of the country evolved from attempts to resolve the problems of channelling the products of monocultural agriculture to the world markets. In more recent times, with the development of a stronger internal market for agricultural products, originating from rapid population increases and industrial growth, the agricultural sector has adapted itself to supply this internal market. Faced with the many difficulties in revising the old system based on exportation, agriculture has not yet been responding efficiently to the increasing internal demand.

If supply and demand are analyzed from an aggregate point of view, the agricultural sector in the state of Sao Paulo apparently has been more responsive than that of the rest of the country and it seems to be reacting more favorably to the increasing demand for agricultural products. However, an analysis of several aspects of the agricultural sector shows a number of specific problem areas.

When the price indices for industrial crops in Sao Paulo are compared with the general price level for the country, it can be seen that they both have grown at about the same rate; at the same time,

the price indices for the two principal basic food crops in the state, rice and beans, show a significantly greater increase when compared with the general price level. To illustrate, the price paid to producers of rice (in index numbers) rose from 99 in 1948 to 3,585 in 1963, and the price of beans for the same period rose from 135 to 3,535; over the same time period the general price index for the country rose from 80 in 1948 to 2,115 in 1963. (Table 1)

If, however, the aggregate price index for agricultural products is analyzed, it does not show such a great increase. It rose from 74 in 1948 to 1,956 in 1963 or a little less than the general price level. Apparently, this lesser increase was caused by the inclusion in the aggregate price index of the agricultural products for export and for industrial raw material, the prices of which did not increase so greatly. The case of coffee, the major export product of Sao Paulo, illustrates this fact. Its price index rose from 53 in 1948 to 1,492 in 1963. The inclusion of export crops in the aggregate price index for agricultural products tends to make the increase appear to be only the result of the inflation which has been occurring in Brazil for decades. The more detailed analysis, however, indicates some increase in the prices that apparently are caused by factors other than the inflationary process.

Most economists in Brazil claim that this rise in prices was, among other things, a consequence of the "moving" characteristic of Brazilian agriculture. The history of Brazilian agriculture can be described as a continuous search for fertile land. Because of the expansive nature of the country, farmers would use a piece of land until

TABLE 1. PRICE INDICES FOR AGRICULTURAL PRODUCTS,
STATE OF SAO PAULO, BRAZIL, 1948-1963 1/

(1948/52 = 100)

Years	General Index of Agr. Prod. (24 products)	Coffee	Rice	Beans	General Price Index Brazil <u>3/</u>
1948	74	53	99	135	80
1956	259	272	339	442	254
1957	283	282	387	414	290
1958	282	205	481	281	329
1959	370	230	524	987	454
1960	516	309	575	1,157	585
1961	726	426	701	950	803
1962	1,198	739	1,980	3,264	1,218
1963	1,956	1,492	3,585	3,535	2,115

1/ Indices calculated from "average prices received by farmers."

2/ Preliminary data.

3/ Based on Index "2" of Conjuntura Economica.

Source: Divisao de Economia Rural.

its fertility was almost exhausted and then move on to more fertile areas. This attitude caused the agricultural "frontier" to be continuously pushed further from the market centers,^{1/} increasing transport costs which are reflected in the price of agricultural products.^{2/} In the older areas, productivity has declined because few attempts have been made to maintain fertility, with the cost per unit of agricultural product working toward raising prices.

It is generally accepted that as a country enters the stage in development of industrialization and urbanization, there will be an increasing need for a responsive agricultural sector; not only to supply the necessary raw materials for the industrial sector, but also to produce food products at low prices and of good quality for the increasing demand created by the growing urban population. If food is supplied at low prices, real wages can be kept lower than otherwise, and profits will increase, creating more incentive for investment; all of which facilitate the industrialization process. The continuous increase in food prices in the more industrialized areas of the country would seem then to create a problem in the overall development of Brazil.

^{1/} The case of coffee is quite illustrative in that coffee has moved from the areas surrounding Rio de Janeiro to the north of the state of Parana, leaving behind immense areas of badly eroded soils.

^{2/} Although this argument may seem a little ambiguous since the price indices are for price paid to producers, which would indicate that transport cost should not influence the producers' prices because it is not a production cost, there is an indirect influence in production costs caused by the increased cost of transportation. The greatly increased demand for food in Sao Paulo due to the industrialization and urbanization occurring there has surpassed the present production of the state's agriculture and so more and more food must be brought in from other states. Therefore, the price paid to Sao Paulo producers is approximately equal to the price paid to producers in other states plus the transportation cost.

It is important to understand that it is not the intention of this study to suggest that the state of Sao Paulo should be self-sufficient in agricultural products. The reason being that as development proceeds in Brazil, commerce among Sao Paulo and the other states will increase as each region becomes more efficient and specialized.

To study the possibilities of increasing food production in the state of Sao Paulo, an agricultural area in the state of Sao Paulo which is industrialized, densely populated, and specialized in the production of sugar cane was chosen. There are several important factors relating to the sugar industry which indicate the possibility of increasing food production within a sugar cane region: overproduction in recent years has brought government controls limiting sugar production and both low income price elasticities are estimated for sugar. To understand more fully the problems facing the sugar industry, these factors will be explored in more detail in the following sections.

The Federal Government and the Sugar Industry

In 1933 the Sugar and Alcohol Institute, a federal agency which controls all aspects of the sugar industry in the country, was created. It was created as a result of a serious crisis in the Brazilian sugar cane industry in the early thirties, which arose from overproduction, the Great Depression, and competition from the European beet sugar industry. At that time, it was decided that no factories were to be built or enlarged without authorization from the Institute and at the same time an annual production quota system was introduced.

Every year the Institute's Executive Commission^{3/} determines production quotas, taking into consideration domestic consumption, possible exports and necessary adjustments for changes in carry over stocks and obligatory reserves under international agreements. Once the total quota has been approved, the Institute divides the total among the individual factories according to a system based on their highest output during the period 1951/52 to 1956/57.^{4/} The Institute also rules that the mills cannot grow more than 50 percent of their cane requirements, having to buy the other 50 percent from fornecedores.^{5/}

The agency determines the prices of sugar and cane. The price of sugar cane is established for each state producing cane and is supposed to reflect the costs of production as well as sucrose content. In this way the individual fornecedor should receive a price that reflects not only costs of production but also the sucrose content of the sugar cane he supplies. The Institute fixes uniform prices for all mills

^{3/} The Commission is composed of representatives of the Federal Government, the sugar industry and cane producers.

^{4/} International Sugar Council, The World Sugar Economy Structure and Policies--Vol. 1--National Sugar Economies and Policies. London, 1963.

^{5/} According to the law, a fornecedor is any farmer who in cultivating his own land or rented land has supplied sugar cane to a particular mill during three consecutive milling seasons (Decreed Law No. 3,855 of November 21, 1941). After three years of supplying sugar cane to a mill, the fornecedor has automatically gained a quota equal to the average quantity he has furnished during the three years. Throughout this paper, the word fornecedor will be used to refer to such farmers. A recent law passed by the Brazilian Congress establishes that in the case of an increase in the quota of sugar for a mill, the mill will have to buy at least 60 percent of the necessary extra raw material from the fornecedores (Law No. 4,870 of December 1, 1965). This law is not greatly different from the one that was passed in the early forties determining that the production should be distributed as 50 percent for mills and 50 percent for fornecedores.

within a region, although these may differ between regions. The Institute also establishes quotas for refineries supplying the urban markets.

The Institute establishes a levy of 3 percent of the official price of sugar of any type to provide revenue to the Special Exportation Fund, which has been created to repay losses occurred in exporting sugar when the domestic price is higher than external prices. It also charges a number of other levies on the sugar and alcohol produced, as well as on the cane produced by *fornecedores*, for a number of purposes including financing its own operating expenses, financing improvements in the industry, and providing operating capital for *fornecedores'* cooperatives.

The main purpose of the Institute, however, has been to control sugar production to avoid crises originating from overproduction. In general, the Institute's policies have been successful and the best indication of this is the growth and importance of the sugar industry of Brazil. The country today has one of the largest sugar industries of the world and since the sugar industry is based primarily on the domestic market, it is comparatively free of the fluctuations and problems involved in the international trade of tropical agricultural products.^{6/}

Present Conditions and Future Prospects for the Sugar Industry in Brazil

Brazil probably has some of the best conditions for the expansion of its sugar cane industry of any country in the world. There are large

^{6/} In 1965 Brazil produced 4,613,792 tons of centrifugal sugar and exported 818,488 tons (see International Sugar Council, Sugar Year Book, 1965, London).

areas of land situated in regions with a climate favorable to cane production. Soils in these regions are of reasonably good fertility and there are large areas of virgin land that, if put into agricultural production employing modern techniques, should yield well and maintain their fertility. The domestic market is large and growing, yet the country is large enough that it will not feel great population pressures on land for other food crops in the immediate future. Despite these favorable factors for expansion of production, the sugar industry in the country faces several problems.

Of these problems, the two that seem to be the most important are low cane yields and low rates of sugar extraction in the mill. Extraction rates are low in Brazil when compared with other parts of the world. For example, in the crop year of 1961/62 the southern region of Brazil had an extraction rate of 9.57 percent and the northern region had an extraction rate of 9.01 percent;^{7/} both are relatively low when compared with 11.0 percent in Peru, 11.6 percent in Barbados, 12.3 percent in Taiwan, and 10.3 percent in Florida.^{8/} Crop yields in Brazil also are low when compared with other sugar producers in the world. Brazil had an average yield in 1961 of 43.5 metric tons per hectare.^{9/} In the crop year of 1960/61 Barbados had an average yield of 76.9; Florida, 71.2; Peru, 155.1; and Taiwan, 81.7 metric tons per hectare.

^{7/} Martini, Eduardo, O Acucar no Brasil - Producao Procura e Precos (M.S. thesis), Universidade Rural de Minas Gerais, 1964, Vicosia, Brasil.

^{8/} International Sugar Council, op. cit. For these countries the crop year used was 1960/61.

^{9/} I.B.G.E., Anuario Estatistico do Brasil, 1964, Rio de Janeiro.

By combining field and industry productivity, a measure of sugar per hectare can be attained which will make the above comparisons more useful. Table 2 gives data which illustrate the relatively low productivity of the sugar economy in Brazil as compared with other regions of the world.

TABLE 2. SUGAR YIELDS PER LAND AREA,
SEVERAL COUNTRIES, 1960/61

Country	Sugar Yield (Metric tons/hectare)
Florida (U.S.A.)	7.3
Barbados	8.9
Peru	17.0
Taiwan	10.0
Brazil (Northern Region)	3.8
(Southern Region)	5.1

Source: Data on Brazil - Martini, Eduardo, O Acucar no Brazil - Producao Procura e Precos (M.S. thesis) 1964. Other countries - International Sugar Council, The World Sugar Economy Structure and Policies Vol. II - The World Picture, London, 1963.

There is little evidence available to indicate that an effort is being made by producers, either farmers or millers, to significantly increase production efficiency in the immediate future. To increase efficiency would require major investments in the processing plant and in the introduction of varieties with higher sucrose contents. This last factor is probably the most important one and is emphasized by the dictum that "sugar is produced in the field and the processing plant only extracts it."

In the past Brazil has not been very successful in producing varieties of sugar cane, and until recently most of the varieties planted in Brazil were produced in India or Java (the Co. and P.O.J. varieties). Now a series of Brazilian varieties have been introduced and are proving to be quite productive (they are the C.B. series produced at the experiment station located at Campos, Brazil). These varieties, however, were selected primarily for their resistance to disease, not for high sugar content.

In spite of these restraints, sugar cane production has been growing steadily in Brazil. In 1965, the country was the fourth largest producer in the world^{10/} producing 4,613,792 metric tons of centrifugal sugar.^{11/} Table 3 shows the increase in recent years.

TABLE 3. PRODUCTION OF SUGAR CANE IN BRAZIL
FROM 1959 TO 1965

Calendar Year	Production (Metric tons)
1959	3,108,211
1960	3,318,719
1961	3,354,137
1962	3,238,061
1963	3,037,160
1964	3,391,034
1965	4,613,792

Source: International Sugar Council, Sugar Year Book, 1965, London.

^{10/} The first three producers were: Russia, Cuba and the U.S.A. (including Puerto Rico).

^{11/} International Sugar Council, Sugar Year Book, 1965, London.

This growth, however, is not expected to continue in the immediate future because of the following factors:

1) At the end of 1965 sugar stocks in Brazil had risen to over 2,000,000 tons which represented an increase of about 1,000,000 tons from the previous year stock level.

2) An analysis of the per capita consumption of sugar in Brazil indicates that the country is rapidly reaching a point of saturation in per capita consumption. In fact,

"it is now known that per capita consumption reaches a saturation point in many countries at about 45-50 kilogrammes and that further gains in income will not lead to additional sugar being consumed. Also, the rate of growth of per capita consumption tends to slow down considerably after a level of about 30-35 kilogrammes has been passed."^{12/}

Brazil has already passed the 30-35 kilogrammes level of per capita consumption and is rapidly getting close to the 45-50 point. (Table 4)

TABLE 4. PER CAPITA SUGAR CONSUMPTION, BRAZIL, 1957-1962

Year	Per Capita Consumption (Kilograms)
1957	34.6
1958	39.5
1959	37.4
1960	39.1
1961	40.5
1962	41.3

Source: Sugar and Alcohol Institute, Sugar Yearbooks, and files of the Sugar and Alcohol Institute, as cited by Martini, Eduardo, O Acucar no Brasil - Producao, Procura e Precos (M.S. thesis), Universidade Rural de Minas Gerais, 1964.

^{12/} International Sugar Council, The World Sugar Economy Structure and Policies - Vol. II - The World Picture, London, 1963, p. 128.

Similarly, according to the findings of a recent study of supply and demand for agricultural products in Brazil, the long-run income elasticities coefficients for sugar in Brazil are 0.07 and 0.08 for 1970 and 1975 respectively.^{13/} These coefficients imply that even large increases in per capita income in Brazil would not cause a significant increase in per capita consumption of sugar. In other words, sugar is an income inelastic product.

Another recent study estimates the price elasticity for sugar in Brazil as being approximately -0.56 for the period 1947 to 1960.^{14/} This indicates that sugar is somewhat price inelastic and that a modest reduction in prices would not increase consumption greatly.

3) The estimates of total domestic demand for sugar in Brazil for 1970 and 1975 are 2,650,000 tons and 3,100,000 tons and the estimates for the total supply are 3,500,000 and 4,100,000 tons.^{15/} This will allow an exportable surplus of 850,000 and 1,000,000 tons. These amounts can be expected to find markets, but a surplus much in excess of that amount would have to be sold on the "world market" at very low prices.

The preferential market of the United States, in which Brazil had a 1966 quota equivalent to approximately 322,526 metric tons will continue to maintain the same basic quotas until 1971.^{16/} This leaves

^{13/} Fundacao Getulio Vargas, Projecoes de Oferta e Demanda de Produtos Agricolas para o Brasil (Texto Preliminar), Janeiro 1966, Centro de Estudos Agricolas, Rio de Janeiro, Brasil.

^{14/} Martini, Eduardo, op. cit.

^{15/} Fundacao Getulio Vargas, op. cit.

^{16/} Stanton, B. F., Sugar and Sugar Beets Economic Statistics and Industry Data for the United States, A.E. Ext. 436, May 1966, Dept. Agr. Econ., N.Y. State College of Agriculture, Cornell University, Ithaca, New York.

approximately 520,000 tons to be put into the "world market" by 1970 and perhaps a little more by 1975. This seems to indicate that no major effort should be made to increase production above the mentioned requirements since the only possible market for a higher production would be the world market, the domestic and the preferential U.S. market having been fully supplied. The possibility of selling more sugar on the "world market" is not promising because the world's sugar production is increasing at a rate which is surpassing effective demand and prices are currently at all-time lows. Prices in the "world market" fluctuate greatly and seem to show a decreasing tendency as contrasted with the price of the preferential U.S. market. (Table 5)

TABLE 5. WHOLESALE PRICE, RAW SUGAR
WORLD MARKET AND NEW YORK, 1959-1965
(Cents/pound)

Year	"World" Spot Price	New York Duty Paid (U.S. preferential market)
1959	3.0	6.2
1960	3.1	6.3
1961	2.9	6.3
1962	3.0	6.5
1963	3.5	8.2
1964	5.9	6.9
1965	2.1	6.8

Source: Sugar Reports, USDA - As cited in Stanton, B. F., Sugar and Sugar Beets Economic Statistics and Industry Data for the United States, A.E. Ext. 436, May 1966. Dept. Agr. Econ., N.Y. State College of Agriculture, Cornell University, Ithaca, New York.

Under these circumstances, it is reasonable not to expect an increase in sugar production in the immediate future; in fact, the government reduced the authorized production for the crop year of 1967/68 by 875,332 bags of 60 kilograms of centrifugal sugar.^{17/}

If these assumptions are correct, sugar cane farmers will have only two possibilities for increases in income: 1) a reduction in the cost of production of sugar, and/or 2) an increase in production of other crops in the farm unit. This study will analyze both possibilities.

Objectives of the Study

The sugar industry is probably one of the economic activities in Brazil that has known the greatest government intervention. The government controls prices of the raw material and of the final product; it controls the quantity to be produced; it controls the allocation of the crop allotments in the different regions of the country and recently it also imposed a monthly marketing quota for the final product on the domestic market. Consequently, farmers' managerial decisions concerning cane production are quite limited. No matter how profitable sugar cane may be in a given period, farmers cannot commit more of some of their resources to the sugar cane enterprise since they are limited by a production quota.

It is this fact, basically, that suggests the problem of this study. Under such circumstances, which would be the best enterprise combination? How strong is the competitive position of sugar cane when compared with other products produced in the sugar cane region? Since the main sugar

¹⁷ I.A.A. Resolutions No. 1963 and No. 1982 of April 29, 1966 and December 29, 1966 respectively.

cane region of the state of Sao Paulo is a progressive, highly industrialized and urbanized area, can food crops compete for resources with cane, or can they be produced in combination with sugar cane and still be profitable or perhaps even more profitable than cane alone?

Probably one of the most important aspects of the laws regulating sugar production in Brazil is the one that allocates the production quotas of sugar cane. According to this requirement, a sugar mill can produce on its own land only 50 percent of the cane needed to manufacture its quota of sugar; the other 50 percent must be purchased from independent sugar cane growers in the vicinity of the mill who are known as *fornecedores*. It is of basic importance for this study to analyze present resource utilization of these farmers (both mill and *fornecedores*) and to compare these with alternative uses, considering one or more food crops in the enterprise combination. The study will also describe the structure of the farms in the region and some of the most relevant institutional arrangements.

Specific objectives can be put as follows:

1. To describe and analyze present resource utilization on the *fornecedores'* farms and one mill farm.
2. To analyze enterprise combinations and competition between crops on sugar cane farms.
3. To analyze the cost structure of one sugar mill as a basis for evaluating shifts in the cost structure induced by change in farming systems.

The analysis of the competition between sugar cane and food crops will be done through partial budgeting of representative *fornecedores'* farms and if the results of this analysis show that food crops can in

fact compete with sugar cane, the study will proceed to analyze the possibility of producing food crops on the mill's farm and also to analyze the changes and adjustments that will occur in the processing plant cost structure.

Method of Study

The core of this study is the analysis of the possibilities of increasing food production in a sugar cane region of the state of Sao Paulo. The hypothesis that guides this study is:

food crops can compete with sugar cane in the Piracicaba region.

It is assumed that the 1966 condition of sugar cane quotas, prices and markets for food crops and sugar cane will remain the same, and that crop results from that year are representative of conditions to be expected over the near future.

The criteria for the acceptance of the hypothesis is arbitrarily established as an increase of 30 percent or more in farm income resulting from a decrease in area planted to cane with a correspondent increase in area planted to food crops.

The reason for establishing a 30 percent increase in farm income as a minimum limit beyond which the hypothesis is not accepted results from the numerous risks involved in the production of food crops. The author discussed the problem of food production with farmers in the region and decided that farmers would probably become interested in the production of food if at least a 30 percent increase in farm income could be expected to result from producing more food crops and less cane.

To accomplish the purposes of this study a sample of sugar cane farms in the Piracicaba region was surveyed. Data obtained from this sample were used to analyze the actual conditions of the agriculture in the region and with the aid of simple tabular analysis techniques, the most relevant farm management factors were analyzed and their influence on the different measures of income were evaluated.

To analyze the possibility of increasing food production three farms, representative of the three modal classes found in the sample survey were selected. The actual income of these three farms was determined and then used as a reference to compare with the potential income originated by several different agricultural plans. The potential incomes were estimated by budgeting, having determined the following:

- a) the crops to be included in the alternative agricultural plans;
- b) quantity and costs of the inputs used in the agricultural plans;
- and c) output prices.

To obtain the data used in this research the author spent four and one-half months in Brazil, most of the time in Piracicaba, where the author interviewed the fornecedores and collected data on one mill. Secondary data on costs of inputs and outputs and labor distribution for various crops were obtained at the "Divisao de Economia Rural da Secretaria da Agricultura" in Sao Paulo. Data on fertilizer trials for sugar cane and other crops were collected at the Instituto Agronomico de Campinas. Information on sugar cane quotas, laws about sugar cane production, sugar prices and the operations of the Instituto do Acucar e do Alcool were obtained from the agency's Piracicaba office. Due to limits on the amount of time and financial resources for this study, it was determined that only one mill could be analyzed. The

chief factors in the choice of the mill studied were willingness of the owners to provide access to data, and that its operations did not differ significantly from other mills in the region.

The population of fornecedores studied was defined as the fornecedores selling to the selected mill. There were 40 such fornecedores and 26 were interviewed. This includes 65 percent of the defined population. The sample farms were surveyed using a questionnaire designed by the author who carried out the interviews himself in the period from mid-March to mid-April, 1967. Data obtained from the survey included information on size of farm, labor force, inventories, receipts, expenses, production, use of fertilizer and other such factors. The survey permitted calculations of the present levels of income, and through budgeting, alternative enterprise combinations with other farming systems were evaluated.

For the mill's operation, data on its plantations as well as on its processing plant were collected and their analysis follows the same procedures described for fornecedores' farms.

II

SUGAR CANE IN THE REGION OF PIRACICABA

The Region

The Instituto do Acucar e do Alcool (the federal agency that controls sugar production in Brazil) divides the country into two broad regions producing sugar cane: the northern and the southern regions.^{18/} The southern region is presently the region that produces the major part of the Brazilian sugar. In the crop year of 1962/63, 51,070,000 bags of 60 kilos of centrifugal sugar were produced in Brazil. Of this, the southern region produced 34,306,000 bags and the northern 16,764,000 bags. The southern region produced 67 percent of all the centrifugal sugar produced; within the southern region, the state of Sao Paulo produced 23,386,317 bags, which represents more than two-thirds of the southern region production and almost half of the entire country's production.^{19/}

In the state of Sao Paulo, sugar is produced in the eastern half of the state in an area of approximately 2,676,000 hectares situated

^{18/} The Northern region included the states of Acre, Amazonas, Para, Amapa, Maranhao, Piaui, Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Sergipe, Bahia, and the territories of Rondonia, Roraima, and Fernando de Noronha. The southern region includes the states of Minas Gerais, Espirito Santo, Rio de Janeiro, Guanabara, Sao Paulo, Parana, Santa Catarina, Rio Grande do Sul, Mato Grosso, Goiaz, and the Distrito Federal.

^{19/} Martini, Eduardo, op. cit., and Brasil, Anuario Estatistico do Brasil, 1964, IBGE, Rio de Janeiro.

between the latitudes of 21° and $23^{\circ}30'$ south and longitudes of $46^{\circ}30'$ and $48^{\circ}30'$.^{20/} (See map)

The sugar cane region of Piracicaba, situated in the southern part of the sugar cane area of Sao Paulo, was defined by Azzi and Carvalho in 1960 as being composed of 11 municipios (political division of the state comparable to counties) with a total area of approximately 390,000 hectares. In 1960, there were 23 sugar mills in this region and they produced 8,500,000 bags of centrifugal sugar in the crop year of 1959/60, which at that time was over 40 percent of the total production of the state.^{21/}

The sugar cane region of Piracicaba is located in a climatic zone classified as sub-tropical, with rainy summers and relatively dry winters. The temperatures of the warmest months are around 23°C to 24°C and the ones of the coolest month are around 17°C to 18°C . Total rainfall in the year varies from 1,100 to 1,400 millimeters and in the driest month it falls below 30 millimeters.^{22/}

The major soils groups in the region are Red Yellow Podzolic soils Variation Piracicaba, Red Yellow Podzolic soils Variation Laras, Latosic B Terra Roxa, and Ortho Dark Red Latosol. These soils vary

^{20/} Moretti Filho, Justo, Caracterizacao da Seca Agronomica na Zona Canavieira do Estado de Sao Paulo como Base Para os Estudos de Irrigacao (thesis), Escola Superior de Agricultura Luiz de Queiroz, Piracicaba, Sao Paulo, Brazil, 1965.

^{21/} Azzi, G. Miller and Carvalho, Paulo C. Torres de, "A Conservacao do Solo nas Usinas de Acucar da Regiao de Piracicaba," Brasil Acucareiro, No. 2, August 1960, IAA Rio de Janeiro, Brasil.

^{22/} Moretti Filho, Justo, op. cit., and Godoy, H. and Ortolani, A., Carta Climatica do Estado de Sao Paulo - Sistema de Koppen, Instituto Agronomico de Campinas, Secretaria da Agricultura do Estado de Sao Paulo, Brasil.

21

THE SUGAR CANE REGIONS OF SÃO PAULO

São Paulo

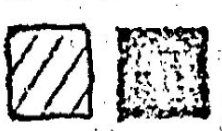
Brazil

23°

21°

46°

47°



Sugar Cane Region of Piracicaba

Sugar Cane Region of São Paulo

Source: See footnotes 20 and 21.

from good to average for agricultural purposes due to somewhat low fertility and erosion.^{23/}

Sugar Cane Crop Requirements^{24/}

Cane is a plant that requires moisture and warm temperatures. Consequently, it develops best in tropical regions. It needs a minimum of 1,200 mm. of rainfall in the course of the year and it is important that the rainfall be distributed in two definite seasons; one wet, for the development of the plant, and the other dry to make possible the maturation of the plant and the production of a juice rich in sucrose. Good luminosity and temperatures above freezing complete the climatic requirements for good development of sugar cane.

Sugar cane develops well in sandy loam or light clay soils; the soils of the Piracicaba region offer good conditions for the development of cane, especially the Latosic B Terra Roxa group.

The sugar cane varieties used in Brazil can be grown in 18 or 12 months depending on the time of planting. The 12 month sugar cane is generally planted in the southern region, from September to November, and will be harvested 12 months later. The 18 month sugar cane is planted from January to March and harvested from June to October of the following year. Eighteen month sugar cane is used more for the renewal of cane fields and the 12 month sugar cane is more commonly used when there is a need to supplement the expected supply of raw material for the mill. The 18 month cane is somewhat more productive

^{23/} Brasil, Ministerio da Agricultura, "Levantamento de Reconhecimento dos Solos do Estado de Sao Paulo," Boletim No. 12, do Servico Nacional de Pesquisas Agronomicas, Rio de Janeiro, 1960.

^{24/} This section was based on Graner, E. A. and C. Godoy Junior, Culturas de Fazenda Brasileira, Edicoes Melhoramentos, Sao Paulo.

than the 12 month sugar cane.

The good climatic and soil conditions of the Piracicaba region, together with the guaranteed markets and prices for sugar undoubtedly have contributed to making the region a predominantly sugar cane producing area.

Specialized machinery has been developed for sugar cane agriculture and today Brazilian industry is producing tractors with high clearance for sugar cane tilling, harvesting machines, planting machines, and loaders and wagons for hauling cane. This equipment, however, has had limited use. Some of the large plantations, primarily mill plantations, can justify their use and do use them under various degrees of intensity. Fornecedores' farms in general do not use any of the specialized machinery, except in a few isolated cases where a fornecedor operates a very large plantation.

In the Piracicaba region, fertilization is used by mills and fornecedores alike. The soils of the region have been in cultivation for over a century and up to very recently few, if any, measures to prevent losses of fertility and erosion have been taken; consequently, the use of fertilizer is now necessary to provide a reasonable yield. Fornecedores tend to use standard commercial formulas while the mills generally have their fertilization plan based on soil analysis and fertilizer trials.

Labor management is usually a problem, primarily for mill's plantations, since large numbers of workers are needed during the harvesting season and they cannot all be absorbed during the rest of

the year. This problem is somewhat eased by the use of the services rendered by the empreiteiros.^{25/}

^{25/} The empreiteiro is a person who contracts with the mill to harvest and transport to the mill a field of sugar cane. In general, the empreiteiro owns one or more trucks and he contracts in nearby villages or small farms laborers whom he transports each day to the field. In the field he supervises the work and drives the truck hauling the harvested cane to the mill.

III

THE SUGAR MILL: A CASE STUDY

Products and Production

Two products are produced by the mill studied: centrifugal sugar and alcohol. Although the mill is over 15 years old, data on its production is available only from 1960 to the present. Production of sugar and alcohol has increased slowly in the period studied; this slowness probably having been determined by government control rather than by choice of the management.

The economic soundness of the mill, which reflects its good management, is indicated by its low indebtedness and more than anything else by the fact that in the interviews fornecedores would almost invariably refer to the mill as one of the best in the region in dealing with fornecedores; this usually meant that the mill paid promptly for the cane it bought from producers and had generally cordial working relationships with the associated producers.

Table 6 shows the mill's production for the last six-year period and illustrates that although the production has varied from year to year, the production has tended to grow slowly.

An interesting point about this mill is its extraction rate, which in the 1966/67 crop year was 10.79 percent and although there was no available data for the state average, it is estimated that for the state of Sao Paulo the average extraction rate was about 9.6 to 10.0 percent for the 1966/67 milling season. This figure is not definite

TABLE 6. SUGAR AND ALCOHOL PRODUCTION - SANTA CRUZ^{a/} MILL,
1959/60-1966/67

Crop Year	P r o d u c t i o n	
	Sugar (Bags)	Alcohol (Liters)
1960/61	101,602	993,153
1961/62	97,759	904,579
1962/63	94,120	695,000
1963/64	92,725	828,500
1964/65	89,755	710,000
1965/66	127,027	1,200,000
1966/67	104,952	1,930,000

a/ Santa Cruz is not the real name of this mill, but is used in this study in order to avoid direct identification.

Source: Piracicaba survey, 1967.

and is based solely on conversation with officers of the local agency of Sugar and Alcohol Institute. This mill's higher extraction rate is the consequence of technical improvements introduced in the mill as well as the results of better technical management in recent years.

Size of the Mill

The mill is one of the smaller mills in the region. Mill capacity in the Piracicaba region (measured in terms of tons of sugar cane milled in 24 hours of operation) varied from 538 tons to 4,779 tons^{26/} in 1965. In 1966 the mill being studied had a capacity somewhere in between 700 and 800 tons of sugar cane milled in a 24 hour period.^{27/}

^{26/} Brazil, I.A.A., Coletanea de Resolucoes da Comissao Executiva de 1965, Rio de Janeiro, Brazil.

^{27/} The exact capacity is not given in order to avoid direct identification of the mill.

Fixed Capital

The mill had an estimated total fixed capital of over one million new cruzeiros in April 1966. Of this total, the machinery and equipment of the factory represented over 50 percent, buildings about 30 percent, and the rest was distributed among miscellaneous items such as vehicles, tools and instruments, telephone equipment, electric power equipment, and land.

Labor Force

The mill had a total of 750 man months working at the factory during the 1966 calendar year, but much of this labor is highly seasonal due to the way sugar mills operate. From January to June-July, the mill is not in operation and is being disassembled for repairs and cleaning. From June to the end of the year, cane is milled, and at least during 150 days it operates on a 24 hour basis during six consecutive days per week. It is necessary to operate the mill continuously during the harvest season because during a period of approximately five months after maturation of the cane, sugar content will remain high; then it declines if not harvested.

This operational set-up is reflected in the labor force over a one-year period at the mill. The mill had an average of 40 men working during the first six months of the year and about 75 men working during the last six months of the year in the processing plant, plus five men working all year in the accounting office.

Costs and Economic Efficiency - A Tentative Analysis

Introduction

In this section, a tentative analysis of the operating costs and

economic efficiency for the mill will be made. Cost curves will be estimated in an attempt to find the mill's lowest operating cost and compare it to possible operating conditions. The degree of refinement for this analysis is limited because a number of obstacles stand in its way: first, data used will be for only one year because the high rate of inflation in Brazil makes it difficult if not impossible to use averages from several years. Second, it will be assumed that relative prices will continue to be the same as they were in 1966, the year analyzed. Third, the mill is part of a larger enterprise under the same management which includes the sugar cane plantations and consequently it is a vertically integrated enterprise which complicates separation of costs; however, since the mill maintains a good accounting system, more costs are separated. Fourth, the mill and its plantations are one single enterprise owned by one family. It is operated by four members of the family and the management consists of two men for the plantations and two for the factory. Fifth, the mill has a labor force of its own and there is practically no interchange of labor from factory to plantation and vice versa.^{28/} The mill is separated from the farms for legal purposes and consequently taxes are also separated.

Fixed Cost Schedule

In order to calculate the fixed costs for the mill the following costs were considered:

^{28/} There are only two possible sources of mistakes on labor interchange: one, the mill's office does the accounting for the mill and the farm and two, the repair-shop repairs the tractors and vehicles of both the mill and the farm. In the last case, the accounting system reported costs such as parts for vehicles and tractors but not labor spent on the farm vehicles. However, these items are relatively small, and it was felt that they should not be a source of significant errors.

- a) Interest on fixed capital
- b) Depreciation
- c) Management
- d) Regular workers
- e) Other fixed operational cost (maintenance)

Costs c, d, and e were considered fixed because the point of zero production was ruled out; consequently, to maintain a minimum production, these costs would exist.

Only 6 percent interest was charged on fixed capital. Although this is quite low when compared with the current interest rates in Brazil, it was felt that it was a reasonable rate to charge since it is assumed for purposes of analysis that prices are fixed at the 1966 level, which eliminates the need for higher interest rates which reflect inflationary pressures.

A 4 percent rate was used for depreciation which means a 25 year life expectancy for the capital goods. The mill used a 10 percent rate of depreciation which is the rate allowed by the law. This rate is, however, too high for present purposes and it was felt that 4 percent was more realistic, since equipment still is in good working condition, and should last for at least another 25 years.

Bearing in mind the above assumptions, the fixed cost schedule for the mill during the year of 1966 was:

	NCr.\$
Interest on fixed capital (6%)	64,196.00
Depreciation (4%)	42,796.00
Management	16,400.00
Regular workers	99,968.00
Other fixed operational costs	75,468.00
Total	298,828.00

Variable Costs

In 1966, the mill produced a total of 105,222 bags of 60 kg. of

centrifugal sugar and 1,806,707 liters of alcohol. That is, for each bag of sugar cane produced, 17.17 liters of alcohol were produced, which means that not all the sugar that could be crystallized from the concentrate syrup was crystallized, because if all the sugar were crystallized, the result should have been 7 liters of alcohol for every bag of sugar produced.

If the number of sugar cane bags produced is multiplied by seven, the result is 736,554 liters of alcohol. Subtracting this result from the number of liters of alcohol actually produced, the result is 1,070,153 liters of alcohol which might have been transformed as sugar if all the sugar from the concentrated syrup had been crystallized. Dividing 1,070,153 liters by 37, which is a coefficient of transformation between liters of alcohol to one bag of sugar, the result is 28,923; which means that instead of producing 1,070,153 liters of alcohol, some 28,923 bags of sugar could have been produced. In addition, there would be seven liters of alcohol per bag of crystallized sugar. The result is then $105,222 + 28,145 = 134,145$ bags of 60 kg. of centrifugal sugar and $134,145 \times 7$, or 939,015 liters of alcohol.

This transformation permits the calculations of the cost curves to be made in terms of two products with a fixed relation between them. In other words, if the mill produces one bag of sugar cane from a given amount of concentrate syrup and extracts from this amount all the sugar that it can crystallize, there will be left an amount of sugar that will not crystallize, but that can be transformed into alcohol. This remaining sugar will yield 7 liters of alcohol. This is why it is possible to say, for example, that if 100,000 bags of centrifugal sugar are produced and in the process the mill had extracted all possible

crystallized sugar, it could still produce 700,000 liters of alcohol.

According to this method, the production of the mill for the year 1966 of 105,222 bags of 60 kilograms of centrifugal sugar and 1,806,707 liters of alcohol can be considered as equivalent to 134,145 bags of centrifugal sugar and 937,015 liters of alcohol. For this level of production the fixed cost was estimated at NCr.\$ 298,828.00 and the variable cost is NCr.\$ 942,652.00. Adding the two costs, a total cost figure for the production of 134,145 bags of centrifugal sugar and 937,015 liters of alcohol is estimated as NCr.\$ 1,241,480.00.

From these figures, variable costs were calculated for two other levels of production. One for a production of 180,000 bags, with an associated 1,260,000 liters of alcohol. This level approximates the point of maximum capacity for the mill studied, during a milling season of 150 days. The other was a point of 100,000 bags and 700,000 liters of alcohol. This point was estimated because it is not much lower than the present production and this should make the results more realistic and still provide a range large enough for analysis.

In calculating these two points for the variable cost curves, several assumptions were made. Before discussing these assumptions an explanation of the items that constitute variable costs is in order. The cost of telephone, magazines and newspapers bought, charity donations, building conservation, and cost of running the office was held constant since it was felt they would vary little with the variation of production assumed. Costs such as raw material (sugar cane), transportation, chemical products, fuel, taxes, cost of sugar bags, and laboratory costs were supposed to vary in a straight line relationship with variation of production.

Labor costs were assumed to be constant with the exception of the amount of labor employed in the handling of the sugar bags. This assumption was made on the basis that the men employed in the plant are used primarily for running the machines which will be in operation if 100,000 or 180,000 bags of sugar are produced; however, the number of men needed to handle the sugar cane bags in the warehouse would vary with the amount of sugar produced.

During the calendar year of 1966, the mill employed a total of 750 man months of labor force. Of this total, 60 man months were office labor force and 480 man months were the permanent labor force of the plant which makes a total of 540 man months of fixed labor, the cost of which was considered fixed and is part of the total fixed cost.^{29/} This leaves 210 man months which are employed only during the milling season. Of these remaining 210 man months, 103 man months were employed in the handling of the sugar cane bags in the warehouse. Since it was assumed that only this part of the labor force would vary, the calculations for labor force were made assuming that this part of the labor force would vary in a straight line relationship with production.

Table 7 shows the costs for 1966 production and for the two points calculated based on the above assumptions of use of labor. As the table shows the lowest average cost is for 180,000 bags, which indicates that the mill should operate at a point close to its full capacity. At this point its profits should be maximized or its losses minimized.

^{29/} For this total the mill paid NCr.\$ 99,968.00. The average cost for one man per month is NCr.\$ 185.13.

TABLE 7. COSTS OF PRODUCTION FOR THE SANTA CRUZ MILL
CALENDAR YEAR 1966

Costs	Production (Bags)		
	100,000.00	134,145.00	180,000.00
		NCr.\$	
Total fixed cost	298,828.00	298,828.00	298,828.00
Total variable cost	717,353.00	942,652.00	1,239,213.00
Total cost	1,016,181.00	1,241,480.00	1,538,041.00
Average fixed cost	2.99	2.23	1.66
Average variable cost	7.17	7.03	6.88
Average cost	10.16	9.26	8.54

Source: Piracicaba survey, 1967.

The Land Operated by the Mill

Land Use

In 1966 the land operated by the mill totaled 1,916.64 hectares.

This farm is about half as large as the average 3,940 hectares mill farms in the region.^{30/}

Utilization of the land operated by the mill was as shown in Table 8.

TABLE 8. GENERAL LAND USE, SANTA CRUZ MILL, 1966

Crops	Area (Hectares)
Sugar cane	1,217.86
Pasture	210.4
Rice	7.26
Reforested	225.06
Idle	116.06
Roads, buildings, etc.	140.36
Total	1,916.64

Source: Piracicaba survey, 1967.

^{30/} Azzi, Gilberto M. and Carvalho, Paulo C. T., op. cit.

Corn and beans were also produced and they are not shown in the table because they were planted in association with sugar cane. For corn the usual practice is to plant it in September and October with a double space between rows (approximately 2.80 meters) and in February and March of next year two rows of sugar cane are planted in between the two rows of corn, and consequently, each row of sugar cane will be separated from the other by 1.40 meters. Corn will be harvested between March and June after having dried in the field.

Beans are planted in between the cane rows and normally two crops of beans are harvested in one year. Dry season beans are planted in February-March and harvested during the dry period of June-July. The other, or wet season crop, is planted in September-October and harvested in December-January. In 1966, the mill's farm harvested about 42.35 hectares of corn and 10.89 hectares of beans in the two seasons.

In 1966 almost two-thirds the total mill land area was planted in sugar cane. It was distributed among the various cuts according to the data given in Table 9.

TABLE 9. SUGAR CANE LAND USE, SANTA CRUZ MILL, 1966

Cuts	Area (Hectares)	Percent
Planted (18 months)	91.96	7.55
Planted (12 months)	16.94	1.40
1st cut	283.74	23.30
2nd cut	222.64	18.30
3rd cut	99.22	8.15
Old cane	503.36 ^{a/}	41.30
Total	1,217.86	100.00

^{a/} From this total, 111.32 hectares were not harvested.

Source: Piracicaba survey, 1967.

As shown in the table, a large percentage of the total crop was old cane, which generally gives poor yields; however, the average yield for 1966 was 49 tons per hectare. It is interesting to note that if such a yield, which is close to the state average can be obtained with this distribution of cuts, a higher yield could be expected with a better cut distribution, reducing the large percentage of old cane.^{31/}

More land could be released from sugar cane while the total production of sugar cane could be maintained at the same level. Land could then be used for other purposes or sold, which would reduce the value of fixed capital charged against the cane enterprise, and increase the efficiency of capital use.

Pasture land was used for dairy, beef and work animals. The 210.5 hectares of pasture land carried 42 work animals, 29 beef animals, 2 bulls, 29 dairy cows, and 6 young animals in the end of 1966. These animals, except for the work animals, did not have a specific economic purpose. The mill maintains these animals at a loss, primarily to provide milk at low cost to employees, and for the most part the herds were poorly managed and had low levels of productivity. In fact, the 29 dairy cows produced roughly 36,000 liters of milk during the year which represents an average of 1,241 liters of milk per cow per year. The pasture land is also poorly managed and there is no pasture rotation or any other good pasture management practice used. In short, livestock is a side enterprise that may serve a social purpose within the mill farm.

^{31/} Divisao de Economia Rural, Secretaria da Agricultura do Estado de Sao Paulo.

Products, Production, and Product Uses

Sugar Cane. From the 1,217.26 hectares of sugar cane, only 997.04 were harvested because 108.90 were new plantings and 111.32 hectares of old cane were not harvested. From the 997.04 hectares harvested, 49,206 tons of sugar cane were produced; this means an average yield of slightly more than 49 tons per hectare, indicating that this mill's yield is about the same as the state average yield. Of the 49,206 tons produced, approximately 225 tons were used for planting the 108.90 hectares and 48,921 tons were milled.

Corn. During the 1966 calendar year, 56.4 tons of corn were produced on an area of 42.35 hectares, giving an average yield of 1.32 tons per hectare. Although this is a relatively low yield, it is important to remember that corn was planted with a distance between rows that is double that which would be used if the crop was not planted in association with sugar cane.

Corn is planted on the mill's land to be used primarily as animal feed, and only that which is not fed to animals is sold. Of the 56.4 tons produced, 39 tons were fed to animals and 12 tons were sold; the rest was unused at the end of the year.

Rice. There were 5.40 tons of rice in storage in the beginning of the year and 12.3 tons were produced, which makes a total of 17.70 tons of rice. From this total 6.78 tons were sold, 5.4 tons consumed by the owners' families, 1.02 tons given to employees, the 4.50 remaining were held in storage at the end of the year. Rice is a crop planted primarily for the mill owners' consumption and the rest is sold.

Beans. Only 3.06 tons of beans were produced in 1966 and from this total 1.2 tons were sold, 0.36 tons used as seed, 0.90 tons

consumed, and the rest was in storage by the end of the year. Like the other crops, beans are primarily for consumption by the owners' extended families and only small quantities are sold.

It is probably correct to say that products such as rice and beans are produced in an uneconomical manner on a large specialized sugar cane farm such as this. In talking to the owners about this matter, the author got the impression that the real reason for the production of rice and beans was that the "owners could not think of themselves buying these basic staples of the Brazilian diet when they had all that land."

Milk and Eggs. No record is kept on the amounts of these two products; consequently, only a very rough estimate was possible. It was estimated that in the 1966 calendar year about 36,000 liters of milk and 960 dozens of eggs were produced. The owners' extended families consumed all the eggs and roughly 11,000 liters of milk. The rest of the milk, 25,000 liters, were sold to the employees at a low price (about 20 percent of the current price of milk sold by other farms in the same region). No other animal product was sold.

Other Products. A relatively large amount of fruits and vegetables was produced on the farm and was all consumed in the owners' households. There were no records on the amounts produced and it was impossible to evaluate either the amount or the value of such products.

During the period in study, the farm also sold five steers.

Capital and Income

Capital. For the 1966 calendar year, the mill's farm had an average capital of NCr.\$ 1,789,743. In the course of the year, its capital stock decreased by approximately NCr.\$ 21,585.00. This decrease was

caused basically by machinery depreciation and a reduction in the stocks of grains and purchased inputs (fertilizer).

The value of land represents the major part of total capital, with the value of machinery being the second largest value. Table 10 shows the values of the different capital items for the beginning and end of the year.

TABLE 10. GENERAL INVENTORY - SANTA CRUZ MILL FARM
CALENDAR YEAR, 1966

Categories	Value (NCr.\$)	
	Beginning Year	End Year
Grains and purchased inputs	29,850.00	11,570.00
Productive animals	18,700.00	19,300.00
Work stock	8,400.00	8,400.00
Machinery and vehicles	128,485.50	124,680.00
Land	1,584,000.00	1,584,000.00
Buildings	30,000.00	30,000.00
Total	1,799,435.50	1,777,950.00
Average	1,788.692.75	

Source: Piracicaba survey, 1967.

The large value of the machinery inventory represents a large amount of equipment rather than specialized machinery. In fact, the farm had only one major piece of specialized equipment which was a sugar cane loader which in the end of the year was valued at NCr.\$ 6,500.00. It also had at the end of the year two cars, two trucks, 15 tractors ranging from small four wheel tractors to heavy caterpillar tractors, 4 tractor-drawn wagons, and 55 other pieces of equipment including plows,

harrows, tilling equipment, both tractor and animal drawn, fertilizer machines and animal drawn carts.

The component "buildings" include almost exclusively employees' houses and some simply constructed buildings for storage of equipment and vehicles, grains, and fertilizer, and some buildings for feeding and handling of animals.

Income. Four measures of income were calculated in this section. To do so receipts, expenses, and changes in inventory were also calculated.

The total cash expenses amounted to NCr.\$ 325,223.00 and the main components of this total were:

	NCr.\$
Labor force	180,626.00
New investments	5,313.00
Other operational expenses	139,284.00
Total	325,223.00

Total cash receipts amounted to NCr.\$ 480,623.60 and it was composed by:

	NCr.\$
Sugar cane	472,867.60
Other agricultural products sold	2,956.00
Animal sales	300.00
Animal products sold	4,500.00
Total	480,623.60

There was a decrease in the inventory equal to NCr.\$21,485.50 (see Table 10).

Net Income. It is defined as the difference between cash receipts and cash expenses. For the period in study it was NCr.\$ 155,400.60.

Farm Income. It is defined as net income plus or minus a change in inventory and in this case it was minus, since there was a decrease

in inventory. For the period mentioned the farm income was NCr.\$ 133,915.10.

Return on Capital. It is defined as the difference between farm income and the operator's wages value. In the case of the mill's farm, the two owners' family members in charge of running the farm received as wages an amount equal to approximately NCr.\$ 18,000.00 in the period in study. Subtracting this from the farm income, a value for return on capital is obtained which is NCr.\$ 115,915.10.

Rate of Return on Capital. It is defined as the return on capital expressed as a percentage of the average capital. The return on capital which was NCr.\$ 115,915.10 is 6.5 percent of the average capital which was NCr.\$ 1,788,692.75.

The Mill's Farm Labor Force

The total labor force of the mill's farm during 1966 was estimated at 1,928 man months. Of this total, 829 man months were permanent labor force living on the lands of the mill farm, 755 man months were temporary labor force, 66 man months were foremen. The 278 man months remaining of the total 1,928 man months were temporary laborers provided through the "empreiteiros" during the harvesting season.^{32/}

Most of this labor force was used for the sugar cane crops shown in the monthly labor distribution of this labor force and, although the

^{32/} The 278 man months provided by the empreiteiros had to be estimated, since there were no records on the number of men the empreiteiros had. The only record available was the amount of sugar cane harvested by the empreiteiros. The mill contracted three empreiteiros and they harvested 14,978.35 tons of sugar cane from July to October. It is estimated that one man harvests on the average 2.25 tons of burned sugar cane. This indicates that 6.657 men days were used, or 266 man months (a 25 work day month was used) plus 12 man months for the empreiteiros themselves or a total of 278 man months.

monthly labor distribution was fairly stable, one can see that the months of heavier labor usage coincide with the harvesting season which occurs from mid-June to mid-November.

Table 11 shows the labor distribution by months and also by different categories.

TABLE 11. LABOR FORCE COMPOSITION AND DISTRIBUTION
SANTA CRUZ MILL'S FARM, CALENDAR YEAR, 1966

(Man-Months)

Months	C a t e g o r i e s				Total
	Permanent	Temporary	Foreman	Empreiteiro	
January	81	62	5.5		148.5
February	82	64	5.5		151.5
March	82	82	5.5		169.5
April ^{a/}	28	83	5.5		116.5
May	74	72	5.5		151.5
June	69	73	5.5		147.5
July	68	48	5.5	69.5	191.0
August	67	41	5.5	69.5	183.0
September	71	51	5.5	69.5	197.0
October	68	53	5.5	69.5	196.0
November	68	62	5.5		135.5
December	71	64	5.5		140.5
Total	829	755	5.5	278	1,928

^{a/} In April a large number of laborers took vacations.

Source: Piracicaba survey, 1967.

Excluding the 278 man months in the "empreiteiro" category, the mill farm paid NCr.\$ 180,626.00 for all this labor. This means that on the average one man month of labor costs NCr.\$ 109.47^{33/} which is

^{33/} Includes all social benefits paid by the mill's farm.

relatively low when compared with the average cost of one man-month of labor in the processing plant, which as was shown costs NCr\$ 185.13. This is probably a good indication that, although total labor cost is a major item in the production costs of sugar cane, field labor still is relatively cheap.

General Conclusions

The cost analysis for the mill indicates that the variable costs constitutes the largest part of the production costs. Indeed, for the actual production (134,145 bags of 60 kilograms of centrifugal sugar) variable costs accounts for three-fourths of total costs and most of this variable costs represents cost of raw material. This point is important for the purposes of this study because it indicates that adjustments in cane production would be fairly feasible in the area. Since the major part of the costs in sugar production are variable, reductions in production would not result in sizeable write-offs of fixed plant and equipment.

In view of these facts, it is possible to expect that if food crops can compete with sugar cane, it will be fairly easy for mill owners and private farmers to shift crop land from cane to other crops reducing the production of sugar cane without causing great direct dislocations. In addition, the farm enterprise operated by the mill offers good possibilities for a more diversified agriculture as far as the physical resources are concerned, although, it might prove difficult from a managerial aspect to diversify a large sugar cane farm such as this one.

In any case it is apparent that the crop land could be used more

efficiently. For example, in 1966 the farm had approximately 1,218 hectares of sugar cane and almost half of this cane was old cane (fourth and fifth cut cane) of which about 111 hectares were not harvested. Also the 210 hectares of pasture carried a little over 100 animals which means about one animal for every two hectares of pasture; and as previously mentioned the animal enterprises were notably uneconomical.

Another aspect of the farming system of the mill's farm that permits more flexibility in its operation is its highly labor intensive characteristic. In fact, machinery represented less than ten percent of the total capital assets and even this amount consisted for the most part of unspecialized machinery, basically land preparation machinery and trucks which could be used in the production of grain crops, providing the same services that they are now providing in the production of sugar cane.

In short, it should be clear that although the mill and its farms are a vertically integrated enterprise specialized in the production of sugar cane, this preliminary review suggests possibilities for a better resource utilization that could eventually make possible an increase in the production of food crops.

IV

THE FORNECEDORES' FARMS

Introduction

The description of the fornecedores' farms will be done in terms of flows of receipts, expenses and stocks of resources. The agricultural resources are land, machinery, livestock, labor, and purchased inputs. Information about the farms was obtained from a survey based on a stratified sample of 26 farms. The population was divided in three strata: small, medium, and large farms. The basis for this division was the amount of sugar cane produced and sold to the mills. Farmers selling less than 500 tons of sugar cane a year were defined as small; the ones selling between 500 and 1,000 tons were defined as medium farms; and the ones selling over 1,000 tons of sugar cane a year were defined as large.

The population of farmers shipping cane to the Santa Cruz mill was divided in these groups and from each one a sample of 50 percent or more was selected using a table of random numbers.

Agricultural Resources

Land

Farms averaged from 18.1 hectares of land for the small farm category, to 74.6 hectares for the large farm category (or 109.0 hectares

if farm A is included^{34/}), and the average size of the medium farm category was 35.6 hectares.

For each of the groups over 50 percent of land was cropped.

Pasture land represented about 30 percent of the total farm land and was used primarily for the grazing of workstock and a few dairy animals which provided milk for the operator's family. (Table 12) Woodland, reforested land, idle land, and farmstead completes the categories of land utilization in the farms surveyed.

TABLE 12. LAND USE ON FARMS ASSOCIATED WITH
SANTA CRUZ MILL, PIRACICABA REGION, 1966

(Hectares)

Land Use	Small Farms	Medium Farms	Large Farms ^{a/}	Large Farms
Cropland	12.50	24.00	76.10	51.51
Pasture	4.10	9.35	24.48	18.87
Woodland	0.10	0.70	1.37	1.60
Reforested	-	0.20	2.33	0.70
Idle	1.00	0.66	2.07	0.40
Farmstead	0.40	0.68	2.68	1.51
Total	18.10	35.59	109.03	74.59

^{a/} Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

Source: Piracicaba survey, 1967.

^{34/} One farm in the sample is a very large farm and in 1966 produced over 10,000 tons of cane. In order to make the analysis more meaningful, this farm is included in a separate category. This farm will be referred to as farm A.

Machinery

The machinery used on the farms of the region is for the most part not specialized for sugar cane. The small farm category had no tractors but there were two trucks. Farms in the medium category had 9 trucks and 3 tractors. Farms studied in the large farm category had 7 trucks and 8 tractors (or 4 trucks and 5 tractors if the farm A is excluded). A number of farms in the small farm and medium farm categories which did not have tractors and/or trucks had their land prepared by hired machinery and their cane hauled by trucks belonging to other farmers in the region. Some of the small farms used work animals for land preparation. Besides the trucks and tractors discussed above, a number of other implements were used, both tractor and animal drawn.

In practically all cases, the tilling of sugar cane was done by mules; however, livestock such as cows and hogs were an unimportant and noncommercial enterprise on all farms, with the exception of one farmer in the medium farm category who produced milk to sell. This farm had 6 dairy cows and he used concentrated feed and also part of his sugar cane for the animals.

Table 13 shows the distribution of animals by categories of the farms surveyed.

The capital assets found on the farms in the sample are shown in Table 14. In the small farm category, the land and buildings represents over 80 percent of the total capital assets and most of this value is represented by land alone, since buildings were few and simple.

Machinery was an unimportant item in the small farm category, but in the next two categories is more important, including mainly trucks and tractors.

TABLE 13. END OF THE YEAR LIVESTOCK INVENTORY
SAMPLE FARMS*, PIRACICABA REGION, 1966

Category	Small Farms	Medium Farms	Large Farms <u>a/</u>	Large Farms
(Average number of animals)				
Dairy cattle	6	2	22	23
Other cattle	-	-	11	11
Sow	1	1	3	3
Boar	1	4	1	1
Other hogs	6	6	26	26
Workstock	4	4	8	7

a/ Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

*/ Includes only farms that had one or more animals of each category.

Source: Piracicaba survey, 1967.

TABLE 14. AVERAGE END OF THE YEAR GENERAL INVENTORY
SAMPLE FARMS, PIRACICABA REGION, 1966

Category	Small Farms	Medium Farms	Large Farms <u>a/</u>	Large Farms
(NCr.\$)				
Grains and purchased inputs	26.00	150.50	373.00	435.50
Land and build- ings	11,369.00	21,615.00	65,063.00	41,980.00
Machinery	712.00	5,688.00	21,953.00	16,316.00
Livestock	1,585.00	3,072.50	7,755.00	6,715.00
Total	13,692.00	30,526.00	95,144.00	65,446.50

a/ Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

Source: Piracicaba survey, 1967.

Use of Land and Labor

Land use is primarily for crops, and this mainly sugar cane.

The relationship between cropland and other uses follows the same pattern in all categories. (See Table 12)

Table 15 shows the land use by crops on sample farms, but does not include associated crops. As can be seen, sugar cane occupies most of the crop land. Corn is undoubtedly the second most important crop in the area, but it is not a cash crop because most of it is fed to animals.

TABLE 15. LAND USE BY CROPS, SAMPLE FARMS,
PIRACICABA REGION, 1966*

Crops	Small Farms	Medium Farms	Large Farms <u>a/</u>	Large Farms
(Average number of hectares)				
Sugar	11.16	19.95	63.55	44.94
Corn	0.90	3.07	6.11	5.51
Beans (W) <u>b/</u>	0.26	0.14	0.34	-
Beans (D) <u>b/</u>	0.04	-	-	-
Rice	0.34	1.18	3.80	1.21
Other	-	0.45	2.59	0.20

*/ Does not include associated crops.

a/ Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

b/ Beans (W) - wet season beans.

Beans (D) - dry season beans.

Source: Piracicaba survey, 1967.

Other crops (rice and beans) are minor enterprises and are basically used as subsistence crops for the farm operator's family. Two crops of beans can be obtained within a year; however, the dry season

beans usually yield poorly and the fact that only the small farm category reported dry season beans may reflect the problem of raising enough beans for the family with only one crop on these small farms.

In Table 16 the associated crops found on the sample farms are summarized.

TABLE 16. ASSOCIATED CROPS, SAMPLE FARMS,
PIRACICABA REGION, 1966

Crops	Small Farms	Medium Farms	Large Farms ^{a/}	Large Farms
	(Average number of hectares)			
Corn and sugar cane	0.34	1.41	1.94	2.27
Corn and beans	-	-	0.08	0.10
Beans (W) and beans (D)	-	0.27	-	-
Sugar cane and beans (W)	0.27	0.38	0.16	0.18
Sugar cane and beans (D)	0.04	0.28	0.85	0.18

^{a/} Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

Source: Piracicaba survey, 1967.

The method of planting corn in association with sugar cane is the same as described for the mill farm.

The corn and bean association is only for wet season beans, since both are planted at about the same time. The category, Beans (W) Beans (D), is not an association but indicates that two crops were grown in the same area, with one crop following the other.

The Sugar Cane Crop

Table 17 shows the average areas harvested for the different cuts of sugar cane on the sample farms.

TABLE 17. SUGAR CANE LAND USE ON THE SAMPLE FARMS
PIRACICABA REGION, 1966

Land in Sugar Cane	Small Farms	Medium Farms	Large Farms ^{a/}	Large Farms
(Average number of hectares)				
12 months	0.86	0.50	4.77	2.36
12 months ^{b/}	0.10	0.85	1.08	1.26
18 months	1.34	3.16	10.90	6.22
1st cut	1.39	3.60	10.64	9.42
2nd cut	2.53	4.56	19.86	13.67
3rd cut	4.33	6.58	16.01	10.51
4th cut	0.63	0.67	1.28	1.50
Left standing	0.17	0.30	1.71	2.00
Total	11.25	19.37	65.17	45.68

^{a/} Includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

^{b/} Twelve month sugar cane planted in area of harvested sugar cane in 1966. Does not add in.

Source: Piracicaba survey, 1967.

Sugar cane can be planted at two different times of the year as was discussed previously. In the case of this table two rows of 12 month sugar cane are presented because one is 12 month sugar cane planted on land that was not being cropped in the period studied and the second 12 month sugar cane is cane that was planted on land that had been harvested in the same year. Consequently, this area should not be added to the land area of the farm, because it is already accounted for in the area harvested from third or fourth cut cane.

Sugar cane is a labor intensive crop. It is estimated that a total of 65.6 man/days are required for one hectare during 12 months

for a rotation of three quarters of adult cane and one quarter of young cane, a common system in the state of Sao Paulo.^{35/}

The operator and his family provided most of the labor on the fornecedores' farms. The operator's labor was considered equivalent to 12 months except in cases where the operator had another job. The family labor, practically all unpaid, constituted the major part of the labor on all farms (except on farm A). The "hired" category listed in Table 18 includes both permanent labor and temporary labor hired during the harvesting season.

TABLE 18. LABOR FORCE ON SAMPLE FARMS
PIRACICABA REGION, 1966

Category	Small Farms	Medium Farms	Large Farms ^{a/}	Large Farms
(Average number of man months)				
Operator and family	16.00	30.50	40.14	44.80
Hired	6.28	2.50	50.43	8.33
Total	22.28	32.10	90.57	53.13

^{a/} Includes an atypical large farm, which by itself ships 12% of the cane milled (farm A).

Source: Piracicaba survey, 1967.

^{35/} UN, FAO, Coffee in Latin America - Productivity Problems and Future Prospects II Brazil, State of Sao Paulo (2 vols.), Mexico, 1960.

Crop Production

Table 19 shows total production and yields for the crops produced in the farms surveyed.

TABLE 19. AVERAGE TOTAL PRODUCTION AND AVERAGE YIELDS OF
AGRICULTURAL PRODUCTS, 26 FARMS,
PIRACICABA REGION, 1966

Agricultural Products	Small Farms	Medium Farms <u>a/</u>	Large Farms <u>b/</u>	Large Farms <u>c/</u>
<u>Total Production</u> (Tons)				
Sugar cane	330.00	662.08	2,807.00	1,620.17
Corn	0.75	3.40	13.15	11.15
Rice	0.20	0.36	1.49	0.94
Beans	0.22	0.31	0.36	0.22
<u>Yields of Main Agricultural Products</u> (Tons/hectare)				
Sugar cane	37.00	47.00	58.00	54.00
Corn	0.80	0.89	1.78	1.92
Beans	-	-	-	-
Rice	0.51	0.61	0.44	0.48

a/ In this category, one farm also produced 0.70 tons of broom corn and another farm produced 1.40 tons of coffee.

b/ In this category, one farm also produced 5,000 boxes of orange and another produced 1.28 tons of coffee. This category includes an atypical large farm, which by itself ships about 12% of the cane milled (farm A).

c/ In this category, one farm produced 1.28 tons of coffee.

Source: Piracicaba survey, 1967.

Yields of beans are not presented because small areas were planted and also in most cases the beans were produced in association with other crops. In these circumstances, it was felt that yields of beans as calculated would not be significant.

Two of the most important factors affecting yields of sugar cane are fertilization and cut combination. The sugar cane yield decreases fast as successive cuts are performed in the same field and although, in general, fields are renewed after the third cut, there were a few farmers who reported having fields in the fourth and fifth cuts.

In order to analyze the yields of all crops, a composite crop yield index was calculated. This was done since there were several different types of associations and in many cases one crop was cultivated by one group of farmers and not by another. As in the case of sugar cane, several factors affect yields of these crops and associations; time of planting, and fertilization are important factors affecting yields.

Table 20 presents a relationship between fertilization per hectare cultivated and crop yields. The first class of farms in this table (0-175 kg. of fertilizer per hectare cultivated) have low sugar cane yields and low crop yield index. The chief reasons for these low yields are linked to low levels of fertilization, high percentage of old cane as shown by the low proportion of total harvested area in first and second cuts, and probably by a more intensive use of crops in association (the fact that the diversity index for those farms are the highest is a good indication that a large number of crop associations are planted on these farms).

Interval (Kilograms of Fertilizer per Hectare Cultivated)	Number of Observations ^{a/}	Average Kilograms of Fertilizer Per Hectare Cultivated	Sugar Cane Yield	Proportion of Total Harvested Area In 1st and 2nd Cut	Crop Yield Index	Diversity Index
0 - 175	10	74.80	36	0.38	85.00	2.02
176 - 349	16	240.77	47	0.47	103.84	1.67
350 -	12	474.28	50	0.35	96.51	1.35

a/ The total population was 40 farms; however, for the purposes of the analysis, two large farms, which produced over 10,000 tons of sugar cane each, were excluded.

Source: Piracicaba survey, 1967.

The intermediary group (176-349 kg. of fertilizer per hectare cultivated) have the highest crop yield index and the second highest sugar cane yield. This is probably a result of a greater use of fertilizer, a larger proportion of first and second cut cane, and probably a lower degree of crop association as indicated by the somewhat lower diversity index.

The third group (350 kg. of fertilizer per hectare of cultivated land and over) had the highest sugar cane yield. This higher yield, however, is not proportional to the increase in fertilization, and is probably a result of the low proportion of first and second cut sugar cane. The crop yield index of this group is a little lower than the previous group, which is probably a consequence of the fact that sugar cane yields influence comparatively more the outcome of the crop yield index in this group as it is indicated by its very low diversity index.

Measures of Income

Five measures of income were calculated for the farms in the sample. Sales of agricultural and animal products and miscellaneous incomes from such things as work off of the farm, machinery rent, and sales of equipment, are receipts. Cash expenses include the purchases of inputs that will be consumed in the crop year and expenditures for such things as buildings, vehicles, and equipment that will be used for more than one year also enter in the calculation of the net income, although they are considered new investments. Table 21 presents the expenses and receipts for the farms in the sample for the period studied.

TABLE 21.

AVERAGE CASH EXPENSES AND RECEIPTS
SANTA CRUZ MILL FORNECEDORES FARMS
PIRACICABA REGION, SAO PAULO, BRAZIL 1966

Classification	Small Farms	Medium Farms	Large Farms <u>a/</u>	Large Farms
		(N Cr \$)		
Operational expenses	1,053.60	3,295.70	11,584.60	5,502.30
Investments	29.00	2,472.30	5,603.40	6,554.00
Total	1,082.60	5,768.00	17,188.00	12,056.30
Agricultural Product Sales	2,099.40	5,514.00	21,906.30	12,489.00
Animal Product Sales	90.00	143.50	-	-
Animal Sales	145.60	61.50	353.50	412.50
Miscellaneous Receipts	431.40	2,038.00	4,308.70	5,026.80
Total	2,766.40	7,757.00	26,568.50	17,928.30

a/ Includes an atypical large farm, which by itself ships about 1% of the cane milled (farm A).

Source: Piracicaba Survey, 1967.

The measures to be reviewed are summarized in Table 22. The meanings of the terms follow:

TABLE 22. MEASURES OF INCOME FOR AVERAGE FARMS
PIRACICABA REGION, 1966

Category	Small Farms	Medium Farms	Large Farms ^{a/}	Large Farms
(NCr.\$)				
Net income	1,684.00	1,989.00	9,381.00	5,872.00
Farm income	924.00	1,999.00	6,806.50	3,739.00
Labor income	266.00	211.00	1,122.00	- 134.00
Labor earnings	984.50	1,740.00	3,553.00	1,992.00
Rate of return on capital (%)	0.0	0.6	5.7	5.8

^{a/} Includes an atypical large farm, which by itself ships 12% of the cane milled (farm A).

Source: Piracicaba survey, 1967.

Net Income

Is defined as cash receipts minus cash expenses.

Farm Income

Is defined as net income minus the value of unpaid family labor plus or minus changes in value of the farm assets. This measure is intended to evaluate the income originated from the farm as a business enterprise and takes into consideration the value of family labor and

the value of any accumulation or depletion of capital assets.

Labor Income

Is defined as the farm income minus a 6 percent interest charge on the capital assets. This measure intends to reflect the income earned by the farmer as laborer and entrepreneur, and not as an owner of productive resources.

Labor Earnings

Is defined as labor income plus the privileges provided by the farm to the operator's family, which includes the value of rent that would have to be paid for equivalent housing plus all the food items provided by the farm. On the average the value of the operator's family privileges amounted to NCr.\$ 716.00 for the small farms, NCr.\$ 1,561.92 for the medium farms, and NCr.\$ 2,483.57 for the large farm.

Return on Capital

Is defined as farm income minus a value equivalent to the operator's wage. Since there are practically no hired managers in the area (except for mill plantations where one or more foremen is common), it becomes somewhat difficult to establish a meaningful wage for the operator. To overcome this problem, the operator's wage was determined on a somewhat arbitrary basis. The criteria used was to allow operators on small farms an annual wage equivalent to approximately the minimum wage for the region which was NCr.\$ 912.00 in the year studied. The reason for this choice was that on the average the operators of the small farms could at least find alternative employment as a regular worker on the mill's plantation and receive the minimum wage. For the medium farm

category, a wage equivalent to two minimum wages which was NCr.\$1,824.00 was established since these farmers probably could find employment as foremen and this was roughly the wages they would earn. For the operator of the large farms a wage equivalent to three times the minimum wage was established.

The rate of return on capital was calculated using these figures and average inventory values; this measure of farm profitability is intended to provide a yardstick for the efficiency of capital use.

Factors Affecting Incomes

A number of factors affect the outcome of the measures of income. The results of the income measures presented in Table 22 can be explained by factors other than the size of the quotas which is the factor determining the classification of Table 22.

Among the several factors affecting farm income, there is a direct relationship between higher crop yields and greater farm income. (Table 23)

TABLE 23. RELATIONSHIP BETWEEN CROP YIELD INDEX AND FARM INCOME, 38 SUGAR CANE FARMS, PIRACICABA REGION, SAO PAULO, BRAZIL, 1966

Interval (Crop Yield Index)	Number of Observations	Average Crop Yield Index	Farm Income (NCr.\$)
0 - 79	14	69	1,504
80 -119	18	100	2,109
120 +	6	157	3,302

Source: Piracicaba survey, 1967.

Another factor which affects farm income is the proportion of cultivated land planted to cane. As the proportion of cultivated land planted to cane increases so does farm income. This is a consequence of the fact that almost the only crop that can be considered a commercial enterprise is sugar cane, and the other crops are for the most part subsistence crops; their value, consequently, does not appear in the calculation of farm income. Table 24 shows the relationship between the proportion of cultivated land planted to cane and farm income.

TABLE 24. RELATIONSHIP BETWEEN PROPORTION OF CULTIVATED LAND PLANTED TO CANE AND FARM INCOME, 38 SUGAR CAE FARMS, PIRACICABA REGION, SAO PAULO, BRAZIL, 1966

Interval (Proportion of Cultivated Land Planted to Cane)	Number of Observations	Proportion of Cultivated Land Planted to Cane	Number of Hectares Planted to Cane	Farm Income (NCr.\$)
0.00 - 0.79	11	0.70	21.0	1,460
0.80 - 0.89	9	0.83	29.8	3,070
0.90 - 1.00	18	0.96	21.4	1,926

Source: Piracicaba survey, 1967.

As the value of farm capital increases, so does farm income as can be seen in Table 25. However, in this case, the increases in income are not proportional to the increase in capital; there are associated variations in the area planted to cane. As Table 25 shows, the average capital doubles from the first category (interval 0-19,761) to the

Interval (Value of Farm Capital) (NCr.\$)	Number of Observations	Value of Farm Capital	Sugar Cane Yield	Number of Hectares Planted to Cane	Farm Income (NCr.\$)
0 - 19,761	17	11,758	41	15.60	1,328
19,762 - 36,599	9	26,329	43	18.70	1,817
36,599 +	12	68,823	52	37.10	3,167

Source: Piracicaba survey, 1967.

second category (interval 19,762-36,599), but the farm income increases only about 37 percent. What occurs is that the number of hectares planted to cane increased only by three hectares on the average. Evidently, the second category has a much larger capital which is represented primarily by land, which is not being intensively utilized probably because of restrictions imposed by the quota and because of the unwillingness of farmers to produce crops other than cane.

The somewhat unusual behavior of labor income as expressed in Table 22 can be explained by a relationship between the ratio of cultivated land to total land area. Table 26 presents the results of this relationship.

The fact that labor income increases as the ratio of cultivated land to total land area increases brings out an important aspect of the sugar economy in the region. Due to the fact that the production of sugar cane is controlled by a quota system and due to the apparent reluctance of farmers to produce other crops, probably in part because of the uncertainty of satisfactory prices (a factor that is guaranteed for sugar cane), farmers appear to prefer having their land in natural pasture, carrying a few animals, making practically no commercial use of this land. In calculating labor income, a 6 percent interest rate was charged against the value of farm capital. Even this relatively low interest rate when charged against land that is not in production greatly reduces the labor income.

The fact that farmers do not put this land into production may not be an irrational economic decision because the only crop that guarantees him a positive return is sugar cane. Keeping this valuable capital asset idle may be viewed by the farmer as a safe protection

Interval (Ratio of Cultivated Land to Total Area)	Number of Observations	Average Ratio of Cultivated Land to Total Area	Proportion of Cultivated Land Planted to Cane	Labor per Hectare Cane Harvested	Labor Income
0 - .74	17	0.61	0.80	2.63	- 1,105
.75 - .84	15	0.80	0.88	2.20	839
.85 - 1.00	6	0.92	0.97	1.67	2,031

Source: Piracicaba survey, 1967.

against inflation. This security against inflation and the risks involved in the production of other crops may lead the farmer to decide to leave the land idle, and this may not be an irrational economic decision given the circumstances in Brazil today.

Summary

This chapter reports on an analysis of the availability and use of resources on sugar cane farms. A sample of 26 farms was used and this sample was divided in three categories: small, medium and large farms. One of the farms in the sample was an atypically large farm which made it necessary to divide the large farms category into two categories, one including this farm and the other not including this farm. This large farm is referred to as farm A.

The average area of the farms varied from 18.1 hectares for the small farm category to 74.6 hectares for the large farm category (or 109.0 hectares if farm A is included), and the average size of the medium farm category is 35.6 hectares.

For each of the groups, over 50 percent of the land was cropped, and about 30 percent was pasture land, although on almost all farms livestock was an unimportant enterprise except for workstock.

No specialized machinery for sugar cane was reported; but trucks and tractors are important items, except in the small farm group.

For all groups, sugar cane occupies well over 50 percent of the crop land, and corn is the second most important crop; but on no farm can it be considered a cash crop. Rice and beans are common crops on practically all farms, but are primarily subsistence crops and sales of these products are incidental. The labor force is largely made up

by the operator and family, although during the harvesting of sugar cane, a few laborers are hired; an exception was farm A which had over 90 percent of its labor provided by hired laborers.

Sugar cane yields of 37 tons per hectare were reported for the small farms, 47 tons for the median farm category and 58 tons for the large farms. This variation could be explained by the use of fertilizer and by the combinations of sugar cane cuts. The larger the percentage of old cane the lower the yield.

Farm income varied from NCr\$924 for the small farm category to NCr\$1,999 for the medium farm category and NCr\$3,739 for the large farm category, or NCr\$6,806 if farm A is included.

Factors such as average crop yield index have a definite influence on farm income; the higher the crop yield index, the higher the farm income. Another factor that influences farm income is the proportion of cultivated land planted to cane; once again the higher this proportion the higher the farm income, which is probably a consequence of the fact that the only commercial crop is sugar cane and the other crops are for the most part subsistence crops, their value not appearing in the calculation of farm income.

Another factor that affects farm income is the value of farm assets; although the increase in income is not proportional to the increase in capital, the reason being the existence of associated variations in the area planted to cane.

POTENTIAL INCOME FROM DIVERSIFIED FARMING

Introduction

In this chapter an analysis of the potential income from diversified farming will be made. The purpose of this analysis is to find out how income of farmers in the region can be increased through an increase in the production of food crops and also to analyze the competition between sugar cane and the other crops.

This analysis will be done by partial budgeting, and will rely on information from the "Divisao de Economia Rural" for prices of inputs, outputs, input requirements and, also, on the agronomic information released by the Instituto Agronomico de Campinas.

In addition to sugar cane, three other crops will be considered; corn, rice, and beans. These three crops are grown by most farmers in the region although not on a commercial scale.

A large array of information about these crops is available, and based on this information, alternative systems of farming will be analyzed. A few comments about this information follow.

Prices

The prices used for corn, rice, and beans are the estimated average prices for 1966. Since in all plans it is assumed that the farmers will not store their products, but sell them in the months immediately following harvest, the average price is corrected for

seasonal variation.^{36/}

Prices for inputs are the prices supplied by the Divisao de Economia Rural. These prices are published monthly, and for the purposes of the analysis the middle year prices were used.

It is also assumed that the relative prices of the four crops being considered (sugar cane, corn, rice, and beans) will be about the same as they were in 1966. This consideration is based on the observation that for at least the last ten years this relationship has been fairly constant (see Graph).

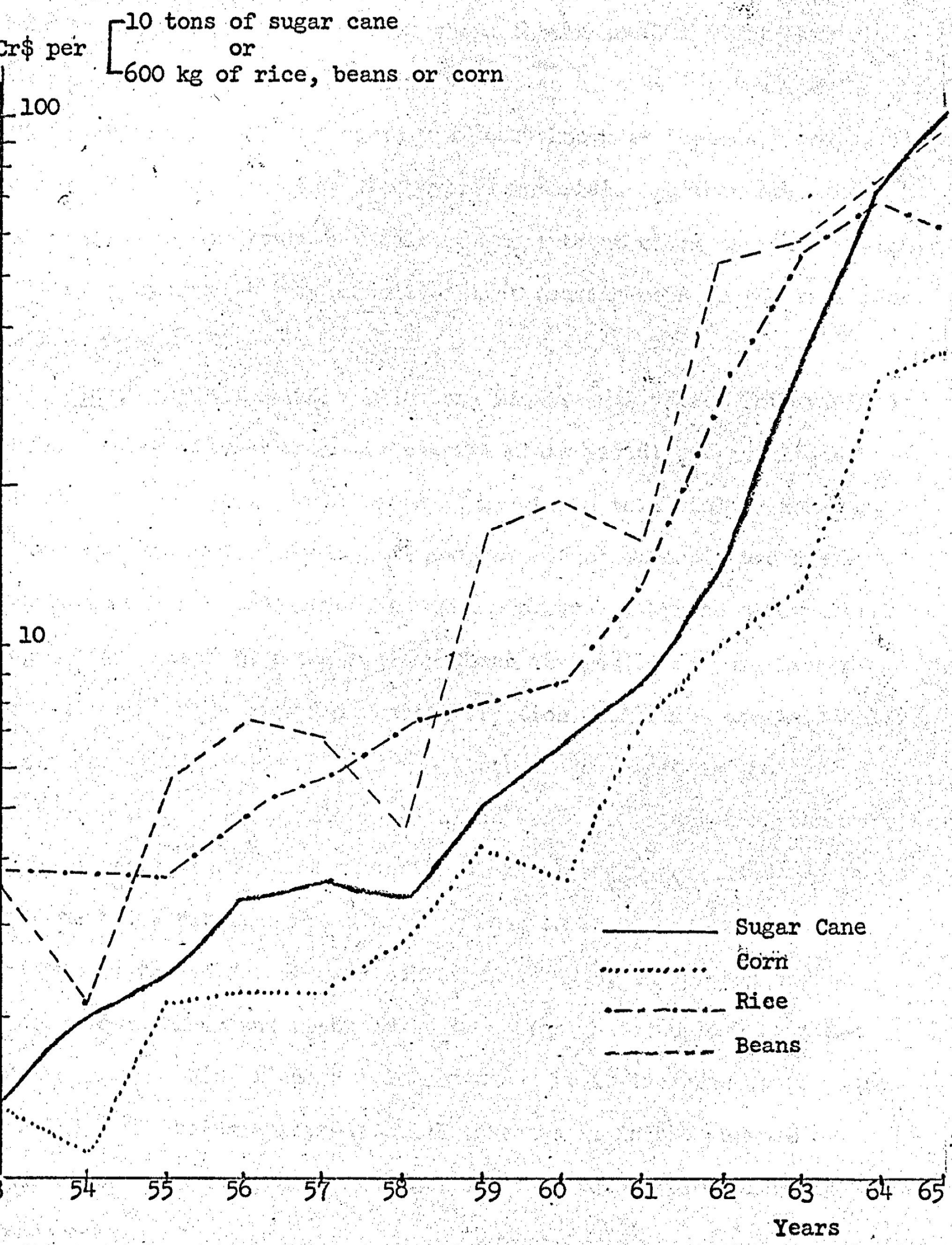
Crop Yields

Sugar Cane. Sugar cane enters in all plans and a standard yield of 55 tons per hectare is considered. This yield is about the same as the state average yield; however, in the sample being studied, yields vary from as low as 26 tons per hectare to as high as 70 tons per hectare. This variation is linked with the use of fertilizer and with combinations of cuts. A large number of experiments have shown that with the right fertilization and cut combination a 55 tons yield is easily obtainable.

Corn. A yield of 4 tons per hectare is considered for all plans and although this yield is about double the state average a number of reasons indicate that this yield should be relatively easy to obtain.

^{36/} For the 1966 average prices see: Divisao de Economia Rural: "Precos Minimos para a Safra 1966/67," Agricultura em Sao Paulo, Ano XIII, No. 5/6, May-June 1966, D.P.V. Secretaria da Agricultura do Estado de Sao Paulo. For seasonal variation indices see: Pereira, I.F. et al., "Variacao Estacional de Precos Agricolas no Estado de Sao Paulo," Agricultura em Sao Paulo, Ano X, No. 4, April 1963, D.P.V. Secretaria de Agricultura do Estado de Sao Paulo.

Relative Prices



Source: Divisão de Economia Rural.

It is not uncommon to find farmers producing corn on a commercial basis with yields as high as three tons per hectare in the state of Sao Paulo. A large number of experiments carried on for several years in the Instituto Agronomico de Campinas have shown that using the right fertilization and the right plant density, yields as high as 4.6 tons per hectare may be obtained using the variety of corn known as "Azteca," and even higher yields are obtained with hybrid material. Furthermore, the agronomists of the state agricultural department claim that few regions of the world have as good conditions for growing corn as the ones found in the state of Sao Paulo.

Rice. A yield equal to 1.6 tons of rice was used. This yield is about 0.6 tons higher than the average state yield, but results of experiments show that it is possible to obtain this yield. However, rice requires certain ecological conditions not found in the state of Sao Paulo and its production has been discouraged by the agricultural department except in a few regions where the ecological conditions are better than average and where irrigation facilities are available. The major problem with rice in the state of Sao Paulo is the fact that over 70 percent of all rice in the state is produced in the uplands with no irrigation, which makes the crop extremely dependent upon a favorable distribution of rain; this results in high year to year variations in yields. Under such circumstances, the production of rice becomes risky and probably it is a crop that should be avoided in the region being studied. In any case, it is included in one plan for the farms being analyzed, mainly because it is the purpose of this study to analyze the potential competitive position of basic food crops.

Beans. A yield of one ton per hectare is considered in all plans, which is about twice as high as the state average. The low state average, however, is probably a consequence of the peculiar conditions surrounding the production of beans in Brazil. The country is the largest producer of edible beans in the world, but beans in Brazil have been traditionally an unimportant crop in the farm unit. Most of the beans are produced by sharecroppers or farm laborers in between the rows of coffee and sugar cane, and practically none are produced on a commercial scale.

Experimental results have shown that yields over one ton per hectare for wet season beans using the right fertilization and good varieties are relatively easy to obtain. A word of caution, however, is necessary. It is becoming more and more evident that when beans are produced on a commercial basis, year after year, some kinds of diseases will appear creating unexpected difficulties. Since farmers in the Piracicaba region have had practically no experience with the production of beans on a commercial scale, the plans that include beans in a relatively large scale should be viewed with some caution.

The Farms

In order to make the analysis of the alternative plans, three fornecedores' farms were selected and four alternative plans were analyzed for each of the three.

The farms are representative of the three modal classes found in the sample frequency distribution of farm size. The smallest of the three farms has an area of 21.90 hectares; the second largest farm of the three has an area of 48.40 hectares; and the largest farm has an area of 82.49 hectares.

The smallest of the three farms chosen for the analysis will be called farm X. The operator of farm X does not have a tractor, but his land is prepared by machinery which he hires. He does, however, have a truck which he uses to haul his cane and that of his neighbors, the custom work providing him with off-farm income which will be maintained for all four plans for this farm.

The median size farm will be called farm Y. The operator of farm Y does not have a tractor and prepares his land with animals. In the four alternative plans it will be supposed that the operator will have his land prepared by machinery which he will hire. This will allow a small reduction in the number of his workstock, which will make possible some reduction in the pasture land of the actual plan, increasing the crop area of farm Y.

This farm also has 2.42 hectares of woodland which will be maintained the same in all four plans since this land is inadequate for agricultural use. The operator of farm Y has a truck which he uses to haul his cane and he also hauls cane for his neighbors, which provides him with off-farm income. This off-farm income will be maintained in all four plans. The farmer also has a large amount of family labor, part of which is employed off the farm part of the year providing additional non-farm income which is also maintained in the alternative plans.

The largest farm will be called farm Z. The operator of this farm has a truck and tractor and consequently all of his cropland is prepared by machinery. This farm has 11 hectares of pasture and 6 hectares of woodland. In the alternative plans all the woodland will be put into

crops as well as half of the pasture land. This is possible because all of this land is suitable for cropping.

The reduction of pasture land by half implies an equivalent reduction in the number of livestock which will reduce the value of the capital assets and consequently the value of interest on average capital from NCr.\$ 5,242.80 to NCr.\$ 2,188.00.

The Alternative Plans

The first plan is called Improved Cane plus Corn, and it is basically a sugar cane plan. In this plan, the area planted to cane in the original period (1966) is maintained, but the rotation among planted cane, first, second and third cut cane is changed to one fourth planted cane, one fourth first cut cane, one fourth second cut cane and one fourth third cut cane. With this cut combination and adequate fertilization the 55 tons yield should be easily obtained. The remaining crop area is planted to corn.

The second plan is called Half Cane Area plus Corn and Rice; as the name indicates, the area planted to cane is reduced by half of what it was in the original plan (1966) and the remaining crop area is distributed between rice, approximately one third, and to corn, approximately two thirds.

The third plan is called Half Cane Area plus Corn and Beans, and it is similar to the second plan, except that instead of rice beans are planted.

The fourth plan is called Half Cane Area plus Corn; in this plan the area planted to cane is reduced by half of what it was in the original (1966) plan and the remaining crop area is planted all to corn.

For the crops considered, the basic information is: ^{37/}

Sugar Cane

Yield: 55 ton/ha. (of area harvested; being 1/3 first cut, 1/3 second cut, and 1/3 third cut)

Prices: ^{38/} NCr.\$ 10.007/ton
NCr.\$ 8.565/ton

Labor Re-quirements: New Cane (not including harvest): 21 man day/ha.
2nd Cut Cane (not including harvest): 11 man day/ha.
3rd Cut Cane (not including harvest): 9 man day/ha.

Harvest: 1 man day harvests 1.5 tons of non-burned cane
or 1 man day harvests 2.25 tons of burned cane

^{37/} Prices and labor requirements for the crops considered were obtained at the Divisao de Economia Rural. Information on yields of the crops were obtained from the following publications:

- a) for cane: Zink, Frederico, "A Cultura da Cana de Acucar," Boletim Tecnico-DPA-No. 3, Secretaria da Agricultura.
- b) for rice: Miranda, Hilario da Silva and Derly Machado de Souza, Instrucoes Para a Cultura do Arroz (mimeo) Instituto Agronomico, Campinas S.P. 1964.
- c) for corn: Miranda, Luiz Gomes de - "Hibridos e Variedades," Bragantia, Instituto Agronomico Campinas S.P.
- d) for beans: Mascarenbas, H.A.A., et al., "Influencia das Formas de Fertilizantes Nitrogenados e suas Epocas de Aplicacao na Cultura do Feigao," Bragantia, vol. 25, September 1966.

^{38/} The prices of sugar cane are determined every year prior to the beginning of the milling season. For 1966 the prices are those shown above, and the reason for their having two prices is that there are two kinds of sugar produced. The higher price is for the cane that will be used for production of white centrifugal sugar for domestic consumption. The lower price is for cane that will be used for the production of the export type sugar (Demerara). The fornecedores were paid the higher price for approximately 76 percent of their cane and received the lower price for the rest. The reason for this percentage distribution is the fact that for the region being studied the mills received a production quota in which 24 percent of the total is export sugar and 76 percent is sugar for the domestic market.

Corn

Yield: 4.00 tons/ha.
Price: NCr.\$ 69.31/ton
Labor Re-
quirements: 17.50 man day/ha.

Rice

Yield: 1.6 ton/ha.
Price: NCr.\$ 172.76/ton
Labor Re-
quirements: 48.00 man day/ha.

Beans

Yield: 1.0 ton/ha.
Price: NCr.\$ 416.98/ton
Labor Re-
quirements: 30.00 man day/ha.

In the following pages the actual agricultural plan as well as the four alternative plans will be presented for each of the three modal farms. Each one of the plans will be presented in a tabular format followed by a simplified budget.

Present and Alternative Agricultural Plan

For Farm X

TABLE 27. PRESENT AGRICULTURAL PLAN - FARM X
PIRACICABA REGION, 1966

(Tons)

Crop	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	4.84				
1st cut	3.60				
2nd cut	3.00				
3rd cut	7.80				
Total	19.24	630.00	24.00	10.00	568.00 ^{a/}
Rice	1.21	0.78			0.78
Cane & beans	0.60	0.24			0.24
Cane & corn ^{b/}	2.24	3.00		2.10	0.90
Pasture	1.21				
Farmstead	.24				
Total	21.90				

a/ 28 tons of sugar cane were discounted. It is a common practice for mills to discount about 3 percent from the gross volume sold for unburned cane and up to 15 percent for burned cane.

b/ Cane and beans and cane and corn are associated crops and the area should not be added to the total area.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

Receipts:	NCr.\$
Sugar Cane Sales	5,486.00
Miscellaneous income	3,920.00 ^{a/}
Total	9,406.00
Operational Expenses	5,071.00
New Investment	5,500.00
Total	10,571.00
Change in Inventory	+ 4,049.00
Farm Family Income	2,884.00

a/ Miscellaneous income is: NCr.\$ 120.00 from the sale of one animal; NCr.\$ 2,600.00 from hauling cane for other farmers; and, NCr.\$1,200.00 from the sale of a used truck.

TABLE 28. IMPROVED CANE PLUS CORN (FIRST PLAN)
FARM X PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	4.75				
1st Cut	4.75				
2nd Cut	4.75				
3rd Cut	4.75				
Total	19.00	783.75	19.00		725.75 ^{a/}
Cane & Beans	1.00	0.50		0.50	
Corn	1.45	5.80		2.10	3.70
Pasture	1.21				
Farmstead	0.24				
Total	21.90				

^{a/} 39 tons were discounted.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	7,011.00
Corn Sales	256.00
Miscellaneous Income	3,920.00
Total	11,187.00
Operational Expenses	5,796.00
New Investment	5,500.00
Total	11,296.00
Change in Inventory	+ 4,049.00
Farm Family Income	3,940.00

TABLE 29. HALF CANE AREA PLUS CORN AND RICE
(SECOND PLAN) FARM X PIRACICABA REGION, 1966

(Tons)

Crop	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	2.37				
1st Cut	2.37				
2nd Cut	2.37				
3rd Cut	2.37				
Total	9.48	391.00	9.00		362.50 ^{a/}
Rice	3.65	5.80		0.70	5.10
Corn	7.32	29.20		2.10	27.10
Cane & Beans	1.00	0.50		0.50	
Pasture	1.21				
Farmstead	0.24				
Total	21.90				

^{a/} 19.50 tons were discounted.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	3,702.00
Corn Sales	1,878.00
Rice Sales	881.00
Miscellaneous Income	3,900.00
Total	10,361.00
Operational Expenses	5,629.00
New Investment	5,500.00
Total	11,129.00
Change in Inventory	+4,049.00
Farm Family Income	3,281.00

TABLE 30. HALF CANE AREA PLUS CORN AND BEANS
(THIRD PLAN) FARM X PIRACICABA REGION, 1966

(Tons)

Crop	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	2.37				
1st Cut	2.37				
2nd Cut	2.37				
3rd Cut	2.37				
Total	9.48	391.00	9.00		362.50 ^{a/}
Beans	3.65	3.65		0.65	3.00
Corn	7.32	29.20	2.10		27.10
Pasture	1.21				
Farmstead	0.24				
Total	21.90				

^{a/} 19.50 tons were discounted

Receipts, expenses and income are summarized below:

Receipts	NCr. \$
Sugar Cane Sales	3,702.00
Corn Sales	1,878.00
Beans Sale	1,251.00
Miscellaneous Income	3,920.00
Total	10,751.00
Operational Expenses	5,650.00
New Investment	5,500.00
Total	11,150.00
Change in Inventory	+ 4,049.00
Farm Family Income	3,650.00

TABLE 40. HALF CANE AREA PLUS CORN (FOURTH PLAN)
FARM X PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	2.37				
1st Cut	2.37				
2nd Cut	2.37				
3rd Cut	2.37				
Total	9.48	391.00	9.00		362.50 ^{a/}
Corn	10.97	43.88		2.10	41.78
Cane & Beans	1.00	0.50		0.50	
Pasture	1.21				
Farmstead	0.24				
Total	21.90				

^{a/} 19.50 tons were discounted.

Receipts, expenses and income are summarized below:

Receipts	NCr. \$
Sugar Cane Sales	3,702.00
Corn Sales	2,896.00
Miscellaneous Income	3,996.00
Total	10,594.00

Operational Expenses	5,643.00
New Investment	5,500.00
Total	11,143.00

Change in Inventory + 4,049.00

Farm Family Income 3,500.00

Discussion

Present Plan (Farm X)

In the actual plan the total labor force utilized was estimated at about 28 man-months. From this total the operator and family provided 24 and the other four were hired labor.

First Plan (Farm X)

The total labor requirements are 31 man-months. Of this total the operator and family will provide 24 man-months as in the actual plan and 7 man-months will be hired. The farmer will continue to haul cane for his neighbors.

Farm family income is increased by almost 50% over the value of farm income in the original plan. This plan, however, is basically a sugar cane plan with a more rational production of sugar cane proposed, and although corn sales are now contributing to the total income, no conclusions can be derived about the competitive position of corn in relation to sugar cane. An interesting point to note, however, is that this farmer would be producing about 100 tons more sugar cane than he was originally producing; with the new plan he not only can produce more cane, but he can also produce corn as a cash crop.

Second Plan (Farm X)

As is clear, farm family income is reduced to a lower level. An increase in the production of corn and rice cannot compensate for the reduction of sugar cane plantings to one half. It becomes clear that these crops cannot compete with sugar cane, at least given the assumptions and enterprise combinations presented in the second plan.

In this plan there is a reduction in the total labor requirement primarily caused by a reduction in the labor requirement for cane harvesting. The total labor requirement is 27 man-months.

Third Plan (Farm X)

The total labor requirement for this plan is 25 man-months; the family will provide 24 man-months and one man-month will be hired.

The farm family income is higher than the one in the second plan. This indicates that beans have a better competitive position when compared with rice. Farm income, however, is still somewhat lower than the income of the first agricultural plan where only cane and corn were considered.

Fourth Plan (Farm X)

The total labor requirement for this plan is 23 man-months which allows another man-month of work off the farm, increasing miscellaneous income. Farm income, however, is also reduced slightly from that of the third plan which indicates beans have a better competitive position compared with corn.

Present and Alternative Plans for Farm Y

TABLE 41. PRESENT AGRICULTURAL PLAN - FARM Y
PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	6.60				
1st Cut	3.60				
2nd Cut	10.80				
3rd Cut	6.60				
Total	27.60	557.00	20.00		520.00 _{a/}
Corn	7.26	6.00		3.60	2.40
Cane & Beans	0.60	0.30			0.30
Pasture	9.68				
Farmstead	1.21				
Woodland	2.42				
Total	48.40				

a/ 17 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and incomes are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	4,277.00
Miscellaneous	4,000.00 _{a/}
Total	8,277.00
Operational Expenses	3,451.00
Total	3,451.00
Change in Inventory	- 107.00
Farm Family Income	4,719.00

a/ Work off the farm plus truck service.

TABLE 42. IMPROVED CANE PLUS CORN (FIRST PLAN)
FARM Y PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	6.90				
1st Cut	6.90				
2nd Cut	6.90				
3rd Cut	6.90				
Total	27.60	1,138.00	28.00		1,050.00 ^{a/}
Corn	10.94	43.76		3.60	2.40
Cane & Beans	1.00	0.30			0.30
Pasture	6.00				
Farmstead	1.21				
Woodland	2.42				
Total	48.40				

^{a/} 60 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	10,144.00
Corn Sales	2,617.00
Miscellaneous Income	4,000.00
Total	16,761.00
Operational Expenses	7,682.00
Total	7,682.00
Change in Inventory	- 107.00
Farm Family Income	8,972.00

TABLE 43. HALF CANE AREA PLUS CORN AND RICE
(SECOND PLAN) FARM Y, PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	3.45				
1st Cut	3.45				
2nd Cut	3.45				
3rd Cut	3.45				
Total	13.80	569.00	14.00		527.00 ^{a/}
Rice	8.74	13.98		0.60	13.38
Corn	16.00	64.00		3.60	58.00
Cane & Beans	1.00	0.30		0.30	
Pasture	6.00				
Farmstead	1.21				
Woodland	2.42				
Total	48.40				

^{a/} 28.00 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses are summarized below:

Receipts	NCr.\$
Sugar Cane Sales	5,092.00
Corn Sales	4,020.00
Rice Sales	2,312.00
Miscellaneous	4,000.00
Total	15,424.00
Operational Expenses	7,925.00
Total	7,925.00
Change in Inventory	- 107.00
Farm Family Income	7,392.00

TABLE 44. HALF CANE AREA PLUS CORN AND BEANS
(THIRD PLAN) FARM Y PIRACICABA REGION, 1966

(Tons)

Crop	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	3.45				
1st Cut	3.45				
2nd Cut	3.45				
3rd Cut	3.45				
Total	13.80	569.00	14.00		527.00 ^{a/}
Beans	8.74	8.76		0.36	8.40
Corn	16.00	64.00		3.60	2.40
Pasture	6.00				
Farmstead	1.21				
Woodland	2.42				
Total	48.40				

^{a/} 28.00 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	5,092.00
Corn Sales	4,020.00
Beans Sales	3,503.00
Miscellaneous Income	4,076.00
Total	16,691.00
Operational Expenses	7,904.00
Total	7,904.00
Change in Inventory	- 107.00
Farm Family Income	8,680.00

TABLE 45. HALF CANE AREA PLUS CORN (FOURTH PLAN)
FARM Y PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	3.45				
1st Cut	3.45				
2nd Cut	3.45				
3rd Cut	3.45				
Total	13.80	569.00	14.00		527.00 ^{a/}
Corn	24.74	98.96		3.60	2.40
Beans & Cane	1.00	0.30			0.30
Pasture	6.00				
Farmstead	1.21				
Woodland	2.42				
Total	48.40				

^{a/} 28.00 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	5,092.00
Corn Sales	6,443.00
Miscellaneous Income	4,380.00
Total	15,915.00
Operational Expenses	7,950.00
Total	7,950.00
Change in Inventory	- 107.00
Farm Family Income	7,858.00

Discussion

Present Plan (Farm Y)

This farm is operated entirely by the farmer's family. It had a total availability of labor of 54 man-months. It was estimated that about 44 man-months worked in the farm and 10 man-months worked off the farm harvesting and hauling cane for neighbors.

This relatively large amount of labor being used for the amount of cropping done in this farm can be explained by the fact that all the land preparation is done by animals.

First Plan (Farm Y)

The total labor requirement for this plan is 50 man-months and the family will provide 44 and 6 will be hired.

Farm family income is greatly increased in this plan relative to the first plan and two factors explain this increase. First, the increase in sugar cane yield doubles the production of cane with the same crop area, and second, the introduction of corn as a cash crop.

Second Plan (Farm Y)

The total labor requirement for this plan is 51 man-months and the family will provide 44 and 7 will be hired.

Farm family income is reduced considerably relative to the first alternative plan, indicating that a reduction in cane area cannot be compensated by an increase in the production of rice and corn.

Third Plan (Farm Y)

In this plan total labor requirements are reduced to 43 man-months, this allows another man-month to work off the farm. Farm family income

in this plan is increased by almost NCr.\$ 1,300 compared to the second plan, which again indicates the excellent competitive position of beans, at the relatively high 1966 prices.

Fourth Plan (Farm Y)

Total labor requirement for this plan is reduced to 39 man-months. This will allow another five man-months to work off the farm. Farm family income is reduced by almost NCr.\$ 1,000.00 from that of the third plan, once again indicating that beans have a better competitive position than corn.

Present and Alternative Agricultural Plans for Farm Z

TABIE 46. PRESENT AGRICULTURAL PLAN - FARM Z
PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	9.68				
1st Cut	3.60				
2nd Cut	29.40				
3rd Cut	6.00				
4th Cut	3.60				
Total	52.28	2,215.00	30.00		1,997.00 ^{a/}
Corn	9.60	12.00		12.00	
Rice	1.20	0.30			0.30
Pasture	11.00				
Woodland	6.00				
Reforested	1.20				
Farmstead	1.21				
Total	82.49				

^{a/} 52.00 tons were not harvested and an additional 136.00 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	17,555.00
Total	17,555.00
Operational Expenses	8,696.00
Total	8,696.00
Change in Inventory	-1,210.00
Farm Family Income	7,649.00

TABLE 47. IMPROVED CANE PLUS CORN (FIRST PLAN)
FARM Z. PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	13.00				
1st Cut	13.00				
2nd Cut	13.00				
3rd Cut	13.00				
Total	52.00	2,145.00	39.00		2,000.70 ^{a/}
Corn	22.58	90.32		6.00	
Pasture	5.50				
Reforested	1.20				
Farmstead	1.21				
Total	82.49				

^{a/} 105.30 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	19,329.00
Corn Sales	5,844.00
Total	25,173.00
Operational Expenses	16,205.00
Total	16,205.00
Change in Inventory	-1,210.00
Farm Family Income	7,758.00

TABLE 48. HALF CANE AREA PLUS CORN AND RICE
(SECOND PLAN) FARM Z PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	6.50				
1st Cut	6.50				
2nd Cut	6.50				
3rd Cut	6.50				
Total	26.00	1,072.50	19.50		1,000.35 ^{a/}
Rice	16.19	25.90		0.48	25.42
Corn	32.39	129.56	6.00		123.56
Pasture	5.50				
Reforested	1.20				
Farmstead	1.21				
Total	82.49				

^{a/} 52.65 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and incomes are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	9,664.00
Corn Sales	8,564.00
Rice Sales	4,392.00
Total	22,620.00
Operational Expenses	15,724.00
Total	15,724.00
Change in Inventory	-1,210.00
Farm Family Income	5,686.00

TABIE 49: HALF CANE AREA PLUS CORN AND BEANS
(THIRD PLAN) FARM Z PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	6.50				
1st Cut	6.50				
2nd Cut	6.50				
3rd Cut	6.50				
Total	26.00	1,072.50	19.50		1,000.35 ^{a/}
Beans	16.19	16.19		0.19	16.00
Corn	32.39	129.56		6.00	123.56
Pasture	5.50				
Reforested	1.20				
Farmstead	1.21				
Total	82.49				

^{a/} 52.65 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr.\$</u>
Sugar Cane Sales	9,664.00
Corn Sales	8,564.00
Beans Sales	6,672.00
Total	24,900.00
Operational Expenses	15,978.00
Total	15,978.00
Change in Inventory	-1,210.00
Farm Family Income	7,712.00

TABLE 50. HALF CANE AREA PLUS CORN (FOURTH PLAN)
FARM Z PIRACICABA REGION, 1966

(Tons)

Crops	Hectares	Total Production	Crop Utilization		
			Seed	Feed Consumption	Sale
Cane					
Planted	6.50				
1st Cut	6.50				
2nd Cut	6.50				
3rd Cut	6.50				
Total	26.00	1,072.50	19.50		1,000.35 ^{a/}
Corn	48.58	194.32		6.00	188.32
Pasture	5.50				
Reforested	1.20				
Farmstead	1.21				
Total	82.49				

^{a/} 52.65 tons were discounted.

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

Receipts	NCr.\$
Sugar Cane Sales	9,664.00
Corn Sales	13,052.00
Total	22,716.00
Operational Expenses	15,369.00
Total	15,369.00
Change in Inventory	-1,210.00
Farm Family Income	6,137.00

Discussion

Present Plan (Farm Z)

This farm has a total labor force of 52 man-months with the operator and family providing 22 man-months. The 30 others were hired labor, primarily for cane harvesting. It should be noted that in 1966 this farm had an average yield of 52 tons of sugar cane per hectare. This relatively high yield is explained in part by a high percentage of first and second cut cane (about 75.5 percent).

First Plan (Farm Z)

The total labor requirement for this plan is 95 man-months with the family providing 22, and 73 being hired.

Farm Family Income in this plan is practically the same as in the original plan and this can be explained by the fact that in this plan it is assumed that all cane will be harvested and none will be burned, contrary to what happened in the actual plan; elimination of burning will increase labor costs.

Second Plan (Farm Z)

The total labor requirement for this plan is 94 man-months; the family will provide 22 and 72 will be hired. Income is reduced by over NCr.\$ 2,000, indicating that rice and corn cannot compete with cane, given the assumptions underlying these plans.

Third Plan (Farm Z)

Total labor requirement for this plan is 83 man-months; 22 months of family labor and 61 hired. Farm Family Income in this plan increases by about NCr.\$ 2,000 over the second plan, indicating again the very good competitive position of beans.

Fourth Plan (Farm Z)

In this plan the total labor requirement is 74, the family will provide 22 man-months and 52 will be hired.

Farm income is reduced by over NCr.\$ 1,500 compared to the third plan, indicating again that between corn and beans, beans have a stronger competitive position.

General Conclusions

Table 51 presents a summary of the results of the plans analyzed.

TABLE 51. INCOME FOR THE ORIGINAL AND FOUR ALTERNATIVE
PLANS FOR THE THREE MODAL FARMS
PIRACICABA REGION, 1966

(NCr.\$)

Plans	Farm X	Farm Y ^{a/}	Farm Z
	(Farm Family Income)		
Present Plan	2,884.00	4,719.00	7,649.00
Improved Cane + Corn (1st Plan)	3,940.00	8,972.00	7,758.00
Half Cane Area + Corn & Rice (2nd Plan)	3,281.00	7,392.00	5,686.00
Half Cane Area + Corn & Beans (3rd Plan)	3,650.00	8,680.00	7,712.00
Half Cane Area + Corn (4th Plan)	3,500.00	7,858.00	6,137.00

a/ The farm family income under the four alternative plans for farm Y are high due to large amount of off-farm income made possible by the large amount of family labor available on this farm.

Source: Piracicaba survey, 1967.

It is apparent that cane enjoys the best competitive position when compared with the other three crops considered. This is clearly shown for all three farm sizes. When the production of cane is reduced, incomes are also reduced, no matter what kind of crop combination is analyzed.

In relation to the other three crops, rice is the one that presents the poorest competitive position as is illustrated by consistently lower incomes whenever rice is produced on any of the three farms.

Between corn and beans, beans present a better competitive position which is illustrated by the fact that when beans are eliminated from an agricultural plan in which they were being grown along with corn, and only corn is then grown, incomes decrease. For all farms, income decreases from the third to the fourth plan. In short, it is possible to say that the four crops analyzed can be ordered according to their competitive position as: sugar cane, beans, corn, and rice.

The strong competitive position of beans probably results from an unusual increase in prices of beans relative to corn in 1966. Referring back to the chart on page 68, it can be seen that relative corn and bean prices have been approximately the same throughout the years, however, in 1966 the price of beans more than doubled from the 1965 price level, while the price of corn in 1966 went up by less than 20% over 1965 prices. (In 1965 the price of beans was 10,370 old cruzeiros per 60 kilograms and the price of corn was 3,650 old cruzeiros per 60 kilograms; in 1966 the price of beans was 24,980 and the price of corn was 4,650 old cruzeiros.) If the relationship between the prices of beans and corn return to what it was in the

period preceding 1965, corn will be in a much better position relative to beans; however, if this recent trend continues, beans will maintain their advantaged position.

It is apparent that when farmers are limited in their production of sugar cane by quotas, and if they have unused resources and wish to increase their income, the results of this study indicate that beans are the next most profitable crop, followed by corn. As was mentioned previously, however, the present state of the agronomic arts leads us to expect problems when beans are produced on a rather large scale, and if there is room for subjective arguments, the author feels that cane and corn would be the best enterprise combination for farmers in the region given the present level of knowledge and experience about these crops.

As shown in Table 51, incomes are the highest for all three farms with the first plan, and although this plan is basically a sugar cane plan, some corn as a cash crop is grown on all farms. Under the first plan, Farm X would be producing 725 tons of sugar cane and this total is 125 tons above the quota entitled to the farms; this relatively small amount of cane above quota probably could be sold to other mills of the region, allowing the farmer the additional income and eventually the acquisition of a second quota for this amount in another mill. If, however, the selling of this cane is not possible, the farmer would have to adjust production to a level compatible with his present quota.

For Farm Y the first plan is quite unrealistic because it implies a production of 1,050 tons of sugar cane and the farm has a quota of only 550 tons of cane; it would be difficult, if not impossible, to

sell all the extra cane the farm would be producing above the established quota.

For Farm Y, the two next best, and most realistic alternative plans, would be the third and fourth. In both plans the farm would be producing 527 tons of sugar cane, an amount very close to the quota allowed the farm. Income is more than half again that in the original plan as a result of an improved sugar cane cropping system, accompanied by the introduction of corn and beans.

On Farm Z, the first plan is by far the best alternative since this farm has a quota of 2,000 tons of sugar cane and with this plan it would be producing 2,000 tons of sugar cane per year. However, as can be seen in Table 51, income with the first plan is about NCr.\$ 7,000 which is practically the same as the farm income the actual plan for Farm Z. These results would indicate that for this particular farm there is no need for any improvement in its farming system; however, it should be remembered that this farm had a high sugar cane yield (52 tons/ha.) which was a result of a large percentage of first and second cut sugar cane (75.5%) which is approximately the program called for under the alternative plan. This high yield, however, will not be maintained in future years unless a more systematic system of planting and replanting is initiated. With the first plan, the proportion of planted, first, second and third cut cane will always be the same, thereby allowing for a constant yield of 55 tons of cane per hectare, permitting income to be maintained at this relatively high level.

It becomes clear from the analyses of these plans that the reduction of sugar cane crop area by half with an equal increase in area planted to food crops does not increase farm income by the proposed

30 per cent put forth as the economic criterion, indicating that the hypothesis proposed for this study should be rejected. The analyses, however, indicate that although none of the food crops can compete with sugar cane, an increase in production of these crops is possible with visible advantages in income. This is particularly true for a farm with available resources which cannot be put into sugar cane production because of quota restrictions; Farm Y is a good example of such a case. With a better sugar cane cropping system and with other crops being produced for sale, income is greatly increased.

Improved Farming System for the Mill's Farm

Introduction

As was suggested in the latter sections, none of the three food crops (rice, beans and corn) can compete with sugar cane in the Piracicaba Region. Under these circumstances it is not reasonable to propose alternative agricultural plans for the mill's farm. However, the improved cane plus corn plan will be presented because with this plan the mill's farm will be producing the amount of sugar cane necessary to supply the mill's needs for raw material and at the same time increase income through the introduction of corn as a cash crop.

Before introducing this alternative plan a summary of the actual plan will be presented in order to make the comparison easier.

Present Plan (Mill's Farm)

The present plan for the mill's farm is presented in Chapter III. In 1966 a total of 1,928 man-months of labor was used and the farm was basically a sugar cane farm. Crops such as beans, corn, and rice were planted, but they were only for use within the farm and not for sale.

For the mill's farm, the income measure that will be used for comparison will be return to capital, because labor income is not an appropriate measure for a corporate farm. Under the original plan return to capital was NCr.\$ 115,915.10.

Improved Cane Plus Corn Plan (Mill's Farm)

Table 52 presents the land utilization for this plan.

TABLE 52. IMPROVED CANE PLUS CORN PLAN
SANTA CRUZ FARM, PIRACICABA REGION, 1966
(Tons)

Crops	Hectares	Production	Crop Utilization		
			Seed	Feed	Sale
Cane					
Planted	302.00				
1st Cut	302.00				
2nd Cut	302.00				
3rd Cut	302.00				
Total	1,208.00	49,830.00	906.00		48,924.00
Corn	122.10	484.38		39.00	445.38
Pasture	105.27				
Reforested	225.00				
Idle	116.00				
Roads, houses, etc.	140.36				
Total	1,916.64				

Source: Piracicaba survey, 1967.

Receipts, expenses and income are summarized below:

<u>Receipts</u>	<u>NCr. \$</u>
Sugar Cane Sales	472,867.60
Corn Sales	30,879.68
Miscellaneous	1,450.00
Total	505,197.28
Operational Expenses	357,693.44
Management Cost	18,000.00
Total	375,693.44
Return to Capital ^{a/}	129,503.84

^{a/} Decrease in inventory caused
by machinery depreciation is accounted for.

This plan calls for a total labor force of approximately 1,600.00 man-months of labor force. Land in pasture is reduced by half, rice is eliminated and corn is produced on the land made available for crops through the reduction of pasture. The land that was idle in the previous plan is left idle because most of this land is unsuitable for agricultural purposes. The amount of land in cane is maintained the same but the cut combination is changed to one fourth of planted cane, one fourth of first cut cane, one fourth of second cut cane, and one fourth of third cut cane.

The return to capital in this plan is increased by NCr. \$ 13,588.74, resulting from the introduction of corn as a cash crop. There was not an increase in the sale of cane even though yields are higher because the new cut combination reduces the area harvested.

VI

SUMMARY

In this thesis an analysis of the possibilities for increasing food production in a sugar cane area was made. A survey of 26 sugar cane farms and one sugar mill was carried out with present land utilization on these farms being described. Simple tabular analysis was used to explain the influence of farm management factors on yields and incomes.

The 26 farm sample was divided into three categories: small, median and large farms. One of the farms in the sample was atypically large which made it necessary to review the large farm category from two perspectives, one including this farm and the other not. This large farm is referred to as farm A.

The average area of farms varied from 18.1 hectares for the small category to 74.6 hectares for the large farm category (109.0 hectares, if farm A is included) and the average size of the middle farm category was 35.6 hectares. For each of the groups, over 50 percent of the land was cropped, and about 30 percent was pasture land, although on almost all farms livestock was an unimportant enterprise except for workstock.

No specialized machinery for sugar cane was reported but trucks and tractors were important items, except in the small farm group.

Sugar cane plantings occupied well above 50 percent of the crop land and corn was the second most important crop, but in no manner could it be considered a cash crop. Rice and beans are common crops on

practically all farms, but are primarily subsistence crops and sales of these products are incidental.

The labor force is largely provided by the operator and family, although during the harvesting of sugar cane a few laborers are hired, except for farm A which had over 90 percent of the labor supplied by hired laborers.

Sugar cane yields ranged from 37 tons per hectare for the small farm category to 58 tons per hectare for the large farm category, with 47 ton yields for the middle farm category. This variation is largely explained by differences in fertilizer use and by the combination of sugar cane cuts. The larger the percentage of old cane, the lower the yield.

Farm income varied from NCr.\$ 924. for the small farm category to NCr.\$ 3,739 for the large farm category, or NCr.\$ 6,806 if farm A is included.

Factors such as high crop yields have a definite influence on farm income; the higher the crop yield index, the higher the farm income. Another factor that influences farm income is the proportion of cultivated land planted to cane; the higher this proportion, the higher the income, which is probably a consequence of sugar cane being the only commercial crop, other crops for the most part being subsistence crops. Their value, consequently, does not appear in the calculation of farm income.

Another factor that affects farm income is the value of farm assets. As farm capital increases, so does farm income; however, in this case, the increase is not proportional to the increase in capital, the reason being the existence of associated variations in the area planted to cane.

Labor income presented a somewhat unexpected variation, it ranged from NCr.\$ 266.00 for the small farm category to -134.00 new cruzeiros for the large farm category (or NCr.\$ 1,122.00 if farm A is included). This variation could be explained by analysis of the relationship between the ratio of cultivated land to total land area. As the ratio of cultivated land to total land area increased, so did labor income; the reason is that many farmers were not making full use of their land resources due to sugar cane quota restrictions. In calculating labor income, a 6 percent rate of interest was charged against the capital assets, and this interest charged against land not being intensively used reduced the labor income of farms which had relatively small sugar cane quotas when compared with their total land area.

To analyze the possibility of increasing production of food crops, three representative farms were chosen, one for each of the three modal size classes identified, and four alternative agricultural plans were analyzed through budgeting for each of the three farms. This was also done for the mill's farm. In the four plans analyzed, sugar cane showed the best competitive position when compared with beans, corn, and rice. Beans presented the next best competitive position after cane, followed by corn, with rice in the worst position.

As was mentioned earlier, the production of beans on a large scale may present some difficulties and the author is reluctant to recommend an increase in the production of beans until more is known about the crop. However, beans present a major potential for increase in income wherever there is land available and sugar cane production cannot be increased.

Corn is the crop which the author believes should be produced in combination with cane. The reasons are: 1) the production of corn in combination with sugar cane, when farmers have resources that cannot be used for cane due to quota restrictions, can increase the income of the farm, 2) a large amount of knowledge about corn production techniques is available to farmers, 3) high yields are readily obtainable when the right plant density and the right fertilization is used, and 4) due to good ecological conditions for corn, the region presents few problems regarding insect and disease control.

For each of the budget plans, it was assumed that crops would be sold immediately after harvesting because practically no farm had adequate storage facilities; this means that production is scheduled to be sold in a period when prices are lowest. Seasonal price variations in the state of Sao Paulo are large, and prices go up fast in the months between harvest seasons; if farmers could store their products it is conceivable that incomes would increase even further.

It was not possible to obtain adequate data concerning the possibility of storing products for this research project, study of this possibility is recommended because on-farm storage might not only increase farmers' incomes, but might also help to stabilize the flow of products to the market.

This study was an exploratory study to open the way for more research in the Piracicaba region. Although limited in its scope, the study suggests that possibilities do exist for increases in food crop production in combination with sugar cane, particularly in view of the possibility that cane production will not increase in the immediate future as was suggested in the introductory chapter. Agronomic informa-

tion about the crops analyzed in this study is abundant of high quality, a relatively good extension service exists and is disseminating this information. However, little has been done about the farmers' economic and social problems. It should also be kept in mind that this study centers on the competition between crops at the farm level for the study zone. All other things were assumed equal; factors which would not necessarily hold if interregional competition between these crops was being evaluated.

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