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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)

ARGENTINA

OPTIONS FOR DIVERSIFYING CANE SUGAR DERIVATIVES IN TUCUMAN PROVINCE AND PROPOSED ACTION PLAN

PROJECT N° US/ARG/89/208

Final Report

November 1993

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INTRODUCTION

The purpose of this study is to identify options for diversifying the production of cane-sugar derivatives in Tucumán province and to develop a plan of action indicating activities thereunder which should be accorded priority.

The prevailing economic, political and institutional conditions at the time the project was identified in 1989 have changed considerably in the meantime. UNIDO had been requested to conduct the present study by the then Regional Development Secretariat, as it was until 1991, to which the National Sugar Directorate reported. Since the Secretariat was discontinued, policy in sugar matters has been the responsibility of the Regional Economic Affairs Directorate reporting to the Secretariat of Industry and Commerce, albeit with extremely limited powers and duties.

In 1991, UNIDO contracted the services of AGORA' 2000 for the study. Following a briefing in Vienna (12 March 1993), work commenced in Argentina on 19 March 1993.

At the provincial level, sugar matters come within the sphere of the Ministry of Economic Affairs (Provincial Sugar Directorate). In practice, however, given the deregulation and disengagement by the State, sugar matters are handled by cabinet members generally, policy formulation relying on the opinion of experts who give their services on a personal rather than an institutional basis. Consultants/experts are coordinated by the government, which *de facto* is the counterpart official for the project.

The institutional restructuring that has gone on has been accompanied by far-reaching structural changes in economic policy.

What has happened has been a change-over from a system of sugar cane production by the State to the complete deregulation of the sector, and from customs arrangements offering an adequate protection for the survival of a certain sector - sugar - to a generalized lowering of the level of such protection, such as to render critical the situation of several activities in the agricultural sector at large.

The coming into being of Mercosur (the common market set up by Argentina, Brazil, Uruguay and Paraguay), due to become an area where goods and services may freely circulate from January 1995 on, offers novel market opportunities but, at the same time, will condition several diversification strategies from the market standpoint, given the highly skewed pattern in scales by production costs and strategic approaches, when Argentina and Brazil are compared.

Against this background, the consultant team has been obliged to revise certain of the priorities assigned at the time their services were contracted, given the context of far-reaching institutional and economic change that has come to prevail.
The present study has the following structure:

1. Analysis of the principal features of the sugar sector in Tucumán - production, institutional and financial context within which the sector operates. This is followed by an analysis in order to discern the factors responsible for the present crisis in the sector;

2. Technical survey of the province's sugar mills. A first part analyses the respective mills, one by one, identifying what is needed in order to limit losses of energy and of sugar during the processing cycle.

   The second part is an attempt to identify potentialities and requirements for producing cane sugar derivatives;

3. Analysis of the situation in the national and international market for byproducts identified in the technical survey and possible substitutes for these, with a view to evaluating the economic feasibility of promoting novel sugar cane derivatives in Argentina;

4. Analysis of alternative financing sources needed to fund (a) the proposed plan of action comprising projects and components identified in the technical and market studies, and (b) the programme of conversion and diversification for small producers;

5. Proposed plan of action to implement a diversification strategy for the industrial sugar sector in Tucumán. Actions necessary for such implementation are identified. These seek to address the main constraints on, and potentialities offered by, the sector.

The contents of the proposed plan of action have been crosschecked with representatives of the industrial (sugar) sector, the financial sector and the authorities, both technical and legislative, of the Provincial and National Governments.

The Plan consists of six action strategies (agricultural production, industrial production, environment, institutional context, *minifundio* production, and financing). In each case are noted:

- the specific measures needing to be taken;
- the impact of such measures - their constraints and potential;
- persons/agencies responsible for implementing the measures;
- the timing called for in implementing the action strategies;
- the investment needed for the diversification plan.

The investment in question comes to US$ 132 million. Of this amount, US$ 39 million are for new industrial undertakings, US$ 10 million for converting the small producers, US$ 26 million for modernizing the sugar industry and the remainder (US$ 57 million) for optimizing the industrial processing technology.

Of the US$ 132 million outlay proposed, 40% could be financed from local and 60% from international sources. Some 24% would need to be disbursed in the short term, 33% in the medium term and the remaining 43% in the long term.

The plan could generate 300 new jobs in industry directly, in addition to those called for if the reactivation of the Tucumán Paper Mill were to be considered, and if the currently inactive distilleries were brought into operation again. In addition, the Plan is likely to benefit 3.160 marginal sugarcane grower families through the production conversion programme.

CHAPTER 1

PRINCIPAL FEATURES OF SUGAR PRODUCTION IN TUCUMÁN PROVINCE

1.1 THE IMPORTANCE OF THE SUGAR SECTOR IN TUCUMÁN PROVINCE

The sugar sector is of no great size in national terms. It accounts for about 0.75% of GDP. In the main producer provinces, however (Tucumán, Salta and Jujuy), it takes on considerable importance.

In the particular case of Tucumán, sugar cane production and processing directly generated 21% of GDP in 1991 - not counting the spin-off in terms of the services and production of other inputs having to do with the sector.

As may be seen from the table 1.1 1, the sugar sector has declined in relative importance in the composition of overall GDP. In 1975, it accounted for 29% of output, but thereafter followed a declining trend, to the point where it reached 21% of GDP, as just mentioned.

Among the factors explaining the trends described, an important place belongs to the share of "Government and Services", which practically doubled between 1970 and 1990, to the detriment mainly of the industrial sector.

According to the estimates of the Faculty of Economics of the National University of Tucumán, between the years in question, the provincial GDP rose by 19.2%. In the same period, the Government's share rose by 98% while that of industry declined by about 19%.

The significance of the sugar sector in Tucumán's output is all the greater if one studies this in the overall context of the production sector. Significantly, sugar cane growing accounts for over half of agricultural output, which in 1975 had come to about 70%.

This relative decline is due to the trend toward diversification in agricultural production, where citrus (especially lemon) plantations have come to the fore, though this is not to disregard increases in other crops such as potatoes and soya (Table 1.1.2).

As regards employment, approximately 100.000 persons, accounting for a third of the economically active population of Tucumán, depend directly or indirectly on the sugar sector.

Primary production as a whole is represented by 9.710 farms, implying farming work for at least a similar number of families.

Table 1.1.1 - Composition of Agricultural GDP for Tucumán

Sector	1970	1975	1980	1985	1990
Agriculture	16,51	18,76	18,66	20,95	19,54
- Sugar	10,75	12,90	11,60	12,11	10,05
Industry	35,63	35,34	32,80	28,10	24,21
- Sugar mills	15,15	16,40	14,43	11,81	10,99
Government and Services	12,02	12,64	14,16	16,43	20,00
Other (1)	35,83	33,25	34,38	34,51	36,52
Total	100,00	100,00	100,00	100,00	100,00
Sugar/agricult. sect.	65,11	68,76	62,65	57,80	51,43
Mills/industrial sect.	42,52	46,40	43,99	42,00	45,39
Sugar mills/GDP	25,90	29,30	26,03	23,92	21,04

Source: Consultant's own calculations from data supplied by the Chair of Statistics, Faculty of Economics, National University of Tucumán.
Note (1) : Includes Electricity, Water, Gaz, Building, Trade, Transport and Communication, Finance.

Table 1.1.2 - Composition of Agricultural GDP for Tucumán

Crop	1976	1983	1989	1990
Sugarcane	69,4	65,6	61,5	52,3
Citrus	5,4	6,2	8,2	11,2
Potato	3,3	5,4	6,3	7,8
Soya	3,6	7,4	3,4	9,8
Tomatoes-Peppers	9,6	7,2	8,2	7,4
Other	8,7	8,2	12,4	11,5
Total	100,0	100,0	100,0	100,0

Source: Consultant's calculations from data supplied by the Chair of Statistics, Faculty of Economics, National University of Tucumán

In industrial processing, the 15 mills currently in operation (following the recent closure of the San Pablo plant), average 1.000 workers each. Of the 15.084 jobs recorded in a survey conducted in 1987/88, some 35% are permanent and 65% are temporary.

Seasonal work is on offer, usually between June and October. According to current UCIT estimates, employment in the sector has fallen by one third in recent years, and thus has contributed to the increase in the numbers of unemployed and under-employed recorded in the province, rising in the aggregate to 25.6% of the economically active population, as recorded by INDEC in October 1992. This compares with the national average of 15.1%.

1.1.1 THE AGRICULTURAL SECTOR

1.1.1.1 Production

In the Argentine Republic, some 356.000 ha are given over to sugar cane. Depending on the year, between 230.000 and 320.000 ha will be harvested, making for an output of between 13 and 15 million tons yearly. (See Statistical Annex to Chapter 1 - Table 1).

Production takes place entirely in the north (basically in the northwestern provinces, which account for 95%), in the provinces of Tucumán, Salta and Jujuy. The remaining 5% comes from various eastern provinces - Santa Fé, Misiones, Corrientes, Chaco and Formosa (Statistical Annex to Chapter 1 - Table 2).

Three major production areas may be distinguished, according to their respective characteristics, thus:

- the provinces of Salta and Jujuy, where production technology is the most advanced and there is a high degree of integration between primary production and industrial processing. This is explained by the presence there of major producers, a circumstance which facilitates the application of advanced technology;
- Tucumán Province, with its major output mostly from fragmented sources, there being a large number of economically undersized *minifundio* holdings with their low level of technology;
- the area comprising the provinces of the Northeast, with problems similar to those met with in Tucumán and an output of little significance in national terms.

Tucumán province has 70% of the planted area and accounts for approximately 55% of production, though this share has been declining in recent years. Salta and Jujuy provinces together account for about 40% of production and are increasing their share (Statistical Annex to Chapter 1 - Tables 3 and 4).

1.1.1.2 Yields

According to SEAG statistics, sugar cane yields in the province have ranged over the last ten years between 39 and 43 tons/ha (Statistical Annex to Chapter 1 - Table 5). The statistics, however, are unlikely to agree wth the real figures, due to shortcomings in the method of compiling the data linked to the assigning of production quotas under the rules obtaining up to 1991. The Obispo Colombres Experiment Station estimates the average yield at around 60 tons/ha, a figure borne out by interviews with the growers' organizations (UCIT, CACTU). It should also be noted that 5% of the land area is down to plantations of new varieties offering yields of 80 tons/ha - yields it is thought will in two or three years' time account for 15% of the total.

With the varieties mentioned, Tucumán should be in a more competitive position vis-à-vis Salta and Jujuy, the latter provinces in 1980/89 achieving average yields of between 61.5 and 80.4 tons/ha, and between 69.2 and 83.3 tons/ha, respectively. Findings from experiments suggest yields of up to 95 tons/ha should be possible.

In Northeastern Argentina, yields were lower than those of Tucumán even, with a very poor average, the lowest levels being recorded in Corrientes province, with 17.1 tons/ha in 1988/89, the most recent year for which data are available. Here again, it is possible to raise yields, since pilot experiments offer results similar to those for Tucumán.

1.1.1.3 Production technology

Sugar cane production is labour-intensive, chiefly because of the heavy demand for labour for tillage and at harvesting times.

The heavy demand for seasonal labour at harvest explains the great movement of workers, together with their families, that takes place from other regions.

In Argentina, there are to be found side by side divers growing and harvesting techniques. A more highly technological type of production based, *inter alia*, on the selection of the most suitable varieties, adequate fertilizer application, makes for higher yields. As for harvesting itself, three technological levels may be distinguished: manual, semi-mechanized, and mechanized.

Hand harvesting consists in cutting the cane at the base with the machete, removing any leaves and "tops", and, lastly, piling and loading the cane onto carts. It is estimated that one worker harvests about 1.5-2 tons/day, thus taking about 30 days per hectare. In many cases, the harvest takes the form of burning the top leaves first of all. For this, it is necessary to know the precise time of ripening, if losses of output are to be avoided. In a survey of growers in Tucumán province in 1988, it was found that 54% of them burn the cane and only 23% practise manual harvesting without burning-over their plantations.

Beginning in the 1970s, semi-mechanized harvesting - of the whole cane - began to make its appearance, a development that deprived a considerable number of people of their jobs.

Semi-mechanized harvesting may consist in mechanized cutting only, or mechanized cutting and loading, reducing the time for the operation by about half that required for manual harvesting.

With mechanized harvesting, machines perform all the operations - cutting, topping, clearing and sizing and loading. In this way, a hectare of cane can be harvested in about five hours, which is equivalent to 0.6 working day per hectare.

The technology here described is the norm only in the entrepreneurial sector, which provides the growers with mechanized harvesting services. Some mills, too, undertake harvesting for the growers from whom they obtain their supplies. The industrial establishments usually grow part of their own requirements and have a considerable amount of machinery for the purpose.

According to the latest National Census of Agriculture, manual, mechanized and semi-mechanized harvesting in the main producing provinces showed the following proportions, as may be seen from the Table 1.1.3. In Tucumán province, manual harvesting is the rule on 84% of the holdings, falling to 56% in Salta and 11% in Jujuy. On the other hand, mechanized harvesting accounts for only 5% in Tucumán, as compared with 61% in Jujuy. Otherwise, the harvesting operation is semi-mechanized.

Coming, next, to the use of agricultural chemicals, one notes that fertilizers which are resorted to in about 30% of the cases, because it is necessary to make good the loss of soil nutrients. Urea is the usual source. Weedkillers. on the other hand, are little used, weeding being done by hand. Irrigation is practised in 17% of the cases - a high figure when one considers that water deficits occur in winter and spring in Tucumán. The RAICA study shows that if water were used efficiently, productive capacity could improve by some 20-30%, but should be accompanied by better levels of weed control, herbicide use, plantation design, rotation, the use of machinery and the introduction of improved varieties that are better adapted to the pecularities of the region.

A further significant element in improving sugar yields per ton of cane is proper post-harvest handling. There are notable delays between harvesting and milling, and these make for lower unit yields and poorer sugar quality. Diminution in yield can be as much as 5% in 48 hours and 10% in 72 hours. In the case of Tucumán, the time taken between cutting and milling exceeds 88 hours in the case of the growers who do their harvesting by hand, and about 66 hours with semi-mechanized procedures. Where the harvesting is wholly mechanized, as is usually the case in the country's northern provinces, the average delay is scarcely more than six hours.

1.1.1.4 Production costs

Output differences related to farm size and the level of technology used make it impossible to calculate production costs valid for all situations.

The RAICA study, in an attempt at some approximation here, divided farms into various strata between 5 ha and 400 ha, making allowance also for the different levels of mechanization within the respective segments.

Table 1.1.3 - Current situation of sugarcane production in Northern Argentina, 1988.

	Tucumán	Salta	Jujuy
Number of growers	9.710	25	84
Area (ha)	211.684	23.111	51.994
Average area per farmer (ha)	22	924	619
Manual handling:			
Number of growers	8.166	14	9
Area (ha)	74.880	742	505
Percentage of farmers	84,10%	56,00%	10,71%
Percentage of ha	35,37%	3,21%	0,97%
Mechanized handling:			
Number of growers	459	-	51
Area (ha)	30.369	-	14.768
Percentage of farmers	4,73%	-	60,72%
Percentahe of ha	14,35%	-	28,40%
Semi-mechanized handling:			
Nu nber of growers	1.085	11	24
Area (ha)	106.436	22.369	36.721
Percentage of farmers	11,17%	44,00%	28,57%
Percentage of ha	50,28%	96.79%	70,63%

Source: *Consultant's calculation - INTA*

In this way, it was found that the most efficient "levels" had a cost per ton of cane more than 50% lower than farms in the lowest levels.

Farms less than 45 ha in size have the highest costs. Although costs are similar within this segment, there are significant differences in their composition.

Thus, small-time growers with 5 ha holdings have a high labour component, since most tasks are done by hand, the only "equipment" being human muscle, where the local expression is *tracción a sangre*, referring to the bleeding caused by the cane on the harvester's hands.

Most of the labour is provided by the grower's family, and represents over 60% of the production cost. The problem affects most growers in Tucumán. A producer with, say, 45 ha will already be mechanized to some extent, will have stable staff on contract as well as seasonal help for the harvest.

At the other extreme, the grower with 400 ha will have a full range of machinery and has all his tasks mechanized, and his costs are less than half those of the group described above.

Between the two "extremes", there is the 100-hectare grower, whose harvest tasks are semi-mechanized.

By way of analysing a standard cost structure, the table below shows the breakdown for March 1992, taking the 100 ha as base, with 90 ha down to the crop and an output of 5.310 tons. The figures were derived by the Secretariat of Agriculture of Tucumán province. In money terms, the production cost per ton of sugar was US$ 42.06 (Table 1.1.4).

Table 1.1.4 - Standard cost structure per ton of sugarcane.

Item	**%**
Planting	5,37%
Cane (seeding)	1,62%
Cane (cuttings)	7,16%
Harvesting	30,81%
Amortization	28,60%
Overheads	7,01%
Return to capital	10,30%
Levies and witholdings	2,07%
Improvements	0,31%
Taxes	6,75%
Total	100,00%

Source: *Secretaría de Agricultura y Ganadería, Provincia de Tucumán.*

Again, if only direct operating costs (planting, ratooning and harvesting) are taken into account, these come to US$ 18.91/ton, and show the following breakdown (Table 1.1.5).

This table shows that among the direct costs of producing sugar, the highest is that for labour. This, together with social security, brings the share of the labour to close on 52%.

1.1.1.5 Marketing

Unlike other crops, sugar cane cannot be stored. Once harvested, its sucrose content declines rapidly. This is why the mills are set up in the areas where the crop is grown, a circumstance that has additional importance because the cane is a heavy crop with a low unit value, which further means that transport costs from plantation to mill are significant.

Table 1.1.5 - Production cost structure

Item	Total cost US$/ha	%
Seed cane	81,42	7,30
Fertilizer	52,57	4,71
Herbicides	88,25	7,91
Spares/repairs	250,23	22,43
Fuel	65,11	5,83
Labour	332,38	29,79
Social security	245,79	22,03
Total	1115,75	100,00

Source: *Unión Industrial Cañeros.*

The cane is delivered to the mills, which generally pay for for the raw material by returning a percentage of the processed sugar. This is the so-called *maquila* system. How this operates is described below.

In most cases, the "price" paid to the producer is determined by the amount of cane delivered to the factory. The average distance from holding to mill is 25 km. This means that transport costs are highly significant, as much as 16% according to UCIT estimates, and even 30% in some cases, making this item the second heaviest after harvesting. Last season, a fixed charge of US$ 1/ton was paid for transport, plus US$ 0.5 per km/ton of sugar in sized bundles, an outlay increasing by 40% in the case of bulk transport.

A further problem constraining marketing in Tucumán province is the average time -over two days - taken for the cane to reach the mill. As noted earlier, this is excessive, as it diminishes the sugar yield per ton of cane. The problem is the resultant of several factors, the most serious among them being the prevalence of manual harvesting, inadequate facilities at the mills for receiving the bulk cane, and the lack of coordination whereby cane deliveries can be planned.

1.1.1.6 Producer cooperatives

Cooperative associations among cane growers in Tucumán had their beginnings in the early 1960s, and had undergone greater development than with other farming activities in the province, especially with the introduction of the *maquila* system in 1985.

At the present time, there are 37 cane producers' cooperatives in Tucumán, three of them "second level", i.e. federating other cooperatives. All told, these bring together 60% of

producers. Certain cooperatives have as their principal purpose the selling of their members' cane to the mills. Most of them, however, are given over to marketing the sugar. A third group engages in both types of activity.

Despite their enabling the grower to market his produce "directly", these cooperatives take on other functions such as providing technical assistance.

In other cases, too, they handle the supply of fertilizer and other basic inputs. Some growers even purchase their families' food through these cooperatives (for example, COPRATIC)

A special case is that of the Ñuñorco mill. This was set up with a capital contribution from the provincial government and from the cane producers' cooperatives, subsequently bringing the mill workers into the cooperative. The raw material is supplied by the Cane Growers' Cooperative League, which has eight federated cooperatives.

The mill has had to face several problems, including bankruptcy in 1978. In 1989, it was bought out, and now the shareholding stands at: Provincial Government: 45%; workers: 2%; and cane growers: 53%. It is currently experiencing serious financial difficulties, as indeed are the other mills as well.

A further problem with this ownership formula concerns the machinery for taking decisions, the process becoming bogged down by conflicting interest between the role of the growers as owners of the mill and as suppliers of the raw material.

Even so, the role played by this mill is an important one as witnessing how the share of the growers under the *maquila* system is determined.

1.1.1.7 The minifundio problem

There is a difference to be noted in the degree of competitivity of primary production in Argentina's sugar sector if one compares production from entrepreneurial groups (located for the most part in Salta and Jujuy) and that of the medium and small growers, especially in Tucumán, where much of the country's output comes from.

As noted above, characteristic of Argentina's sugar production is the existence side by side of small-time growers and vertically integrated mills.

The province's sugar cane sector, again, has this peculiarity, that much of the production is in the hands of *minifundio* holders.

The *minifundio* is defined as a small holding below economic unit size for the production of a given crop. For definition, therefore, it is not simply a matter of the size of the holding but the size as a function of the crop it is intended to grow there.

The emergence and consolidation of the small grower is the resultant of successive settlings of populations made possible by, *inter alia*, the demand for labour on the part of the mills, of the

higher wage costs that led to the dividing up of the land belonging to the mills and the sedentarization of former day labourers and, again, of the intervention of the State with its various measures to protect the farmer.

The table 1.1.6 shows that, according to the 1988 National Census of Agriculture, producers with less than 10 ha land make up 53% of the 9.700 farming population but hold less than 8% of the land.

If the *minifundio* criterion is extended to producers with up to 20 ha, then 70% of farmers own 15% of the land.

Against this, owners of over 100 ha land account for 7% of producers and over 50% of the area under cane.

In Tucumán, *minifundio* growers are met with throughout the province but are concentrated mainly in the Departments of Monteros, Simoca and Rio Chico.

Table 1.1.6 - Distribution of minifundios

N°. of Producers Area (Ha) |	N° of holdings	%	Cumulat. %	Area	%	Cumulat. %
< 3	1.891	19,47	19,47	2.982,5	1,41	1,41
1 a 5	1.269	13,07	32,54	3.870,1	1,83	3,24
2 a 10	1.973	20,32	52,86	9.609,5	4,54	7,78
3 a 15	1.059	10,91	63,77	8.171,5	3,86	11,64
4 a 20	651	6,70	70,47	6.724,7	3,17	14,81
5 a 50	1.559	16,05	86,52	27.538,5	13,01	27,82
6 a 100	614	6,32	92,84	23.049,2	10,89	38,71
> 100	695	7,16	100,00	129.737,8	61,29	100,00

Source: *Consultant's calculations based on 1988 National Census of Agriculture.*

From a survey conducted in 1988 in the Department of Simoca, the following *minifundio* situation emerges.

Land tenure: Most small farmers own their holding, which in no case exceeds 7 ha. Less than 1% are tenants.

Housing: Most growers live on their holding. Some 60% of them have dwellings less than 70 m^2 in size, and not more than three rooms per family - and families are usually large. Some 29% of dwellings have earth floors and 22% are built with adobe walls; 10% have roofing of leaves. Only 5.5% have indoor toilet facilities, while 87% have outside closets. Fewer than 4% have a drinking water supply; and 60.55% have no electricity.

Production features: In 80% of the cases, only one crop - sugar cane - is cultivated, and no other type of work is contemplated. Often, supplementary cropping with grains is practised to ensure self-supply. Of the area under cultivation, 65% is down to sugar cane. In most cases, the labour for tillage and harvesting is supplied by the family, though 45% of the growers call in paid labour.

Characteristics of the population: The growers' standard of education is low. The illiteracy rate runs at 10%; the 80% who have had primary schooling do not continue beyond the third grade. An important point here is that two-thirds of the population are over 50 years of age and most growers have four or more children.

Mechanization: The agricultural machinery situation has evolved in the last few years. A third of the *minifundio* growers have introduced a certain level of mechanization - in the form of a tractor. Many growers, moreover, have a cart for transporting their cane, indicating that they have assigned priority to the transport side.

Technology: A plantation has to be renewed every four or five years; but 30% of the *minifundio* growers see to this every six or seven years. Considerable progress has been made with fertilizer use, many growers adopting this practice, albeit applying less than the recommended amounts. Weed control is done by hand, without the use of herbicides. Harvesting, too, is a manual operation.

Marketing: The cane is made over normally to a single factory under the *maquila* system, while the sugar is marketed via the cooperatives. Delivery in almost all cases is made to a collection point, about 3 km distant from the farm, and this is typical of *minifundio* cane production since with the sort of transport that the growers possess, it is uneconomical for them to deliver to the mill itself.

The aspects that characterize *minifundio* production as described in what precedes are a constraint ting one crop only, and the lack of funding - all greatly limit the possibilities otherwise offered by such programmes.

A further point to be taken into account is this: while a mastery of the difficulties of competitivity that the agricultural sector is going through does not depend on the *minifundio* sector - since this does not account for a major proportion on any conversion programme based exclusively on the greater potential of other crops, when regional characteristics - soil type, climate, etc. - are taken into account. Holding size, and little or no use of machinery, implements or chemicals, taken together with the low level of skills, the fact of the grower cultivation of the output - the *minifundio* growers taken together represent an enormous social problem that must be allowed for in any specific measures designed to raise their standard of living.

1.1.7 THE INDUSTRIAL SUGAR SECTOR

1.1.7.1 Sugar production

Argentina's current sugar production is carried on at 24 mills located in the growing areas. These mills have an installed capacity of 1.750 000. Of the 24, sixteen are located in Tucumán province, three in Jujuy and two in Salta. A further three are to be found in northwestern Argentina (see Statistical Annex to Chapter 1 - Table 6).

The mills with the largest output are in Salta and Jujuy, the five plants there accounting for 40% of the country's sugar processing. In Salta there is the Ledesma plant, which of late years has had an output of nearly 250.000 tons each year and by that token is the most important as regards finished product.

Tucumán's installed capacity stands at 1.200 000 tons. The largest plant is the Concepción mill. In 1992, this produced 134.000 tons. The other mills in the province generally produce between 30.000 and 60.000 tons a year.

As will be noted from the table 1.1.7, there are marked differences between each pair of major producing areas. The *maquila* system has taken on greater significance in Tucumán, accounting for 68% of deliveries, whereas it represents only 10% in Salta and Jujuy, and 40% in the coastal provinces.

Table 1.1.7 - Canne milled in 1991 (million tons)

Province	Plant's own		Bought in		Maquila		Total
	tn	%	tn	%	tn	%	
Tucumán	1,3	14,6	1,5	17,0	6,0	68,2	8,8
Salta and Jujuy	3,4	65,4	1,4	26,4	0,5	9,7	5,3
Northeastern province	0,1	20,0	0,1	40,0	0,1	40,0	0,3
Total	4,7	32,9	3,0	21,0	6,6	46,1	14,3

Source: Consultant's own calculations from data supplied by the Centro Azucarero Argentino.

Against this, cane harvested directly by the mills, in Salta and Jujuy, exceeded 65% of deliveries. It accounted for nearly 15% in Tucumán and 20% in the northeastern provinces. In the case of bought-in cane, Tucumán accounts for 17% and Salta and Jujuy for 26% and the northeastern region for 40%. For Argentina as a whole, 34.4% of the cane is owned by the mills.

As regards yields obtained by the mills (kg sugar produced per kg cane processed), the national average for 1992 was slightly below that for 1993, at 9.91%. The highest yields were achieved by the Arno (11.86%) and Río Grande (11.17%) establishments, located in the Litoral and Norte regions, respectively.

At the other extreme, the poorer performances are associated with the San Pablo (8.59%) and Marapa (8.96%) mills, both in Tucumán.

In terms of individual mills, some have achieved yields approximating 11% in 1991 and 12% in previous years. On the other hand, some mills failed to achieve 8% (Table 1.1.8).

Table 1.1.8 - Sugar processed in 1991 ('000 tons).

Province	Milled Cane tons	White cane tons	Crude cane tons	Total (tons)	Net yields aver.	min.	max.
Tucumán	8789,0	798,0	80,0	878,0	9,99%	8,75%	10,96%
Salta and Jujuy	5253,0	537,0	33,0	570,0	10,85%	10,71%	11,74%
NEA province	288,0	24,0	-	24,0	8,83%	7,30%	10,38%
Total	14330,0	1359,0	113,0	1472,0	10,28%		

Source: Consultant's own calculations from data supplied by the Centro Azucarero Argentino.

The sugar industry in Tucumán is generally very backward as regards technology and product quality.

Few of the mills there produce type A refined white sugar, while there are considerable differences in product quality between the various mills.

This is due to a series of factors, among them:

- Poor management;
- Financial difficulties leading to half the mills at the present time being the subject of bankruptcy proceedings or in receivership;
- The fact that mills are rented, usually in the hope of obtaining the highest output with the lowest outlay, with repercussions on quality;

- The fact that, prior to deregulation, a closed market and the imposition of quotas created a captive market.

A more detailed analysis of the situation is made in Chapter 3 and Annex 2, with a description of the individual mills and of the outlay likely to be needed if greater quality and competitiveness are to be achieved.

1.1.2.2 Environmental impact

Sugar production, using current technology, is the source of certain problems where the environment is concerned. The fundamental element here is the press cake (*cachaza*) residues to the tune of 30 kg per ton of cane milled, and the lees (*vinaza*) resulting from alcohol distillation (12 litres per litre alcohol obtained). To this must be added the environmental problem of the air pollution from steam generating plant.

The industrial waste referred to is chemically polluting. It is usually discharged into watercourses, contaminating these in the process, with the highly dangerous consequences if water is drawn from this source for irrigation, drinking or other uses.

The environmental impact produced by these residues is to be seen in high levels of organic matter, which take up the dissolved oxygen and reduce it to levels that hinder or preclude aquatic life or, again, any consumption of the water.

Tucumán has laws and regulations prohibiting the discharge of polluting residues into rivers, but these are largely disregarded, since there is no strict enforcement.

Today, the sugar industry is the principal cause of environmental pollution in the province.

At the same time, experiments are going forward for the use of these residues, e.g. press cake as an organic fertilizer, and as a substitute for nitrogenous chemicals, e.g, urea; while the lees are noted for their potassium content.

Experiments have shown that, if applied in certain proportions, both residues have a beneficial effect on the development and growth of sugar cane similar to that obtained with chemical fertilizers.

1.1.2.3 Marketing

Some 50% of the sugar processed in Tucumán is marketed by the mills, the remainder being handed back to the growers under the *maquila* system, usually via their cooperatives.

The *maquila* system, as noted earlier, consists in the delivery of the cane to a mill by the grower, who receives in exchange a proportion of the processed sugar. The system was reulated by a decree issued in 1988, which provided that the grower was to receive 57.6%, while the molasses and bagasse remained entirely with the mill.

As a result of the deregulation brought in in 1991, the grower's share is now a matter of negotiation in each individual case, allowance being made, *inter alia*, for whoever does the transporting and the harvesting. As a rule, this share has dropped to around 52%, freight costs being borne by the grower.

Prior to deregulation, the 57.6% share applied to cane where the grower was entitled to a production quota and was much lower if the grower delivered his cane without such entitlement, the quota in theory being unmarketable. The current percentage is, however, applied to the entire consignment.

According to unofficial estimates, the overall result is more or less the same, but the effective share is smaller, since the grower now has to pay freight costs which were previously borne by the mill.

A further point here is that the *maquila* system now makes no provision for the estimation of bagasse or molasses.

Whether it is the mill or the cooperative that does the marketing, the sugar is sold to consignees or directly to the food industry, supermarkets or wholesalers.

The last-mentioned in turn sell to retailers. Reference should also be made to the role played since 1992 by the Mercozucar S.A., a limited company, as market regulator. Because this firm is so important, its functioning will now be explained.

1.2 HOW MERCOZUCAR OPERATES

The changes coming about following deregulation have encouraged the Tucumán sugar sector (industrial growers) to come together in a new sectoral context where the principal operator is the private person or firm, in such a way as to stabilize the sector's earnings at sufficiently remunerative levels.

The Tucumán provincial government has brought in a Law (N°. 6383) in the hope of providing a solution to the problem of financing the sugar sector. To this end, it made available funding from the Banco de la Nación Argentina, with the Federal Government sharing in the provision of collateral. It was laid down as a condition for drawing on these funds that they must be channeled through a private organization consisting of industrial and cane growing undertakings.

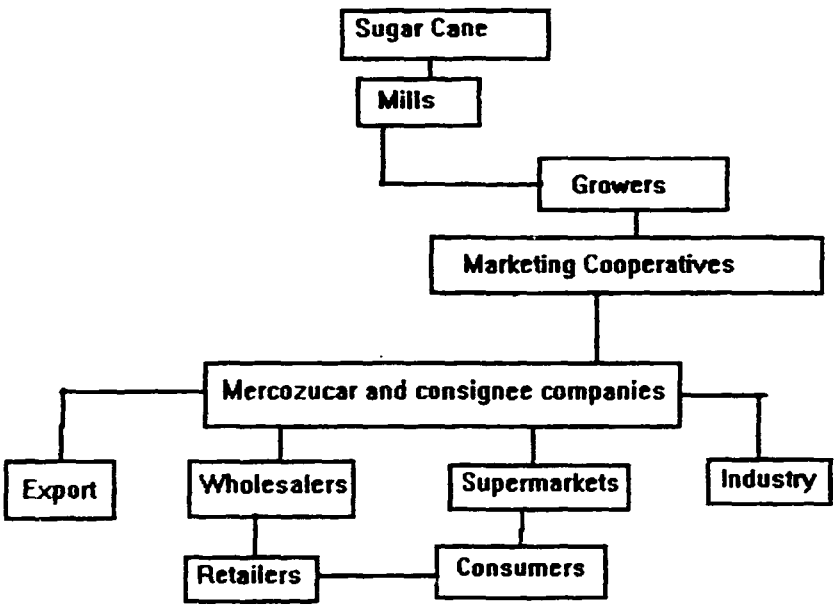
In this way, in September 1993, Mercozucar S.A. came into being, its constituent bodies consisting of the sugar producing industry, *maquila* marketing cooperatives and growers (approximately 20 members representing the producers of half the sugar produced in Tucumán) (Fig. 1.2.1).

Mercozucar's object is to channel internal market surpluses toward international markets and to bring order into the internal market, with a view to obtaining the highest possible price for

the product - where the limit is regulated by the international ceiling plus freight and administrative charges.

Every member undertakes to export a proportion of his output as determined for each harvest by reference to the volume of over-supply. The latter stood at 20% in the first year of operation. The export undertakings contain clauses providing means and ways of securing performance. In addition, there are contracts for delivery to Mercozucar whereby the member undertakes to deliver monthly quotas from his sugar stock.

Fig. 1.2.1 - Marketing chain



At the same time, as a means of bringing order into supply, Mercozucar is empowered to buy and sell in an attempt to balance supply and demand. In the 1992/93 season, the intervention stock handled by Mercozucar stood at 10.000 tons, and it is hoped that this figure can be doubled for the next season. A delivery contract must be accompanied by a deposit of 10% of the sugar, or otherwise by recourse to warrants

Firms are required to make over to Mercozucar certificates of deposit corresponding to these warrants, as security for loans granted under the system; and Mercozucar will each month provide the respective firms with certificates of deposit corresponding to the loans falling due, and equivalent to the selling quota on the home market.

As a result of this type of operation, by end 1992, producers had raised between 50% and 100% the price obtained for their sugar on first sale, though this did not entail major changes in the final price for the product. The result was also facilitated by the fact that the formation of Mercozucar coincided with heavily depressed sugar prices.

Even so, it is not possible to state categorically that this novel formula is in a strong position, in that:

- so far, it has not played an efficient role in the marketing phase. This is because, among other things, it has been unable to solve the problem of ensuring a product of consistent quality for marketing, and has had difficulty in meeting consignment deadlines;

- the operation is partly at the mercy of developments in the financing of stocks by means of warrants - a procedure intimately bound up with the Mercozucar operation; and

- Mercozucar brings together a significant volume of supply, whereas there are major segments still outside its control.

The formula has yet to pass the acid test of operating under conditions of significant levels of oversupply.

1.2.1 FINANCING

A major problem confronting the sugar sector concerns financing. This is because, in addition to the need for cash at harvest time, there is the further need for maintaining stocks until the following harvest.

With the financial crisis that the primary and secondary sectors have been going through in recent years, bank financing has been practically non-existent.

The beginnings of a solution to the problem has emerged since the 1991/92 season, with the introduction of the warrant system, offering a formula whereby it is possible to pledge the commodity irrespective of the financial situation of the grower.

As a financial instrument, the warrant has been in use in Argentina since the beginning of the century. With it, it is possible to obtain credit against collateral represented by commodities placed in specific storage deposits. It is based on the traditional pledge system, introduced by Law 9643, of 1914, which was in use for the grains, sugar and wine trade until discontinued as a result of a worsening capital market and inflation. The system has been revived but, notably, no changes have been introduced despite the considerable time that has elapsed since it was first created.

The mechanism consists in the placing of the merchandise in an authorized storage deposit administered by an authorized company which issues two documents against the deposit, namely, the certificate of deposit and the warrant itself.

The certificate attests to the fact of the deposit and to the ownership of the merchandise, and can be used as a commercial paper.

The warrant is complementary to the certificate and entitles the holder to a pledge on the merchandise specified there, and enables him to obtain credit for which the merchandise constitutes security. The due date of the warrant is cancelled at the place where the first endorsement is paid. If the creditor does not cancel his debt, the warrant holder has a series of privileges which convert the warrant into a highly secure instrument permitting him to request the company operating the storage deposit to auction the merchandise immediately; and the operation may proceed, as the law provides, without any judicial intervention being needed.

With both instruments (they can circulate separately) which are issued by an authorized firm guaranteeing the existence of a given commodity, it is possible to obtain credit thanks to the warrant, without actually selling that commodity, and to sell it at a later date once it is thought advantageous to do so by transferring the certificate of deposit.

For the system to function at all, it is thus necessary to have storage deposits or warehouses, which are physical premises where the merchandise can be placed and must answer to determinate requirements and characteristics. Against goods deposited, the certificates and warrants here described are issued to the order of the depositor. The premises can be the property of the company issuing the certificates, or of the depositor himself. In the latter case, the company takes over, by contract, the use, management and total control of the premises in order to have them recognized as a "warrant depository".

The company operating the depository "assesses" the commodity, assigning it a value on the basis of its characteristics.

By endorsing a deposit certificate, the ownership of it can be transferred to others, while with the endorsing of a warrant it is the credit entitlement that is transferred. It is only when the deposited goods are made over to a third party that the certificate of deposit and the warrant have to be produced together.

Warrants can cover freely negotiated assessments. These are generally for 180 days and can be issued in terms of Argentine or foreign currency. Likewise, they have certain peculiarities - the fact that they can be divided into smaller amounts, that the loan covered by the warrant can be paid off before the due date and that they can be virtually a bearer title, since only the first endorsement has to be nominative and entered in the register of the depository firm. If the debt is not paid off by the due date, the holder of the warrant may apply for the goods to be sold by auction, and this will proceed even if the debtor dies, or is declared bankrupt.

As for costs, the firm issuing the certificates is paid for the deposit and administrative expenses, plus the cost of the quarterly inspection and an all-risks insurance. Then there are the costs of the loan itself, which will be in the region of 18% p.a. Even so, this arrangement is better than selling, because one has financial problems, the bulk of one's sugar at the start of the season and at low prices.

In the particular case of sugar, with the 1992 crop the financing provided under these arrangements came to approximately US$ 45 million, whereby it was possible to hold 30% of Tucumán's output in deposit under warrants, and in so doing take the pressure off supply and making possible a recovery in the price. Of these US$ 45 million, thirty were made available via the Caja Popular de Ahorros de la Provincia de Tucumán (a publicly owned savings bank) and the remainder via private banks.

The season began with prices at a very low level, which meant that sugar had to be sold at about US$ 0.20/kg. Growers resorting to the warrant arrangement, which came into operation from August on, were able to retain ownership of their crop, and obtained good results in the second semester when the price rose to US$ 0.38/kg.

The use of the warrant was optimized by the self-regulation mechanism which operated through the agency of marketing agreements within the Mercozucar formula.

The 1993 crop projections are that the price will have a floor of about US$ 0.30/kg (as compared to US$ 0.20 for the previous year), thanks to the operation of these warrants and to Mercozucar, because there will be very little surplus national production and to the rise in world prices as a result of the fall in supply itself, a consequence of climatic problems in the major producing countries.

Where financing requirements for the 1993 crop are concerned, Mercozucar estimates are in terms of US$ 70 million. With this amount, it should be possible to finance 74% of the stocks intended for the domestic market. The remaining 26% would be in the hands of the large mills in the north of the country. The figure mentioned is derived by estimating that financing requirements are equivalent to approximately half the sugar output of Tucumán province for the next crop (650.000 t), for a value assessed at slightly more than the US$ 20/kg of the previous year.

The warrant mechanism yielded good results in the 1992/93 season, but has its weak points where the costs, currently very high, are concerned. In the previous season, costs were amply offset by the size of the sugar price rise but the pattern is unlikely to be repeated in the 1993/94 crop year since prices are begining to be very close to their maximum (the maximum being determined by the price of sugar that might be imported).

According to information supplied by the Banco de la Nación and Mercozucar, the cost of warrants, calculated over a six-month period, is made up of 8% for bank financing, to which must be added 14% for costs of storage deposit, freight, insurance, security, differences in exchange rates and administrative items. The total cost thus comes to 27% per six-month period. This is extremely high when compared with the domestic and international rates of inflation, with bank interest rates and with the expected price for the sugar.

At the present time, people resort to warrants because these are the only expedient available to them in view of the financial situation the growers and firms in the sector are going through. However, given the unlikelihood of a rise in sugar prices, the cost of maintaining stock becomes a significant variable.

Allowance must also be made for the fact that, in the event of a diminution in sugar prices, the warrant mechanism stops operating only when an assessed value is low enough to absorb the diminution, together with the cost of maintaining the stock. Otherwise, many of those who take out warrants would not be able to meet their commitments, with the result that the sugar would be auctioned off; and this could lead to a loss of credibility in the only system of financing that is feasible for the sugar sector at the present time.

1.3 DESTINATION OF THE SUGAR

1.3.1 DOMESTIC MARKET

What happens to sugar production is intimately bound up with the domestic market. Demand runs at between 850.000 and one million tons a year, depending on people's purchasing power. The difference between production and consumption within the country goes to the external market, so that the proportion of the output going to the one or the other market is determined by the volume produced (Statistical Annex to Chapter 1 - Table 7).

Domestic sugar consumption has been stable over recent decades, varying within the amounts just referred to, despite population increase. The explanation lies basically in the appearance of artificial dietary sweetners, which has led to a decline in per capita consumption of sugar. The latter fell to 39.3 kg p.a.; at the moment, it stands at about 30 kg. The trend is reflected in the fact that, in 1981, 93.4% of sweetners were sugar whereas by 1988 the share had fallen to 77%.

An estimated 700.000-800.000 tons (or 65-70%) of domestic consumption is accounted for by industry, the rest going to direct consumption. Of the industrial total, about 150.000 tons are taken by two firms, one more important in the beverages sector, the other in that of confectionery, chocolate and jams.

1.3.2 MERCADO EXTERNO

International sugar prices are usually insufficient for the external market to be considered a regular market. In 1972/73, with the rise in world prices, Argentina's sugar industry was encouraged to become a regular exporter but in the 1980s, with the decline in imports in the major client countries and the increase in EC exports, the price fell.

As a result, the ratio of sugar exported to the volume produced has fluctuated in recent years, between 6% and 30%, in harmony with domestic production and the level of domestic demand.

Between 1985 and 1991, Argentina's sugar exports ranged between 82.000 and 386.000 tons, and constituted a source of foreign exchange to the value of from US$ 20 million to US$ 134 million, the peak figure in 1990 and the lowest in 1987.

The main volumes (between 72% and 98%) exported consisted of unrefined sugar, except in 1990 when it accounted for only 36% (Statistical Annex to Chapter 1 - Table 8).

The United States is the principal market for coarse sugar and the market where the best prices are obtained (as much as twice those obtained in Argentina). For the current year, the volume so taken is in the region of 50 000 tons coarse. China, too, has been a major buyer in certain years. Among other countries taking coarse sugar may be noted Uruguay, Chile and Morocco, the actual markets varying from year to year.

Refined and semi-refined sugar, on the other hand, find their principal markets in the countries of South America, foremost among them Chile, followed by Uruguay and Paraguay. In some years, Mexico has also purchased significant amounts (cf graph in the Statistical Annex). As for sugar imports, these have been non-existent during recent years. At the moment, they bear a 10% import duty, plus a variable duty as well.

1.3.3 PRICES

If one takes the "white sugar" item in the Consumer Price Index calculated by INDEC, and converts to US dollars the going price for May and June each year, and using the official market dollar rate as base (selling rate for financial transfers), one arrives at the following prices per kilogram of sugar (Table 1.3.1).

Table 1.3.1 - Prices evolution

Year month: june	**US$/kg**	**price indices at constant values (1980 = 100)**	
		C.P.I.	**W.P.I**
1980	1,26	120,68	119,66
1981	0,81	142,13	135,84
1982	0,67	124,06	95,54
1983	0,51	122,03	75,82
1984	0,66	133,36	88,33
1985	0,48	123,15	94,76
1986	0,45	85,16	83,76
1987	0,72	132,83	133,37
1988	0,06	162,05	131,03
1989	0,47	187,72	114,72
1990	0,61	86,08	88,61
1991	0,75	66,84	85,25
1992	0,59	43,18	65,34
Average 1980-92	0,66		

Source: *Indice de Precios al Consumidor - INDEC.*

It will be noted that the trend in consumer prices has followed no hard and fast pattern over the above period. The average for the 13 years works out at US$ 0.66/kg. For seven of the thirteen, the price stood below this average and coincided with it for the other five.

Again, from the consumer and wholesale price indices published by INDEC, at constant values and with base 1980 = 100, one finds that compared with June prices for the current year:

- Wholesale prices have declined in terms of Argentine currency over the past six years, and consumer prices have shown the same trend over the last four years; and

- Consumer prices have fallen to a greater extent than wholesale prices, chiefly as a result of the fluctuations recorded for the last two years.

Movements in prices in both dollar values and in constant values did not keep pace with trends on the international sugar market. This is due to the fact that, prior to deregulation, the domestic market was entirely closed and regulated, and disregarded world prices.

Taking into account the value added at each stage, the price composition shows the following percentage breakdown:

Cane grower:	20%
Sugar producer:	30%
Transport:	8 a 10%
Whole trade and taxes:	30 a 32%
Retail trade:	10%

1.4 SUGAR DERIVATIVES PRODUCTION

At the present time, the entire crop processed goes to sugar production, the industrial process yielding bagasse and molasses as byproducts.

Bagasse is exploited as fuel for the sugar and paper mills. That bagasse should have provided raw material in the latter case is due to the installation of a large paper mill in Tucumán, and this obtains its supplies from the sugar factories nearby.

Molasses are used by the industries, and yield various byproducts, chief among them alcohol.

While cane is not milled at present specifically in order to obtain byproducts, in the past there was a major programme for producing alcohol for use as an additive in fuel blending. Since the programme was an important one, its main features will now be described.

1.4.1 THE PETROL-ALOCHOL ("ALCONAFTA") PROGRAM

With the 1973 energy crisis, advantages began to be seen in the international community of intensifying the resort to renewable resources; and a premium was placed on lines of research geared to producing energy from biomass - agricultural products and byproducts.

Several countries have concentrated on incorporating alcohol into petrol fuel, some in order to make use of a resource ready to hand, others to boost home fuel demand, and others again to abate environmental pollution.

In Argentina, the main reason was to exploit a resource in surplus, namely sugar cane, with the result that these novel lines roused considerable interest in Tucumán, especially in view of the see-sawing sugar prices. Even though in the mid-1970s and in 1980 and 1981 world prices were highly favourable, troughs last much longer than the crests.

The circumstances described led in 1981 to the first petrol/alcohol (*alconafta*) programme, limited to the province. Shortly afterwards, from 1982 on, a slump took place in external prices reducing demand for sugar processing for export. The expanded acreage of previous years would have remained unharvested had it not been decided to extend the programme to other provinces.

The decision was reached after lengthy discussions, and since petrol prices are lower than the price of alcohol, the central Government was obliged to forgo fuel tax in respect of the alcohol content in the fuel blend. The obligation to use blends of 85% petrol oil and 15% alcohol anhydride was introduced in 1982 in the provinces of Tucumán, Salta, Jujuy, La Rioja, Catamarca and Santiago del Estero.

Subsequently, in 1985, the National Petrol Alcohol Act (*Ley Nacional de Alconafta*) was introduced declaring it to be in the national interest to manufacture alcohol for fuel use, and prescribing the gradual introduction of petrol oil throughout the country. Earlier in the current year this compulsory use of the blend was made law in the provinces of Chaco, Formosa and Santa Fe, with Misiones, Corrientes and Entre Rios following later.

Summarizing, therefore, one may say that the approach was based, on the one hand, on prescribing petrol alcohol as the only automotive fuel and, on the other hand, on income transfers thanks to the discontinuance of the tax on fuels in the case where they had alcohol blended in them.

The options open were, otherwise:

- not to harvest cane surplus to consumption and export requirements; with the result that plantations would gradually disappear; or

- to take up the surplus for export. This implies selling some 400.000 tons sugar at the current international price, which is lower than the cost of production; or, again,

- to produce alcohol anhydride and export the surplus petrol oil. In this way, it would also be possible to reduce environmental pollution and eliminate tetraethyl lead from the petrol benefiting under the programme.

The final decision favoured the third option. Alcohol production has been mainly the task of the sugar mills, since these already had distilleries, and these in turn supplied the petroleum companies responsible for blending and distribution.

The price of alcohol was established by the National Government and was to be indexed constantly. Shortly afterwards, the authorities decided on a reduction in price which in turn affected the profitability of production; and the consequences thereafter made themselves felt on sugar prices on the domestic market - or on distillery economics - depending on the circumstances.

In recent years, there has been a marked downturn in world oil prices as a more efficient use is being made of energy and petroleum output has risen, just as other sources of energy, too, are coming to be used.

Again, the mounting concern over environmental pollution, with its emerging aspects such as the thinning of the ozone layer, the greenhouse effect, acid rain and the aggravation of already familiar phenomena - all point to the need for a deeper commitment to, and a wider adoption of, government policies for the protection of the environment.

Production of alcohol anhydride was suspended in 1989. Two considerations led to this decision: the loss of profit due to the reduction in prices in real terms and the smaller harvest in 1989/90 as a result of the drought (which mainly affected Tucumán) and the consequent smaller supply of cane. Alcohol production has not started again to date. The situation as regards production, potential and markets for other sugar byproducts is dealt with in the relevent chapter.

1.5 PUBLIC AND PRIVATE INSTITUTIONS

There are several operators in the sugar sector who have their weight in formulating policy here, notably the following (Fig. 1.5.1).

1.5. NATIONAL PUBLIC SECTOR

- The Executive

Up to 1991, there was a Regional Development Secretariat to which the National Sugar Directorate reported. Since the Secretariat was discontinued, sugar policy has been carried forward by the Regional Economic Directorates of the Secretariat of Industry and Commerce.

The latter secretariat is responsible for, *inter alia*, allocating quotas for exports to the United States among the various interested parties. This it does by basing itself on the share that the

respective firms had in exports for the previous year by way of making good, in part, the very low world prices obtained in foreign sales.

Next, for the technical aspects, the Famallá delegation of the National Institute of Industrial Technology (INTA), which reports to the Secretariat of Agriculture, undertakes several types of research on sugar growing.

- The Legislative

The Legislative's task is to enact laws of particular reference to the sector and general laws affecting it in any way.

1.5.2 SECTOR PÚBLICO PROVINCIAL

- The Executive

These days, the Government has centralized provincial policy in the hands of the Deputy Governor, a political person who is an acknowledged authority on the sugar sector.

For the functional aspects, the sugar sector comes under the authority of the Ministry of Economic Affairs, and its Provincial Sugar Directorate. In practice, however, following deregulation and the disengagement of the State, sugar questions are handled by cabinet members who develop policy, taking into account the views of experts, who give advice on a personal rather than an institutional basis.

As regards agricultural research, the Obispo Colombres experiment station is engaged, among other things, in work on higher-yielding sugar cane varieties. The Centre is funded from an 0.5% levy on cane and sugar sales.

- The Legislative

The deregulation pursued under the national economic policy has limited what the provincial legislature can do. The latter, however, has recently introduced several specific enactments and made resolutions recommending action by both the provincial and national Executives.

At the level of the provincial Executive, sugar matters are dealt with in a thorough manner by the Science and Technology and the Economy and Production Committees.

1.5.3 NATIONAL PRIVATE SECTOR

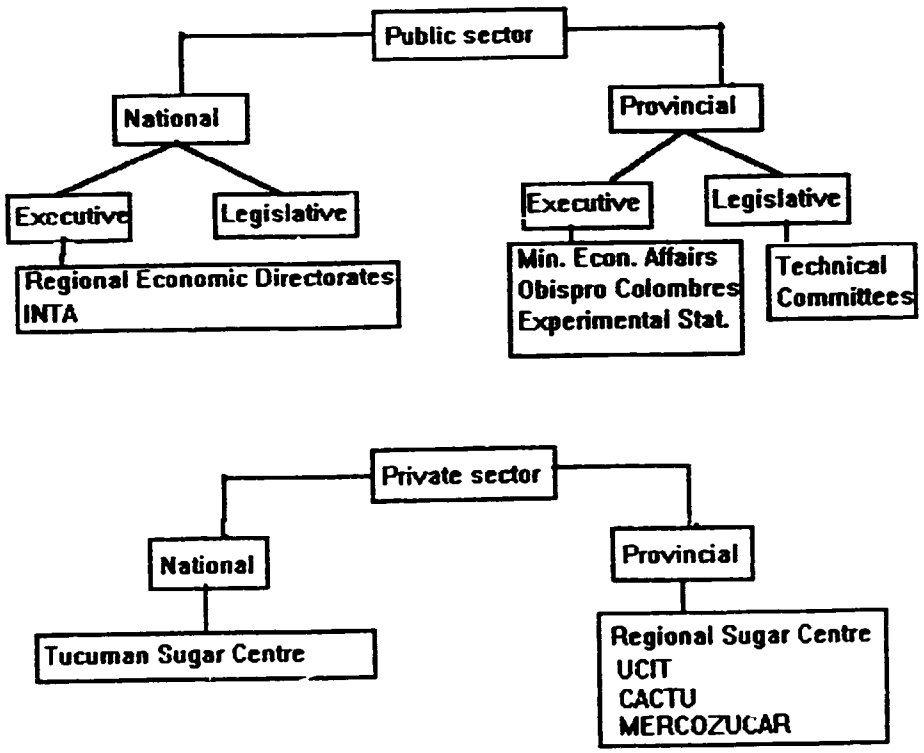
The private sector at the national level is represented by the National Sugar Centre. This is the body that brings together representatives of most of the country's sugar mills.

1.5.4 PROVINCIAL PRIVATE SECTOR

Making up the sector are:

- The Regional Sugar Centre, consisting of representatives of the mills in the province;
- The Unión de Cañeros Independientes (Independent Cane Growers' Union -UCIT), representing the medium-sized and larger growers; and
- Mercosucar. This is an association of mills and growers and coordinates sugar marketing.

Fig. 1.5.1 - Sugar sector operators



1.6 GOVERNMENT POLICY

1.6.1 PUBLIC BASIC FACILITIES AND SERVICES

Government policy is currently attaching importance to basic facilities provided in the past by the public sector and having implications for production. Where the sugar sector is concerned, the main areas of concern are:

Electricity: Present output of electricity in Tucumán province covers only 50% of requirements. Much of the equipment is nearing the end of its useful life. However, since the province is linked up to the National Grid, there are no problems of supply.

Water: If agricultural yields are to be raised, the irrigation facilities must be expanded, since present facilities are insufficient. There are no effluent treatment facilities that could prevent water pollution from run-off containing toxic industrial residues.

Natural gas: The province obtains natural gas from Salta, and supplies are abundant.

Transport: The province has an adequate transport network but the condition of the latter has deteriorated considerably over recent years for lack of investment. Much of the network, which links up places in the interior of the province, consists of dirt roads, which become impracticable when it rains.

The rail system, offering cheap transport, has also markedly deteriorated, and thus has come to be used less and less, with freight now going to truck transport. The Government hopes to improve this situation through its current privatization policy.

As far as air transport is concerned, there are daily connections between Buenos Aires and other provinces. Tucumán city has its aiport. This was raised to international airport rank in June 1993.

Telecommunications: These are adequate.

Education: Here, the basic facilities are adequate for the three educational levels. There is the National University of Tucumám and Santo Tomás de Aquino University of the North, the latter being private. In addition to the usual subjects, both provide training for careers in the sugar sector.

There are also specialized technical schools, among them the secondary establishments, the Instituto Técnico and the Escuela de Agronomía y Sacarotecnia, which come under Tucumán University.

Support for technology development: There are two institutions in the public sector, one at the national and one at the provincial level, namely, INTA, and Delegación Famaillá - Obispo Colombres Experiment Station. These provide support services for agricultural diversification programmes and carry on research on the introduction of higher-yielding cane varieties.

1.6.2 ECONOMIC POLICY: AS THINGS STOOD PRIOR TO DEREGULATION

Conflict between industrial processors and growers that arises at the beginning of every harvest, over and above the problems caused by overproduction and difficulties in placing the crop on the international market, led the central Government to intervene in the early 1920s in an attempt to regulate production and marketing.

Among other instruments resorted to in the course of time were consumer levies and levies on sugar stocks in order to subsidize exports; tariff restrictions and import quotas; fixing internal prices for cane, and the alcohol programme for fuel blending.

The most recent specific enactment here was the 1972 Act, N°.19.597, which operated by limiting production by means of output quotas and restrictions on processing, the base volume here being governed by domestic demand and export openings. The Act also fixed the price of cane and conditions governing payment to growers.

The limitations in question took the form of, among other procedures, the following:

For cane growers:

- Fixing production quotas tied to the holding itself. The quotas could be transferred only along with the holding.

- A penalty in the form of forfeiture of quota, for ten years, was applied to any grower not making use of his quota for ten years consecutively. There were further penalities for growers producing less than their allocated quota.

For mills/industrial processors:

- It was prohibited for ten years to build a new factory, though there was no bar on extending existing plant.

- A mill failing to produce for two consecutive years was obliged to close.

For the marketing sector:

- Aggregate monthly sugar quotas were laid down for the home market;

- Mandatory export quotas were prescribed.

A fundamental object of the Act was to achieve a balance between supply and demand but this proved possible only in part and at certain periods. Among the factors explaining this negative result may be mentioned the drop in world prices and the failure to prohibit any expansion in the milling capacity of existing factories. In this way, industrial production quotas rose, and with it the need to export, all of which made for a worsening of the crisis with low world prices and overproduction at home. Yet another element militating against the efficacy of the

Act was the fact that non-quota sugar was processed and marketed, even though this was forbidden.

Where exports were concerned, one Resolution passed in the 1970s provided that anyone importing sugar must do so in equal-sized quotas, throughout the year - a requirement that precluded the entry of the commodity, what with the high financial costs entailed in keeping it immobilized. This proved to be more restrictive than import duty.

1.6.3 THE SITUATION ONCE DEREGULATION BECAME LAW

In late May 1991 began the deregulation of the sugar sector upon the repeal of the Resolution mentioned earlier, along with a lowering of customs duties, which now stood at 11%. This marked the start of a series of measures culminating in Decree No. 2284, in October 1991, which took deregulation even further both for sugar and for other commodities.

Article 19 removes "all restrictions, including quotas and other quantitative limitations on imports and exports of merchandise." Article 45 went on to do away with the National Sugar Directorate. The most significant element is to be found in Article 46, where all regulations having to do with sugar production and related industries are repealed.

The Decree thus removed quotas, the prohibition on new plantations, and liberalized industrial processing and marketing.

Irrespective of the measures described that affected the sugar sector specifically, others were introduced under general economic policy which also had their impact on the costs of producing and exporting, since these entailed reforms in the rules governing foreign exchange, taxes, credit and transport.

The following may be singled out for mention:

<u>As regards exporting:</u>

- Discontinuance of the statistics levy;
- Discontinuance of the tax (0.6%) on currency transfers;
- Discontinuance of the contribution to the National Mercantile Marine Fund (2% on marine and river freight);
- Removal of the obligation to obtain foreign currency for exports, along with that of the relevant bank fee (approximately US$ 50-100 per operation);
- Discontinuance of earlier intervention measures;
- Increased taxes, since 1 November 1992, from the former 6.70% to 10%.

In the more general context, one now had:

- Reduction in, and later discontinuance of, the tax (1.2%) on debit bank accounts;

- Discontinuance of the fuel tax.

Deregulation also affected transport and lading restrictions in land, sea and air transport; these were accompanied by measures to deregulate shipping and port activities, but these have not so far brought about a lowering of transport costs.

The combined effect of these deregulation measures was deleterious for the sugar sector at the various stages of production. The measure with the most adverse effect was the one that did away with the quota system, with the consequent lowering of domestic prices of sugar.

With the removal of the regulation governing volumes of supply on the domestic market, the price of cane under quota fell further than the price of the processed sugar.

The other side to the picture is that in export terms these measures brought about a nearly 7% improvement in prices, and in turn had an approximately 5% incidence on domestic production costs.

As a long-term trend, there is in progress, among other things, a falling off in demand, an effort to improve efficiency and a decline in the level of employment.

1.6.4 MEASURES INTRODUCED SUBSEQUENT TO DEREGULATION

Subsequent to deregulation, and given the size of the crisis in the sugar sector, measures were introduced to support the production of this commodity in the regions by both the national and provincial governments. The private sector in its turn adopted a series of expedients designed to improve sugar prices.

At the national level:

The need to allow the sugar industry a reasonable time in order to make the investment and modifications to adapt to the changed situation, together with the admission that there were international practices where subsidies were concerned that distorted sugar prices, led the central Government in May 1992 to bring in a fresh measure to protect the country's sugar production now that subsidized supplies could be imported.

Decree No.797/92 introduced a variable levy, additional to that on sugar imports of whatever origin (price equalization levy), equivalent to the percent difference between buying at the monthly average for the last four years, of the price per metric ton of white sugar at London, as compared with the price on the last market day of the month immediately previous to despatching the consignment.

If the peculiar situation were to arise where the price difference is to the advantage of the importer, the amount in question counts as a credit in his favour, which he can apply to the payment of the current *ad-valorem* duty of the relevant rate levy.

At the provincial level:

Between December 1992 and March 1993, the Executive of Tucumán province paid an allowance to permanent clerical and technical staff of the factories where work was suspended. A similar measure was introduced in connection with growers producing less than 30.00 tons sugar. The allowance was set at US$ 50 per month. The total cost of the programme came to US$ 0 million. Negotiations were entertained with the National Bank of Argentina and foreign banks in order to obtain financing for marketing the sugar by recource to warrants.

The Legislative in its turn took action as follows. It:

- enacted law in April 1992 prescribing limits for lead in fuels sold in the province, making way for a percentage of cane sugar alcohol in the fuel blend. Enforcement has been suspended because of resistance in petroleum quarters;

- enacted a law empowering the Executive to draw on the joint contribution funds as security for the loan granted by the National Bank to the tune of 20 illion pesos in order to finance the 1991/92 harvest and marketing;

- encouraged the setting up of Mercozucar, since the authorization mentioned in the previous indent called for multi-sector agreement for the marketing operation, in which all the "factors of production" were represented;

- issued in an ongoing fashion resolutions for action that it recommended might be taken by both the National and the Provincial Executives.

Private sector action:

It took the form of setting up Mercozucar to regulate domestic and foreign marketing through the application of sugar quotas.

The quota system, with differences in the ways it is applied, and in the forms it takes, reduplicates at the private level the regulatory effect previously brought about by law. The distinction lies in the handling of the raw material, which continues to be entirely deregulated.

The fact that the Mercozucar company is in operation makes it possible to work for higher sugar prices, up to the level allowed by the price of imported sugar, the latter consisting of CIF, plus import dues, statistics levy and the variable duty.

1.7 HOW THE CRISIS MANIFESTS ITSELF

The crisis in the sugar sector, both national and in Tucumán province in particular, has two facets - the world market situation and problems inherent in Argentina's production.

1.7.1 THE INTERNATIONAL MARKET SITUATION

The international sugar market is made up of canesugar (60%) and beet sugar (40%).

The sector is regulated in most producing countries by policies geared to self-supply and protecting the national producers.

The international trade accounts for a quarter of world output and operates to a certain extent via special agreements.

The future of sugar is conditioned by the expansion in fructose and calorie-free sweeteners, which are in harmony with the dietary trends of developed countries

In the developing countries, with 80-83% of the world population, food requirements are not met. Here there are people with a very low level of consumption and a high growth potential, given the feeding power of sugar. Among these countries, China is of the utmost importance, with its per capita consumption of 8 kg per year and little reason to increase its consumption of calorie-free or low-calorie sweeteners. This is why it is reasonable to expect a growth in consumption in the developing countries and a stagnation or slight downturn in the developed countries.

The outlook for the international market is one of output levels similar to those of recent years, and a similar pattern of consumption, a falling off in the developed countries and an increase in the developing ones. Estimates point to oversupply, unless special circumstances should intervene leading to a reduction in output due to problems of climate.

Given the excess supply, many countries find themselves obliged to subsidize exports. World prices on the free market are generally lower than the cost of production in most countries.

Argentina's production, in this context, was once also protected. Nowadays, even though the production and consumption quotas have been done away with, several protection measures remain in force where imports are concerned. Sugar appears in the Mercozucar list of exceptions, and bears a variable import duty over and above the *ad-valorem* duty.

The situation is also felt in the rest of the Mercosur countries. Uruguay has an imports regime similar to Argentina's. Paraguay prohibits imports and Brazil has production and marketing completely regulated, from the raw material to the finished product.

From 1 January 1995, with Mercozucar operating at full regime, it should be possible to import sugar from Brazil, where production costs are much lower due to the differences in treatment and the subsidies that the production in the less competitive regions receives.

1.7.2 AT NATIONAL LEVEL

The crisis in sugar production is due to various causes (Table 1.7.1), among them the following.

Table 1.7.1 - Table of Restrictions and Potentialities

Factors	Restrictions	Potentialities	Notes
Agricultural sector			
Land		X	
Climate		X	
Yield	X		Current: 60 tn/ha Potential: 80 tn/ha
Agrochemical use	X		Little use
Harvest	X		Mostly manual
Draining	X		Insufficient
Reeds renewal	X		Insufficient
Exploitation volume	X		Minifundio
Post-harvest use	X		Delay /grinding
Production cost	X		High
Transport			High cost
Marketing		X	Maquila
Labour		X	Available
Financial means	X		Insuficientes
Investigation and Extension		X	
Industrial sector			
Energetical balance	X		
Yield	X		Heterogeneous
Prod. white sugar		X	
Prod. refined sugar	X		Insufficient
Phytosanitary condistions	X		Insufficient
Tecnology	X	X	Obsolete
Environmental impact	X		High contamination
Stocking capacity		X	Sufficient
Marketing		X	Mercozucar
Financing		X	Warrant
Machinery and local equipment		X	Adequate

Source: *Consultant's own elaboration.*

There is excess production over domestic consumer demand, and this has ranged, during recent years, between 50 000 and 200.000 tons each year. Since world prices are much lower than the costs of production, for reasons explained before; since the mills that Argentina has at the present time for sugar products and byproducts are insufficient to take in excess production, and since there are few alternatives for making use of the sugar, over production pressures domestic prices to fall.

This situation is further aggravated by many producers having to sell their crop at the start of the season because they cannot afford to pay for the stocks to be stored.

Sugar cane growing in Tucumán, in general, has been a matter of smallholdings, the when ideal module is about 200 ha. Small size, then, together with low prices, makes for poor yields due to:

- Inadequate stand renewal (usually 20% of plantations are not renewed each year, as should be the case), together with the slow introduction of new high-yielding varieties;
- Poor level of irrigation, especially when actual needs are considered;
- Poor fertilizer use;
- High costs of harvesting if machinery is not used;
- Holding sizes and yields precluding rural families from access to the basic necessities of life, with the serious social crisis that ensues;
- Shortage of funds for introducing technology, working capital, harvesting and storage.

The industrial side of sugar production, too, is poorly competitive due to:

- Lack of technological innovation;
- Sugar losses in molasses and bagasse;
- An unsatisfactory energy balance sheet;
- Lack of financing.

1.7.3 EFFECT OF CRISIS ON PROCESS OF INTEGRATION WITHIN MERCOSUR

In addition to the factors deriving from the international market and the constraints effecting Argentine industry must be mentioned those connected with the process of integration now going forward within Mercosur.

On 31 March 1991, Argentina, Brazil, Paraguay and Uruguay signed the Asunción Treaty; which set in motion the Southern Cone Common Market - Mercosur, the latter due to become fully operational on 1 January 1995. The market will have some 200 million inhabitants, i.e. 45% of the population of Latin America, 60% of the continent's land area and 51% of its GDP.

The principal mechanisms of this common market will be:

- free circulation of goods and services;

- establishment of a common external tariff;
- coordination in macro-economic policies.

So far progress has been made in coordinating the policies mentioned thanks to the technical work being done by the Working Groups. Customs and tariffs have been reduced progressively, generally and automatically.

The reduction to-day encompasses a 68% preference as compared with the tariff where markets of non-Mercosur countries are concerned; and the figure is extended every six months and is due to reach 100% by 1 January 1995.

Reference here comprises all products save for a small list submitted by the respective member countries but even this is due to disappear by that date.

In the list Argentina has included sugar, as being a sensitive commodity.

That being so, any development proposal put forward for the sugar sector in Tucumán - or for any other of Argentina's productive sectors, for that matter - must of necessity allow for Mercosur sugar production in the then member countries must therefore be taken into consideration in order to assess the extent to which the integration process may aggravate or alleviate the crisis.

There follows (Table 1.7.2) an analysis of the various aspects that impinge on Argentina's productivity as compared with both the other partners and the international market (Statistical Annexes to Chapter 1 - Tables 11, 12, 13, 14 and 15).

Table 1.7.2 - Sugar production

	Argentina	**Brasil**	**Paraguay**	**Uruguay**	**MERCOSUR**
Production ('000) Tn 1990/91	1.473	7.365	100	70	9.023
Proportion of world production	1,36%	8,24%	0,10%	0,08%	9,78%
Variation with respect to 1990/80	-3,83%	-13,83%	82,84%	-0,09%	-10,36%

***Source:** Consultant's own elaboration.*

Except for Paraguay, the Mercosur countries produced less sugar in 1990 than in 1980. The downturn, to the tune of nearly 10%, is to be explained by the lower figure registered by

Brazil, the largest producer in the region. This came about, despite the growing output of sugar cane, because Brazil sets aside a large proportion of the raw material for alcohol production.

Taken together, the Mercosur countries are in surplus and accordingly allocate part of their sugar output to the foreign market. This is true even of Uruguay, which imports from time to time (Table 1.7.3).

Since, in all cases sugar production surplus to domestic consumption, the trend (variations) in exports in the years considered more or less follow that of production.

In the case of Uruguay and Paraguay almost all foreign sales go to the USA under the quota that they are allotted by that country at prices higher than on the free market. For Argentina and Brazil, too, this quota represents a sizeable percentage of what these two countries export.

Uruguay, meanwhile, is beginning to cover all domestic requirements, having ceased importing in 1982. From 1983 on, it began to achieve sustained exports of between 10% and 15% of its production.

Table 1.7.3 - External trade and internal consumption of sugar

	Argentina	**Brasil**	**Paraguay**	**Uruguay**
Export.1990 ('000/Tn)	386	1.097	8	8
Share of world exports	1,98%	6,23%	0,06%	0,06%
Volume taken by USA 1991/92 ('000/Tn)	56,8	191,6	7,3	7,3
Variation Export. 1990/1980		-15,66	-40,48	-83,21
Approx. share in national output	10-30%	20-30%	10-15%	10-15%
Imports 1990 ('000/Tn)	---	---	----	3
Domestic consumption ('000/Tn)	850	7.401	101	102
Per capita consumption (Kg/inhabitant)	30	45	23	27

Source: *Consultant's own elaboration*

Coming, next, to per capita consumption, one notes the great difference between Brazil's figure as compared with the rest of its Mercosur partners, the difference to be explained in large measure by the fact that Brazil prohibited the use of artificial sweeteners until 1989.

Characteristics of primary production (Table 1.7.4):

Argentina: Some 70% of the area down to cane and 50% of production belongs to Tucumán even with its low level of technology uptake. Holdings are *minifundio* holdings, where only single cropping is the rule, and harvesting is done manually.

A further 40% of production comes from Salta and Jujuy provinces, which have vertical integration and a high level of technology, harvesting being largely mechanized.

Brazil: This country has two major producing areas, the more important being the Centre-South region, which includes the State of Sao Paolo, and its 52% share in the sugar cane output. Technology is at a satisfactory level here. The other region is the North-Northeast, where cropping is more labour-intensive and production is poorly competitive, due to the climate, the type of soil, the level of technology and management.

Paraguay: Sugar cane is grown within a *minifundio*, single crop context. Some 75% of the growers work plots of between 1.5 and 2.5 ha. Primitive practices predominate. These are of the family type, with little use of fertilizer and practically none of weedkillers and, in addition, widespread cane diseases which depress output.

Uruguay: Cane supplies 75% of the raw material for sugar, and beet the remaining 25%. Harvesting is done by hand. Production is largely a matter of farmers' grouped in cooperatives in irrigated areas, averaging 25 ha each.

Table 1.7.4 - Yields

	Argentina	Brasil	Paraguay	Uruguay	World
Tn/ha 1989/90	49,00	61,49	50,52	66,57	61,33
Variation 1990/80	1,10%	11,34 %	33,63 %	59,20%	7,15%

Source: Consultant's own elaboration

Uruguay shows the highest average yield, and indeed has advanced more than the other countries in this respect between 1980 and 1990.

Brazil has yields slightly above international levels and a positive growth rate, again above the world average.

Paraguay has yields lower than the world average but has achieved a fair growth rate nevertheless.

Of all these countries, Argentina has the lowest yields - also lower than the world average. Even so, the situation as regards the average for the country as a whole shows fundamental

variations between one area of production and another, with wide differences like those met with in Brazil.

The table 1.7.5 illustrates how Salta and Jujuy provinces have yields similar to the highest levels achieved in Brazil (in its Centre-South region - particularly Paraná and Sao Paolo). Both growing areas have yields much higher than Uruguay and Paraguay and the world average.

On the other hand, Tucumán, which accounts for half the production of Argentina, has yields that are significantly lower than those in Salta and Jujuy. Its relative importance here brings down the national average to the levels noted. The situation in the provinces of Northeastern Argentina is even worse.

A similar state of affairs may be noted in **Brazil**, with this difference, that the bulk of production comes from the regions showing the highest yields. Some areas, such as the State of Rio de Janeiro and most of the holdings in the North Northeast could not survive without the subsidies they receive from the National Government.

Table 1.7.5 - Yields in Brazil and Argentina

Province Argentina	**Yield Tn/ha - 1980/89**	**State Brazil**	**Yield Tn/ha - 1989**
Jujuy	69,2 a 83,3	Paraná	73,6
Salta	61,5 a 80,4	San Pabo	76,1
Tucumán	38,7 a 48,0	Alagoas	46,8
Pcias. NEA	17 a 38	Pernambuco	48,8
		Minais Gerais	58,8
		Rio de Janeiro	27,2

Source: Consultant's own elaboration

End use of primary production

In **Argentina** and **Uruguay** 95% of cane output goes to sugar production. The remaining 5% is used for other purposes such as alcohol distillation.

In Brazil, on the other hand, 64% of the cane output goes to alcohol production for use in automotive fuel. The remaining 36% goes to making sugar.

In **Paraguay** 40% of the cane output is used for sugar manufacture, the rest for alcohol and beverages and for honey production.

Characteristics of the sugar industry

There is a major difference in the industrial phase in that in Argentina about half the cane is milled under the *maquila* arrangements, whereas in the other Mercosur countries such a system is unknown. As noted, the system is basically one under which the cane is made over the mill for processing and the grower receives a proportion of the sugar so processed, the share being about half of the resulting product.

Again in **Argentina**, the mills with the highest production are, like the primary production stage, to be met with in Salta and Jujuy. The average yield for the country as a whole, in terms of kilogramme sugar per kilogramme cane is 10.28%, the maximum 12% being achieved in the provinces here named, while the minimum - below 8% - is to be met with in the Northeastern provinces

Brazil, too, shows variations in yield between one region and another. Sao Paolo has the highest yields at 11.3% while Rio de Janeiro manages a bare 7%

For **Uruguay** yields fluctuate between 9.5% and 11%.

Alcohol for fuel

In **Brazil** alcohol production represents the main end use for sugar cane. This country's PROALCOHOL programme was launched in 1975, in order to save foreign exchange through import substitution - alcohol anhydride and alcohol hydrate for use in automotive fuel. The programme is still in effect. It is very difficult to wind it down because the country's 4.5 million motor vehicles depend on this alcohol for fuel. The future will be governed by economic feasibility - whether it will cost more to produce a barrel of petrol or a barrel of alcohol. According to studies conducted in Brazil, the cross-over point is represented by a price of US$ 24 per barrel of petrol/alcohol anhydride and US$ 29 for the hydrate blend.

Argentina has a programme, in operation from 1981 to 1989, under which an alcohol petrol blend ("alconafta") was imposed as the sole automotive fuel for certain regions of the country, along with the abolition of the fabrication tax here.

The reason why the programme was suspended is the fact that production became unprofitable, with the lowering of the price, in real terms, of the alcohol petrol blend and with the fall-off in sugar cane production in the 1989/90 season, and the consequent reduction in the supply of cane.

In the other Mercosur countries there is no programme of the kind. Even so, **Paraguay** sets aside 20% of its cane output for alcohol manufacture, while in **Uruguay** there is a public company that holds a monopoly for the production, distribution and marketing of alcohol.

Prices; production costs

Consumer prices in **Argentina** and **Brazil** are similar, though the composition in the respective cases is totally different, because costs of production and the returns on the

operation at the respective stages are much lower in Brazil. The similarity is accounted for by the fact that in Brazil sugar prices bear a heavier tax component.

Nowadays, both in the primary sector and in the industrial sector, all components of the cost of production are lower in Brazil, mainly due to exchange rates, a factor that is aggravated (for Argentina) when it comes to labour costs.

The situation is similarly skewed where energy is concerned. Since the bagasse that would otherwise be used for the production of alcohol is used as fuel, this (fuel) cost item is virtually zero in Brazil, whereas this is a significant item in Argentina's balance sheet.

Effect of government policy

It is here that differences between Brazil and the other Mercosur countries are most marked. In **Brazil**, production and marketing are wholly controlled even as regards quantities and prices. **Argentina** deregulated production and marketing, though there is still a measure of protection for the country's production, since sugar appears in the list of exceptions under the Mercosur Treaty and because imports bear a variable levy in addition to import duty.

In Paraguay, sugar distribution and marketing have been decontrolled since 1988, and prices both for the raw material and for the final product are concerted between the country's seven mills.

Since 1978, **Uruguay** has left sugar and raw material (cane and beet) prices free. The government intervenes through the public enterprise ANCAP which holds a monopoly for alcohol production and marketing and offloads its surpluses on the domestic market. The State also intervenes in credit policy, with lines of credit for both cane and beet growers. The protection afforded this sector through import regulation is conditional upon the beneficiary firms making a start with the requisite conversion process.

Customs policy

Argentina: The import duty on sugar is 10%, to which must be added a further 10% as a statistics levy. Besides this, there is a variable levy, which is equivalent to the percent difference between the price of a ton of white sugar on London as compared with that on the last market day of the month previous to the offer of the commodity on the retail market. Should the difference be favourable to the importer, the value is applied to the current *ad valorem* rate. It is recalled that sugar appears among Argentina's list of exceptions under the Mercosur Treaty.

Brazil: Sugar carries a 24% import duty. It does not figure in the country's list of exceptions, so that commodities from other Mercosur countries attract a 61% preference, itself due to be raised to 100% by 1 January 1995.

Paraguay: Sugar carries a 24.5% import duty. It is listed among the exceptions, so that there is no preferential treatment under the Mercosur Treaty. Furthermore, sugar imports were prohibited for 180 days from July 1992.

Uruguay: The aggregate customs tariff stands at 24%, the highest for any item in this country, and sugar appears in the list of Mercosur exceptions. Tariff protection is further reinforced by the reference price system, whereby a variable levy is applied in order to maintain protection levels irrespective of international prices.

1.8 CONCLUSIONS

1.8.1 YIELDS AT THE GROWING STAGE

The national average for Argentina as a whole is below the world level and that of the Mercosur countries in particular. Even so, both in Argentina and in its Mercosur partners, the range of variation between the different areas of production is very wide.

As the foregoing comparative analysis shows, Salta and Jujuy provinces have a similar yield performance to that of Brazil's highest producing areas (in Sao Paolo State) and much higher than the best in Uruguay and Paraguay and the world average. Yet Salta and Jujuy account for only 40% of the national production, though this share is increasing.

Tucumán province, on the other hand, has 70% of the area down to sugar cane, and 50% of the output, yet its yields are well below those of Salta and Jujuy and depress the national average. This situation is even worse in the provinces of Northeastern Argentina, where ten percent of the country's sugar is grown.

The differences in yields are due basically to the size of holdings, cultural care, the use of chemicals, planting suitable varieties and the level of technology used.

1.8.2 YIELDS AT THE INDUSTRIAL STAGE

Industrial yields show differences from one area to another, as with the primary production stage, but these are not unduly significant.

The national average is higher than that for Uruguay and Paraguay and slightly below that for Brazil. For this reason industrial yields are unlikely to affect Argentina's competitiveness vis-à-vis its Mercosur partners.

1.8.3 END USES OF PRODUCTION

End uses are of particular relevance where sugar is concerned, chiefly in comparison with Brazil, whose situation is fundamentally different from that of Argentina.

Whereas Argentina uses practically its entire cane for sugar, most of Brazil's sugar mills also manufacture alcohol and in so doing bring down unit costs by reason of the overheads that are absorbed in this way. A further element here is the fact that bagasse when used for alcohol also

provides fuel for the sugar milling stages, so that there are dissimilarities in the composition of the cost of energy.

Since a portion of the output is exported to a decontrolled market where prices are generally lower than the costs of production, Argentina's sugar sector would be less vulnerable if some of this output could be used for manufacturing other products.

1.8.4 PRODUCTION COSTS

Given the cost structure and the characteristics of production in Brazil and Argentina, labour becomes the most significant cost item. Accordingly, the major wage differences between the two countries take on additional significance.

This, together with the skewed nature of energy costs between the two countries and the lower costs of most components, means that in Brazil costs of production will be lower.

1.8.5 GOVERNMENT POLICIES FOR THE SUGAR SECTOR

In view of the peculiarities of sugar production, a sector in large measure under regulation by the producer countries, government policies take on considerable relevance when one is analysing competitiveness. The widest differences here are those between Argentina and Brazil.

For the domestic context Argentina has deregulated sugar as from 1991, whereas previously output quotas and price ceilings for cane were in operation.

As regards open market policy, Argentina's industry continues to enjoy protection by the fact of sugar being included in the list of Mercosur exceptions and by the application of the variable levy over and above import dues.

Brazil, in contrast, has production and domestic and foreign marketing entirely under government regulation. Not only does the government prescribe quantities and prices but also operates a system of differential levies and subsidies applying to the different areas of production by way of protecting the less competitive growers.

This is explained by the fact that under the Brazilian Constitution there is a state monopoly on the extraction, processing and distribution of petroleum and fuels obtained therefrom. If alcohol is used as a substitute for petrol or as an additive in petrol blends, inevitably it comes under regulation. The fact of establishing a ratio with the amount of alcohol obtained as compared with a kilogramme of sugar leads to cane and sugar prices being dependent on the government's fuel pricing policy. By laying down prices and quantities together with price equalization policies all entrepreneurial risk and any competitive differences are virtually eliminated.

From what is said here it will be seen that Argentina's sugar sector has to compete with the production of Brazil's Sao Paolo State, which is that country's most efficient in the different production stages. Despite the differences, competitiveness is brought on a par with that of Sao Paolo by the operation of the government subsidies. In other words, Argentina has to compete with a "homogeneous" situation in Brazil.

1.8.6 LIKELY EFFECT OF DEREGULATION

If sugar production and marketing were totally deregulated in the Mercosur countries, the first areas of production in Argentina to be adversely affected would be those of Tucumán and the northeastern provinces, since they are in no condition to compete with Sao Paolo or, for that matter, with several other Brazilian states, such as Rio de Janeiro and those of the North and Northeast.

1.8.7 INTEGRATION

It is highly unlikely that Brazil will change its policy for the sugar sector, so that Argentina should not open up its market to that country, since regions as inefficient as, or more inefficient than, Tucumán and the northeastern province, would go out of production altogether.

1.8.8 ALCOHOL

Representatives of the Mercosur private sector, at the Sugar Workshop (Group No. 8), proposed that the problem of surplus supply of sugar within the region might be solved by broadening the market for alcohol. Under this proposal it would be obligatory to blend alcohol into fuels - for ecological considerations. Even so, the obligation would need to be accompanied by subsidies for the sugar sector, since prices are favourable for petrol at the present time.

1.8.9 POSSIBLE OPENING UP OF THE MARKET TO BRAZIL

Should the respective governments not consider the above proposal to be viable, and if no alternative presents itself for the region's surpluses, it will be difficult to deregulate the sector unilaterally.

CHAPTER 2

TECHNICAL STUDY OF THE PRESENT CONDITION OF SUGAR MILLS IN TUCUMÁN PROVINCE

2.1 INTRODUCTION

The purpose of this technical study is to determine the investment required in order to modernize and diversify the sugar industry, with an assumption as to the feasibility of manufacturing a further range of cane byproducts.

In Annex 2 of Technical Annexes will be found the model technical questionnaire regarding the condition of the equipment.

Annex 3 contains the technical notes drawn up at the respective mills in connection with the visits that the consultant made to each, and as a result of conversations held with the respective technical staffs, in an attempt to establish both the degree of obsolence of the equipment and the requirements in terms of technology transfer.

The study first analyzed the site of the respective mills in relation to the infrastructure there, and the availability of raw materials, in order to determine the degree of backwardness in each case and the technical innovations required if productivity was to be enhanced.

Based on the findings of the present study, a general investment programme has been outlined with a view to modernizing the basic production stages in the sugar industry, to enhancing yields and to reducing as far as possible sugar losses and energy consumption. This should provide the basis for a general evaluation of potentialities and requirements for promoting the production of sugar cane derivatives in Tucumán.

The analysis considers the diversification described below:

Bagasse derivatives

- Pulp and paper (printing paper, stationery and newsprint);
- Particle board and laminates;
- Livestock feed (roughage as well as complete feed) to be obtained by pelleting a mixture of bagasse, pith and molasses, a mixture of molasses and vinasse;
- Furfural and derivatives.

Molasses derivatives

- Sugar recovery from molasses for producing liquid sugar by chromatographic separation;
- Fermentation and distillation of molasses for the production of:
  - rectified alcohol
  - fodder yeast
  - fresh baker's yeast
  - active instant dried yeast (AIDY)
  - crystallized acetic acid; vinegar
  - organic solvents (e.g. acetone-butanol)
  - carbon dioxide as a byproduct of fermentation for use in the beverages industry, and
  - citric and other acids.

The technical study is arranged in two parts:

- first part: technical appraisal of the present condition of the respective sugar mills in Tucumán; recommendations emerging from the analysis of the weak points and constraints in each case; and the proposed investment programme; and
- second part: examination of the possibilities of, and requirements for, manufacturing sugar cane derivatives, and the impact of this on employment opportunities and on the economy at large.

2.2 TECHNICAL APPRAISAL OF THE CURRENT CONDITION OF THE MILLS

The following situation emerges from the appraisal:

2.2.1 TYPES OF LOSSES

2.2.1.1 Excessive energy consumption

In almost all cases the steam consumed per ton of cane processed lies in the 550-750/hour range.

This is due to:

- Absence of thermal insulation on the processing equipment and steam piping;
- Inefficient utilization of the condensed steam, leading to an additional fuel demand;
- Inappropriate and defective design of the evaporation station, again leading to an excessive consumption of steam;
- The fact that most steam generators are of the low-pressure type (12-16 bar), indicative of thermal inefficiency.

Calculation of energy loss due to the boiler being fed with water from condensed steam at 85° C instead of 100° C, and the fact that 20% more cold water is used to feed the boiler because

there is not enough water from the condensed steam source (due to inappropriate evaporator design) gives rise to additional (about 5.4%) consumption of the entire bagasse produced (see Technical Annexes - Annex 5).

Calculations for energy saving obtained by drying the bagasse and reducing its moisture content from 52% to 40% show that (see Technical Annexes - Annex 6):

- a 15% saving (approximately) on the total bagasse produced;
- the amount of bagasse so saved represents an economizing of some 5.4 million m^3 gas or, in money terms, approximately US$ 416.000 p.a.;
  the outlay for a bagasse dryer for a factory having a 500.000 tons/year milling capacity and a daily average 4.000 tons cane intake could be made good by the end of the very first season, on the basis of the US$ 400.000 so saved.

2.2.1.2 Sugar losses in final molasses

Losses in this case amount to 1.6% of the cane due to sucrose extraction deficiencies in the various boiling stages and the imperfect draining of the molasses. This is because most mills have no cold water crystallization equipment for C massecuite.

Improved extraction is therefore needed in order to bring these losses down to a normal level, i.e. 1.3 % of the cane - a rate achieved by the La Fronterita mill.

La Fronterita has a milling capacity of 500.000 tons per season, representing a US$ 600.000 in money terms, on the basis of US$ 400/t white sugar output.

If a cooled crystallization plant is installed and the batch centrifuges used for clearing C massecuite are replaced (as has been done in some mills), this represents a cost of some US$ 600.000, which, as has been said, can be amortized in the first season's operation.

2.2.1.3 Sugar losses in bagasse

From data obtained by means of the questionnaires at the time of the visits to the various mills it is clear that bagasse sugar losses are in excess of one percent of the cane, this is due to:

- inadequate preparation of the cane;
- improper use of the preparation equipment and protracted stoppages due to supplies of cane not arriving at the mill, notably during rainy periods, when supplies may be held up for as much as ten days;
- the low water imbibition percentage.

In those cases where the cane is not properly prepared, the recommendation is made that the mills should acquire defibering and cane washing equipment.

Among the chief measures needing to be taken is that of beginning harvesting no later than early or mid-June and completing the process no later than late October or early November.

This will obviate transporting cane during the rainy season - a time when the pol value of the cane during this brief period is at a minimum.

Again during this brief period, the small amount of increase will be lost: moreover, greater losses occur due to the improper use of the cane preparation equipment and to the insufficient arrivals of fresh cane - top burnt cane must be delivered within 24 hours to prevent spoilage and sucrose inversion.

Loss of sugar in bagasse is normally in the 0.6-0.7% range. Sugar yield increases that are possible if this normal level can be maintained, and the implied saving of an estimated 0.7 million dollars, should be an incentive for the mills to make the necessary investment.

2.2.2 APPRAISAL OF EQUIPMENT AND MACHINERY MANUFACTURERS IN TUCUMÁN

From visits to these manufacturers and from conversations with the staff it was clear that the technical capacity was there, together with qualified human resources, in order to implement the mill rehabilitation programmes recommended and the new projects for diversifying.

The only problem remaining concerns the need for acquiring the know-how and the technology for producing these novel products, if not otherwise available in Argentina.

For the activities implicit in the above, there is an urgent need for:

- Efficient organization;
- Financial resources.

Tucumán is thought to be capable of being among the best suppliers of machinery and complete equipment ranges for sugar mills in Latin America. An analysis of the manufacturers visited appears in Annex 4 of Technical Annexes.

2.2.3 ANALYSIS OF THE INVESTMENT PROGRAMME CALLED FOR

An analysis of the technical information regarding the mills covered by the questionnaires at the time of the respective visits, and of the conversations held with the technical staff, offers a basis for making recommendations specific to each mill and covering a span of three years.

Table 2.2.1 brings together the technical recommendations in question together with the investment schedule for the respective cases.

The outlay required for rehabilitating Tucumán's sugar mills thus comes to some US$ 26 million. Table 2.2.2 illustrates the rehabilitation schedule for the successive years and the work needing to be done in each case.

The programme accordingly proposes, for Year 1, an outlay of US$ 8.5 million in order to correct the serious energy losses and, for Year 2, some US$ 7 million in order to modify

processing procedures, raise yields and reduce sugar losses. In Year 3, approximately US$ 10.5 million would be assigned to vinasse utilization processes and river pollution abatement.

Table 2.2.1 - Summary of estimated investments required for mill rehabilitation over the next three years (US$ '000)

Outlay for	Bella Vista	La Fronterita	La Corona	Trinidad	Santa Rosa	Concepción	Santa Barbara	Suhorco	Providencia	Marapa	Cruz Alta
Isolation of processing equip. and steam piping	100		100	100	100		20	100	10	50	15
Cane washing plant	300		300	50				300		20	
Bagasse drying plant	300	400	400	400	300			200	300	200	300
Shredder plant				300	300			300	300	300	300
Rotary vacuum filter plant	150					350			120	120	120
Talo filtrate plant									60		
Modernizing evapor. station	800		600	600	400		400	600	600	600	400
Replacement of horizontal heat exchangers			200	50				150			
Replacement of batch centrifuges for C massecuite			400					300			
Modification of vacuum boilers			200							120	
Modification of mill plan and relocating equipment at 3m below ground level								150	50		
Balling presses		200									
Instal. of a water cooling crystallizer for C massecuite	250		250	250	250			250		250	
Increasing capacity of water regenerating system				50							
Vinasse utilization plant	1.500	3.000	1.500	1.500			1.500			1.500	
Modif. of pumping system for water condensed steam				100							
Total (millons US$)	3.400	3.600	3.950	3.400	1.350	350	1.920	2.350	1.440	3.160	1.035
Aggregate outlay proposed (millons US$)						**26.000**					

Source: *Consultant's own elaboration.*

Table 2.2.3 summarizes the proposed investment programme for replacing the old, low-pressure boiler and steam turbines. The programme covers the period 1997-2002. The annual outlay is approximately US$ 11.4 million.

This represents the cost, in Argentina, of the different operations proposed, as estimated from consultations with the manufactures.

Table 2.2.2 -Schedule of disbursements for sugar mill rehabilitation

Year	Proposed outlay (estimate) (US$)	Operation
1994	8.500.000	Equipment insulation; redesign of evaporation station; Installation of bagasse dryer.
1995	7.000.000	Installation of cane washing system; de-fibering plant, replacement of horizontal heat exchangers; batch centrifuges; modification of specified rotary vacuum filters; modification of equipment lay-out; installation of cooled crystallization for water for C massecuite.
1996	10.500.000	Vinasse utilization
Total	**26.000.000**	

Source: Consultant's own elaboration

Table 2.2.3 - Summary of estimated investment for refurbishing boilers and turbines under the 1997-2002 plan ('000 US$).

Outlay for	Bella Vista	La Fronterita	La Corona	Trinidad	Santa Rosa	Concepción	Santa Barbara	Ñuñorco	Providencia	Marapa	Cruz Alta
Steam boilers 60 t/h at 2o bar minimum pressure	2 cv 4.000	2 cv 4.000	2 cv 4.000	2 cv 4.000	2 cv 4.000	3 cv 12.000	- -	1 cv 2.000	2 cv 4.000	2 cv 4.000	- -
Steam turbines-4 Mw each at 2.5-2.8 bar pressure	2 tv 2.000	2 tv 2.000	2 tv 2.000	1 tv 1.000	1 tv 1.000	1 tv 1.000	- -		1 tv 1.000	2 tv 2.000	- -
Total **Aggregate outlay**	6.000	6.000	5.000	5.000	5.000	16.000 57.000	-	2.000	5.000	6.000	-

Source: Consultant's own elaboration

2.3 CONCLUSIÓN

The final conclusions of this part of the technical appraisal for the Tucumán mills are to the effect that:

- Energy consumption and sugar losses are excessive in most cases:

- In previous years, especially the last three, the mills were short of financing as a result of the crisis in world sugar prices;

- Tucumán has abundant technical capacity and highly-qualified human resources, but is lacking in administrative organization capable of controlling the sector's development and diversification;

- Funding is urgently needed in order to rehabilitate the province's mills and rescue the sugar industry;

- Additional sources of financing are lacking with which to finance the sugar industry and secure product diversification.

What is said here holds good for most mills in Tucumán. Exceptions are the three mills that have a distillery for producing 96° degree proof alcohol denatured alcohol from molasses.

2.4 RECOMMENDATIONS

- The rehabilitation programme should be launched as a matter of urgency;

- An advisory committee should be appointed, to have a technically highly-qualified membership and the task of planning policy for the sugar industry, from the basic objectives to the individual aspects and of monitoring disbursements made for modernizing and rehabilitating the mills;

- Highly qualified staff should be recruited with the task of detecting shortcomings and solving the technical problems faced by mills at harvest time in order to keep losses to a minimum;

- Harvesting should start in early June and be complete by late October, i.e. should last about 150 days. Consideration should be given to utilizing the mills' installed capacity to the full. For this purpose a study needs to be made of the design capacity for the respective phases of the production process and any bottlenecks removed. Mills should not operate during the rainy season, so that when the cane is delivered supplies can be assured on a continuous basis.

2.5 APPRAISAL OF FUNCTIONAL STATUS OF MILLS

In order to determine the degree of functionality of the mills an analysis has been made of the information contained in the questionnaires that were handed to the respective mills. These covered the following matters (see Technical Annexes - Annex 2 and 3)

- Age and condition of mill equipment;
- Design capacity and efficiency of the machinery in the principal sections of the most important mills, namely:
  - tandem mill
  - processing equipment for the different production stages
  - steam and electricity generating plant;
- How the mills operated over the last three seasons: this in order to determine the technical problems and bottlenecks inherent in equipment design and functioning;
- Availability of byproducts of sugar processing (bagasse, molasses); and advice needed as regards possible industrial diversification with these byproducts as starting materials. The findings of a market analysis must also be taken into account here.

Tables 2.5.1, 2.5.2 and 2.5.3 bring together the findings emerging from the last three sugar seasons for the respective mills. These show clearly that the main problem facing the mills are:

- Excessive energy consumption, when it is realized that steam consumed per ton of cane processed is within 550-750kg/hour range;
- Heavy losses of sugar in the molasses - exceeding 1.6% of the cane;
- Heavy losses of sugar in the bagasse - exceeding one percent of the cane; and, in general, major aggregate losses of between 2.6 and 3.1%, when the normal level is somewhere between 2.2 and 2.4%.

Table 2.5.1 - Summary of operating results of the sugar mills (Season 1992)

	Bella Vista	La Frontera	La Corona	Trinidad	Santa Rosa	Concepcion	Santa Barbara	Suinorco	Providencia	Marapa	Cruz Alta	Leales
Pol °o cane	13.000	12.640	12.440	12.514	13.153	12.309		12.700		11.850		
Sugar yield °o	10.300	10.040	9.350	9.77	10.090	9.280		9.940		8.960		
°o molasses	4.500		4.100	4.140	4.763	4.130		3.800		4.100		
°o bagasse	30.000	30.000	29.000	30.060	31.287	33.000		30.000		30.200		
°o moisture in bagasse	52.000	52.000	52.000	51.100	51.500	53.000		52.000		52.100		
°o sugar loss in bagasse	8.000	0.900	1.200	1.100	1.151	0.860		1.130		1.020		
°o sugar loss in molasses	1.500	1.260	1.600	1.420	1.578	1.570		1.350		1.440		
°o sugar loss in mud	0.300	0.340	0.200	0.190	0.254	0.370		0.230		0.390		
°o undetermined sugar loss	0.100	0.100	0.100	0.030	0.065	0.230		0.060		0.410		
Total losses	2.700	2.604	3.100	2.740	3.065	3.030		2.760		2.900		
Steam consumption kg t.c.h.	600	580	612	550		520		750				
Electrical consumption	17.000	20.000	20.700	14.000		20.000		15.200				

Source: Based on information supplied by the mills.

Table 2.5.2 - Summary of operating results of the sugar mills (Season 1991).

	Bella Vista	La Fronterita	La Corona	Trinidad	Santa Rosa	Concepción	Santa Barbara	Sinbor-co	Providencia	Marapa	Cruz Alta	Leales
Pol °• cane		12.363		12.63	13.478	13.383		13.800		12.340		11.636
Sugar yield °•	11.310	9.780	9.648	9.790	10.035	10.340	9.947	10.890	10.213	9.220	11.430	8.570
°• molasses	4.050		4.748	4.300	4.991	4.709	5.460	3.800	4.940	4.400	4.716	4.640
°• bagasse	31.200		31.400	31.100	31.310	33.009	39.800	35.410	32.220	31.030	30.770	33.780
°• moisture in bagasse	52.200		51.330	52.300	54.000	53.000	54.000	53.600	51.600	52.560	50.300	53.000
°• sugar loss in bagasse	1.069	0.978	1.224	1.100	1.281	0.960	1.220	1.140	1.162	1.120	0.851	0.977
°• sugar loss in molasses	1.269	1.200	1.710	1.470	1.846	1.630	2.230	1.490	1.464	1.550	1.655	1.722
°• sugar loss in mud		0.340		0.220		0.270		0.160		0.360		9.137
°• undetermined sugar loss		0.065		0.060		0.180		0.110		0.090		0.131
Totale losses	2.538	2.583	3.360	2.850	3.443	3.040	2.615	2.900	2.957	3.120	2.506	2.966
Steam consumption kg t.c.h.				550								
Electrical consumption				14.000								

***Source:** Based on information supplied by the mills.*

Table 2.5.3 - Summary of operating results of the sugar mills (Season 1990)

	Bella Vista	La Fronterita	La Corona	Trinidad	Santa Rosa	Concepción	Santa Barbara	Sinbor-co	Providencia	Marapa	Cruz Alta	Leales
Pol °• cane	12.129	13.119	12.285	11.910	12.076	11.713	11.910	12.500	11.920	12.830	11.459	11.636
Sugar yield °•	9.687	10.620	9.002	8.850	9.973	8.980	9.030	9.450	9.200	9.370	8.230	8.670
°• molasses	3.776	3.970	5.260	4.940	4.364	4.461	4.360	4.200	4.680	5.500	4.940	4.640
°• bagasse	30.500	30.700	31.000	31.540	29.000	33.600	31.950	31.300	26.600	29.620	28.040	33.780
°• moisture in bagasse	54.500	53.400	51.600	51.600	50.300	53.000	53.400	54.000	49.900	52.500	51.800	53.000
°• sugar loss in bagasse	0.970	0.905	1.205	1.140	0.998	0.920	1.076	1.040	0.805	1.000	0.686	0.977
°• sugar loss in molasses	1.405	1.310	1.758	1.580	1.497	1.570	1.582	1.760	1.494	2.100	1.570	1.722
°• sugar loss in mud	0.146	0.210	0.230	0.290	0.251	0.180	0.145	0.160	0.354	0.300	0.092	9.137
°• undetermined sugar loss	0.046	0.074	0.090	0.048	0.102	0.100	0.087	0.150	0.077	0.070	0.281	0.131
Total losses	2.570	2.499	3.230	3.060	2.843	2.730	2.930	3.050	2.730	3.460	2.929	2.966
Steam consumption kg t.c.h.												
Electrical consumption												

***Source:** Based on information supplied by the mills*

The causes of the heavy losses described are now examined under the relevant headings.

2.5.1 HEAVY CONSUMPTION OF ENERGY - THE CAUSES:

- The high moisture content of the bagasse, at times as much as 54%, requires more energy to evaporate before the bagasse can be burnt. To evaporate one percent moisture, a one kilogramme of water, some 540 Kcal are needed, and this reduces boiler efficiency by 3%.

- Inefficient use of condensed steam and the fact of using cold (raw) water feed to the boiler. This results in consuming more bagasse for the extra energy needed. To raise the temperature of water from 20° C (ambient temperature) to 100° C (the temperature of the feed water) an additional 80 Kcal are needed per kg water, i.e. a 69 kg higher consumption of bagasse per cubic metre of cold (raw) water (see Technical Annexes - Annex 5).

- Inadequate temperature for the condensed steam recovered from evaporation and the vacuum boiling station. The normal temperature for feed water is 100° but in most mills in Tucumán water from condensed steam goes in at 85° or, in the most favourable cases, at 90° . This is due to the fact that the condensation piping or evaporators and the vacuum boilers, and, again, the tanks for the water condensate are not insulated. A further cause is the inappropriate design of the pumping equipment for the water condensate. Because of this a further 10-15% enthalpy in the water condensate is needed in order to bring the temperature up to 100° C;

- Inappropriate design of the evaporation group. This results in a heavy consumption of exhaust steam and steam from the electric turbine generators, instead of exploiting the steam generated by the respective effects of the evaporation group;

- Most steam boilers are of the low pressure type, with a maximum rating of 16 bar (rarely 18 bar). Some of the boilers were manufactured at the beginning of the century. Bagasse feed and ash removal are done manually, with the high labour costs that this entails;

- Defective insulation of the processing equipment and of the steam piping and, again, of the exhaust steam piping and piping conveying hot fluids. Enormous losses of energy occur in this way;

- The direct application of the superheated exhaust steam from the processing operations. It should be desuperheated first.

2.5.2 CAUSES OF SUGAR LOSSES IN FINAL MOLASSES

These losses occur because insufficient importance is attached to extracting or recovering the maximum possible sucrose during the various boiling stages, and because there is no cooled crystallizer, in most mills, for the water for C-massecuite in the final molasses. The causes may be ascribed to:

- The fact that almost all mills have a distillery for molasses production;

- The very low price of sugar. For the last season this was 20 cents/kg. Some mills in Tucumán have reduced final molasses sugar losses to normal levels of 1.2-1.3%, while the others operate at an 1.4-1.6% loss (a high figure, this) and aggregate sugar losses of 2.6% of the cane instead of 3.1%.

By bringing sugar losses in the final molasses down to 1.6% and to 1.3%, one has a 3% increase in sugar yield. For a mill with an annual milling capacity of 500.000 tons cane per

harvest. this represents a saving of 1.500 tons sugar, or US$ 600.000 in money terms. assuming a sugar price of US$ 400/t. A reduction in aggregate sugar losses from 3.1% to 2.4% represents a sugar yield increasing by 3.500 tons/season, or US$ 1.400.000.

2.5.3 CAUSES OF SUGAR LOSSES IN BAGASSE

Most mills record losses here in excess of one percent, due to:

- Faulty preparation of the cane and failure to wash the cane;

- Improper and discontinuous processing (and prolonged idle periods) due to insufficient supplies of cane, a situation caused by:

    - difficulties in delivering the cane to the mills, due to the poor state of the roads, especially during the rainy season and, on occasion, due to shortage of transport;

    - burning the cane and delays in delivery to the mill - sometimes amounting to 10 and even 20 days - with the consequence that the quality of the cane has deteriorated in the meantime. The various mills state that burning is usually done to save on labour costs.

    - the low rate of water imbibition, when the normal cane fibre level is 20%;

    - the need for overhauling the mills, and bringing their capacity into line with the specific fibre load. Mill turbine speed and hydraulic pressure need to be checked daily;

- discontinuous operation of a mill at full regime and major variations in the volume of cane milled per hour.

2.6 PROPOSED TECHNICAL STRATEGY

Various technical recommendations are now in order, following the above analysis of the causes of energy and sugar losses, in order to keep these losses to a minimum.

2.6.1 TO REDUCE ENERGY CONSUMPTION

It is recommended that the following measures be urgently adopted:

- Redesign the evaporation station on modern criteria. The principal elements to be borne in mind here are that:

- The evaporation station needs to be arranged in train fashion, and consist of five effects. The total design surface area per ton cane per hour and the evaporation surface must not be less than 35 m^2 or 10 m^2, respectively. The surface area of the different effects needs to be

designed in relation to exhaust steam requirements for the vacuum boiling station and the different stages of the heating process.

Below are given the percent ratios recommended for the heating surfaces of the different effects vis-à-vis the aggregate heating area of the evaporation station:

- pre-evaporation	34,0%	% of aggregate area
- first effect	24,0%	% of aggregate area
- second effect	17,0%	% of aggregate area
- third effect	12,5%	% of aggregate area
- fourth effect	12,5%	% of aggregate area

For the above design water condensate must be available at 100 C in amounts 30% greater than the feed water needs for the steam boiler. This should yield a saving of about 5.4% of the bagasse that is produced per season and is used for heating raw water from ambient temperature (20° C) to 100° C and for raising the condensates from 85° C to 100° C (this being necessary because of the heat losses due to the lack of insulation - see Annex 5).

Again, in order to exploit the bagasse to the full, savings must be made in, or such measures taken as:

- The cost of chemicals and equipment for water treatment, e.g. caustic soda, phosphates, injection pumps and related equipment, resins and chemicals used for regeneration purposes;

- Boiler scaling - i.e. in order to enhance boiler efficiency;

- Protecting the steam and exhaust steam piping, and processing equipment and, again, the piping conveying hot fluids such as water condensate, juices, syrup, molasses, massecuite and magma;

- Installing a steam separator in the water condensate piping and expansion tanks in order to keep steam and water condensate apart;

- Installing a heater in the steam return beginning with the last effect and as far as the condenser, i.e. a heater for the condenser such as will offer the following advantages:

    - it will heat the juice which is at ambient temperature to approximately 40–45° C by exploiting the latent heat before the steam is condensed;

    - reducing, by approximately half, the amount of cold water for condensing the steam;

    - installing a bagasse dryer in order to increase the thermal efficiency of the boiler and the steam generator. This would make it possible to save some US$ 300 000 each season (see Annex 6).

2.6.2 TO REDUCE SUGAR LOSS IN THE MOLASSES

- Aiming for a purity difference of 20 degrees of the massecuite and that of the mother liquid. This difference is considered the minimum for the three (A, B, C) massecuites;

- Preparing separate (A and B) molasses and refining (C) by raising the boiling temperature and diluting with water in order to dissolve the fine crystals and adjusting the feed molasses to 75 brix;

- Reducing as far as possible the purity increment in the final molasses at the centrifuged stage. This can be achieved by making use of the maximum amount of massecuite and the minimum amount of water in order to achieve the required purity for C sugar and to adjust the temperature of the molasses chamber. Acceptable purity difference between the mother liquid and C massecuite should not exceed 15 degrees;

- Installing a cooled crystallization station for the C massecuite water;

- Replacing the old batch centrifuge for purging the C-massecuite with a continuous centrifuge.

2.6.3 TO REDUCE SUGAR LOSS IN THE BAGASSE

- Installing cane washing equipment;

- Reducing mill down time and exploiting the mill's maximum capacity in such a way as to prevent hourly fluctuation percentages of milled cane. The fluctuation should not exceed 15%;

- Monitoring the preparation of the cane by continuous measurement of the preparation index (this should never fall below 90%);

- Adjusting water absorption by the fibre to ensure that it is never below 200%;

- Adjusting hydraulic pressure and the speed of the mill hammers;

- Constantly monitoring mill calibration - to the specific fibre load.

2.7 POTENTIAL FOR MANUFACTURED SUGAR CANE DERIVATIVES: REQUIREMENTS

Given the present economic situation of the sugar industry it is necessary to look for alternative and complementary activities and to attenuate as far as possible the impact of the economic problems arising from the crisis on the world market.

One approach here is to diversify, in turn implying, among other things, a profitable utilization of both byproducts and available resources.

By promoting byproducts the industry itself can be diversified and its dependence on a single product eliminated.

The purpose in the following sections is to determine the potential for utilizing sugar cane byproducts - bagasse and molasses - in Tucumán.

2.7.1 BAGASSE BYPRODUCTS

From an industrial standpoint, two aspects can be distinguished - fibre, between 60 and 65% and pith - 30-35%. The fibre is essential for the manufacture of pulp, paper, particle board, furfural and its derivatives, and animal feed.

The pith is first put through a process of hydrolysis and is then used to make feed. Special boilers would be needed if the pith were to be used as fuel, since the usual steam boilers cannot achieve complete combustion.

2.7.2 MOLASSES BYPRODUCTS

Molasses are used mainly in fermentation and distillation for a wide range of products.

2.7.3 AVAILABILITY OF SUGAR CANE BYPRODUCTS: BAGASSE AND MOLASSES

2.7.3.1 Quantity of bagasse produced by the respective mills

The following tables (2.7.1, 2.7.2, 2.7.3 and 2.7.4) show the amount of sugar cane milled and the qualities of sugar, bagasse and molasses produced in Argentina and in Tucumán in the last three seasons (1990, 1991 and 1992)

Table 2.7.1 - Cane milled in Tucumán; aggregate for Argentina:

	1990	1991	1992
Tucumán	6.631.320	8.058.607	8.019.098
Argentina	12.506.000	14.328.000	12.934.420

Según la información recogida en el ficha técnica, el porcentaje medio de bagazo en la caña es de alrededor de 30%, y el de la melaza de 4%.

Table 2.7.2 - Sugar produced in Tucumán; aggregate for Argentina:

	1990	1991	1992
Tucumán	609.781	815.758	756.840
Argentina	1.243.029	1.472.646	1.282.021

Source: *Estación Experimental Obispo Colombres*

Table 2.7.3 - Aggregate bagasse and molasses produced by the sugar industry: Tucumán and Argentina.

	1990		1991		1992	
	Bagasse	Molasses	Bagasse	Molasses	Bagasse	Molasse
Tucumán	1.989.396	265.253	2.417.582	322.344	2.405.729	320.764
Argentina	3.742.772	499.036	4.311.600	574.880	3.880.326	513.377

Source: *Estación Experimental Obispo Colombres*

2.7.3.2 Bagasse as raw material for cellulose

The mills consume the entire amount of bagasse, plus 0.8% natural gas, as a source of energy - due to the low level of efficiency of the steam generators (itself due to these being of low-pressure design), the high moisture content of the bagasse and the contamination of the latter from dust particles and sand. Added to this, as noted earlier, the evaporation station is of inappropriate design and the processing equipment and steam piping have no insulation.

From the materials balance sheet (bagasse de-pithed for subsequent reduction by chemical means) it will be seen that one ton of bagasse yields about 220 kg fibre (see Technical Annexes - Annex 7 and 8) for use in the manufacture of stationery and paper for printing, notebooks, magazines, envelopes, folders and cigarette paper.

Something would be gained, therefore, if it were possible to utilize (a) the entire bagasse for making pulp and paper, particle board, feedstuffs and furfural derivatives both to supply domestic demand and for export and (b) natural gas, which Argentina has in abundance, as sources of energy for the sugar industry. A further consideration here is the fact that natural resources for cellulose are declining markedly in world terms. A parallel advantage would be

gained here if the boiler thermal efficiency were to be raised to 85%, though an economic appraisal of the proposal would need to be made first.

Table 2.7.4 - Bagasse quantities produced by the mills in 1992.

Mill	Cane quantity (t)	Bagasse %	Bagasse quantity (tons)
De Bella Vista	500.000	30.0 %	150.000
La Corona	346.500	29.0 %	100.485
Concepción	1.433.333	33.0 %	473.000
Marapa	413.657	30.2 %	124.924
Santa Rosa	540.000	31.2 %	169.020
Ñuñorco	500.000	30.0 %	150.000
Trinidad	750.000	30.0 %	225.207
La Fronterita	800.000	30.0 %	240.000
Santa Bárbara	800.000	30.0 %	240.000
Cruz Alta	380.000	30.0 %	114.000
Leales	500.000	30.0 %	150.000
Providencia	800.000	30.0 %	240.000
Total bagasse produced			2.376.636

Source: Data contained in the questionnaires and information supplied by the technical staff of the mills.

2.7.3.3 Molasses as raw material for the fermentation and distilling industries

Tucumán's mills produce an aggregate of close on 50. 000 tons molasses each year. All except three (Ñuñorco, Providencia and Cruz Alta) have their own distilleries, where they produce ethyl alcohol, and have the capacity to produce denatured alcohol suitable for admixture with automotive petrol. Molasses can be exploited in several ways, such as:

- For sugar recovery (molasses sugar);
- The production of denatured alcohol as was done from 1981 to 1989 for petrol-alcohol blends. This is quite attractive for the mill and technical staff for the prospects of profit that it offers. The PUMA petroleum firm, moreover, has expressed considerable interest in seeing the programme launched again;
- The creation of a chemical industry would produce alcohol derivatives.

- The manufacture of novel products from molasses fermentation.

The various possibilities here described are treated in what follows:

2.7.4 DIVERSIFICATION OF SUGARCANE BYPRODUCTS

2.7.4.1 Bagasse derivatives

a. Pulp and paper:

Argentina has ten main establishments manufacturing pulp and paper (for stationery and newsprint) out of the 125 with related lines of production. Their aggregate capacity in 1991 stood at 871.000 tons pulp and 1.350 000 tons paper of all types. In 1980 five were using bagasse, two of them in Tucumán. At the present time there is only one paper mill in the province namely Papel Tucumán, which has been producing about eleven percent of Argentina's pulp and eight percent of its paper.

Even this mill has halted production because of financial difficulties. In 1991 Argentina imported 193.000 tons paper and 34.000 tons pulp. The Tucumán mill in question has installed vertical bagasse depithing equipment in most factories as a means of securing supplies of fibre of bagasse so treated the criterion on which the selling price of bagasse fibre is sold, assumes an equivalence between 4.71kg fibre for one cubic metre of gas. Production capacity stands at 100.000 tons/year pulp and 110.000 tons/year paper.

b. Particle board

To judge from the documentation, there was one factory in operation in Argentina, namely Azucarera Tucumana, manufacturing particle board with bagasse. It was first established in 1967. The technical staff of the sugar mills in the province speak of there having been another particle board factory, the Taglosa, which had to close after six months due to technical and market problems.

Since the aggregate yearly output of bagasse from the Tucumán sugar mills exceeds two million tons, some purpose would be served in diversifying bagasse cellulose for the manufacture of particle board as well as pulp and paper. There is a growing potential demand for the product and its various laminates in the world, now that natural timber resources are becoming scarcer.

<u>Possibilities for using bagasse particle plywood</u>

Bagasse has always been looked upon as a waste product and no more, or in the most favourable view, as fuel for burning in the mill boilers. And yet bagasse can be used in the manufacture of:

- particle board panels as a substitute for, and with better technical characteristics than plywood made from wood only. The uses envisaged there are:

- cabinet making
- prefabricated panels for housing purposes
- architectural applications

For industrial applications may be noted:

- corrugated sheeting in housing construction
- crates for transporting fruit and vegetables
- ducting for cables, etc., substitute for plastic (which is more expensive)
- framing for automobile windscreens, and
- miscellaneous other products (desk and table tops, trays, etc.)

The above recommendation allows of incorporating added value in terms of the labour needed for cultivating a special variety of cane that has a high cellulose and a low juice content. The variety calls for no more than (i) a device for the milling operation such that the largest amount of bagasse may be obtained accompanied by the lowest amount of juice; (ii) a bagasse dryer; (iii) the depithing equipment, and the industrial plant for the manufacture of board and moulded items.

In the manufacture of items for housing construction, the board passes through a tunnel where a coating (0.5 mm) of plaster is applied automatically, prior to the drying process, the product consisting of a finished panel ready for painting or have wallpaper applied to it. All ducting for electricity or sanitary purposes is incorporated at the assembly stage. Corrugated sheets for roofing can also be made from plywood bagasse, which then only needs to be spray-dried. Indoor furniture, including cupboards and kitchen fittings, doors and door frames, can be made from the same materials.

As regards the market for plywood panels, etc., there is a strong international demand for melamine faced components that can be disassembled into kits, and crates for transporting fruit and vegetables (these creates are more hygienic than those made from poplar wood), since they are not porous in the same way and can be sterilized with steam, thus preventing fungus, etc., development. At the present time the European Community continues to import their supplies from Réunion.

If the Papel Tucumán plant were reactivated, it should be possible to manufacture 4- or 5-ply craft sacks for bagging sugar, rice, cement, etc., and corrugated cardboard packaging materials.

It is therefore recommended that:

- particle board plant be set up with the La Fronterita mill, and utilizing about 40% of the bagasse produced there. It should be borne in mind that the mill has a satisfactory energy consumption and can call on a larger amount of bagasse, as well as the necessary infrastructure and equipment. The installed capacity here would be 40.00 tons yearly.

- The cost of setting up a factory to produce prefabricated houses along industrial lines (manufacturing plywood in 3/4 inch (19.5 mm), 1.530 mm and 2.44 mm thicknesses comes to approximately US$ 13.000 000, while the production line for melamine-faced pressed items comes to approximately US$ 8.000 000.

- Manpower demand for a project of this size amounts to 150 jobs directly concerned in the process, in two shifts. Local manpower would also be favourably affected thanks to the manufacture of low-cost products for the housing market, which are in very short supply in the province and in the region.

Cost and job creation

Cost estimates

The approximate cost of a plant of the kind described is estimated at US$ 21 million.

Employment opportunities

The plant would generate 150 jobs (in two shifts).

c. Livestock feed

The proposal was made earlier to utilize 50% of the bagasse produced by the Concepción mill for making paper pulp and paper, and to burn gas instead of bagasse for the heat required. The pith constitutes from 30 to 35% of bagasse so used.

This amount represents approximately 145.000 tons/year. The proposal accordingly is made that the pith be hydrolysed and used for poultry feeding - especially geese, which are capable of consuming considerable amounts of fibre. Pith has a fundamental nutritional value as a source of readily assimilable carbohydrate (sugar) and digestible fibre. It needs to be supplemented with protein, minerals and vitamins, depending on the type of feed required and on the final mixes for native cattle, milch cows, sheep and goats, as recommended by Argentina's animal nutritionists.

It is recommended that a plant be set up, initially as an experiment) with a capacity totalling about 15.000 tons/year but in terms of 100 tons/day.

It is further recommended that another plant with a similar capacity be installed at La Fronterita mill to utilize some of the pith there.

Employment Opportunities

Twenty jobs should be created.

Outlay

According to estimates, the cost of setting up such a plant, including the hydrolysis reactors, the mixers, homogenizers, pelleters, dryers and bagging equipment, should come to about US$ two million.

Advantages

Utilizing pith for livestock feed should overcome the ecological problem of air pollution caused by the fact that it is difficult to burn pith completely in a normal boiler. Special burners are required and these are very costly. Livestock feed exploits a product of the drying process that otherwise causes pollution, while a useful commodity is obtained in this way at low cost. The process can also be applied to the entire amount of bagasse, as illustrated in the materials balance sheet in Annex 8 of Technical Annexes.

It is also possible to make rough forage by using dried bagasse and pith without putting the latter through the hydrolysing process. In this case the product comes in pellet form. It consists of 75-80% bagasse, with or without pith, and 20% molasses, together with other ingredients such as a salt/vitamin premix that are blended and homogenized. Complete forage, too, can be obtained if protein is added. The necessary process is costly, calling, as it does, for an outlay of at least US$ eight million.

d. Furfural and derivatives

It appears that Argentina already has one furfural factory, but a market survey shows that there is little point in expanding production here.

e. Steam and electricity co-generation

Co-generation is feasible if new boilers can be installed to produce steam at high pressure and temperature (60-80 bar and superheated to approximately 470° C), together with new turbines for supplementary electricity, using the exhaust steam from the turbines to feed the present low-pressure turbines which provide the motive power for the cane fibre shredding knives, the milling process and the present generators.

Improving boiler performance by means of higher temperatures and pressures allows of generating more steam, though using the same amount and quality of bagasse and thus of generating electricity at lower cost. An important requisite here is that the thermal economy of the mills must be improved, so that the surplus electricity can be sold. This is not the situation with Tucumán's mills because, as explained earlier, these have 0.8% of their energy obtained by using natural gas, and burn the entire amount of bagasse produced. As a general rule, the following factors should be taken into account regarding the co-generation proposal:

- thermal and fuel requirements, and how to reduce these to a minimum so that as much bagasse as possible can be used for generating electricity;

- the need for high-pressure steam exploiting the thermal gradient across the turbines; and

- bagasse drying using the heat provided by the combustion gases from the boiler in order to enhance the thermal efficiency of the latter.

It is not recommended that sugar be produced for generating electricity for sale in Argentina because of:

- the heavy consumption of electricity in the Tucumán mills;
- the considerable outlay entailed;
- the availability of natural gas, which is better than bagasse for the electricity generation process, and the new trend in gasifying bagasse for its thermal yield;
- difficulties in ensuring a continuous supply of electricity after the harvest and the high production cost here;
- the need to determine the precise responsibilities of those in charge of installing and maintaining the distribution and high voltage transmission lines and transformers and low voltage distribution to the user;
- the need to have boilers in number and of capacity such one can be taken out of service at a time following the harvest, for maintenance;
- the need to accord priority to the operation and maintenance of boilers, turbo-alternators and auxiliary equipment to ensure their reliability. This calls for highly qualified staff and for an adequate supply of replacement parts.

2.7.4.2 Diversification of molasses derivatives

a. Recovery of sugar from molasses

Thus process is based on chromatographic separation of the molasses in three fractions:
- sucrose;
- invert;
- salt.

The sucrose fraction, following concentration, can be conveyed directly to the vacuum boiling pans for extraction; the invert sugar fraction is concentrated to produce invert syrup; and salt is concentrated and used for feed or fertilizer. The procedure is dependent on a special kind of resin, which is very costly. In fact, the entire process is very costly, and its viability is at the mercy of the price of sugar. In view of the world crisis in the sugar market, it is not recommended that the relevant unit be installed, even though Tucumán and Argentina as a whole have excess sugar production; and the process cannot compete when sugar prices are low.

b. Denatured alcohol for fuel use

The programme for producing denatured alcohol (anhydride) for admixture with petrol for automotive fuel operated from 1981 to 1989. Almost all the mills in Tucumán have a distillery and solid experience in producing denatured alcohol, and are prepared to start production immediately. Three mills (Ñuñorco, Providencia and Cruz Alta) have no distillery. The mill owners, almost all the institutions authorized for this purpose, one petroleum company and the

government authorities are anxious that the programme should get under way. The advantages in implementing such a programme are:

- no investment is called for except where novel items are to be produced;
- an energy saving of up to ten percent will be possible because the final C massecuite crystallization stage is eliminated. This is the most laborious and costly phase and one in which less sugar is obtained, since the mills will now be producing A sugar and B sugar and begin the fermentation process with B molasses;
- it will be possible to reduce the sugar output by about 16%, thus helping to sustain the price of the commodity at an acceptable level on the local market;
- it will be possible to economize on the extra amount of natural gas otherwise used once the measures have been put in hand that are recommended for reducing energy consumption and for eliminating the C boiling stage and, along with it, all the related equipment - vacuum pans, centrifuges, mixers, conveyors, etc.

c. A chemical industry producing alcohol derivatives

The graph and diagrams showing chemical products obtained from ethyl alcohol illustrate a wide range of derivatives. Their production offers one way of diversifying the activities associated with molasses fermentation. Market studies show that in 1992 imports of acetic acid and its esters stood at a high level. Similar remarks are true of butyl alcohol. Import volumes of other derivatives are at a lower level, and there is no marked interest for these.

Some purpose would be served by putting in hand a programme for producing acetic acid and butyl alcohol and other derivatives of interest such as ethylene and its derivatives. The necessary know-how and technology could be purchased, to judge from the detailed market surveys conducted in the principal producer countries. The relevant purchase contracts must cover staff training at a similar plant in the supplier country. The programme can be implemented without major problems by the machinery manufacturers in Tucumán, since these can call on a considerable technical capacity and on highly qualified human resources.

Agreements of the kind proposed would offer the advantages now described.

Savings could be made on the cost of importing ready-to-operate industrial plant by limiting the purchases to know-how and the technology needed for manufacturing the machinery locally. The saving should be at least 30% of the outlay normally required for such plant, quite apart from the fact that the local staff would improve their skills and experience and strengthen the country's industry in the process.

The outlay for a 4.000 tons/year capacity for acetic acid and derivatives is estimated at US$ four million.

Depending on the product in question, it is recommended that negotiations for the transfer of technology be initiated with the following countries:

Product:	Country:
Acetic acid and derivatives, acetone, butanol	Brazil, India, Egypt
Ethylene and ethylene based products	Brazil, India
Polyvinylchloride (PVC) for plastics	South Africa, Peru

It is further recommended that the plant be installed at Ñuñorco, as this mill has no distillery.

d. Novel products obtained from molasses fermentation

The agro-industrial scheme and procedures for sugar cane diversification in 1990 in Argentina and Brazil show that the foilowing items are not produced from sugar cane in Argentina.

- Acetic anhydride
- Acetone-butanol
- Ethylene
- Ether
- Glycollic ethers
- Ethyl silicate
- Aminomonoethylene
- Ethyl chloride
- Anil-acetate
- Molasses protein
- Monosodium glutamate
- Sorbitol mannitol
- Citric acid

It would be possible to produce these items if a chemicals/alcohols industry were to be set up in Tucumán (as illustrated earlier) and if the necessary know-how and technology could be purchased.

The findings of the market studies are to the effect that the volume of citric acid imports in 1992 came to 6.000 tons, gluconic acid 39 tons and lactic acid 370 tons. The clear implication here is that the items with the best demand prospects are citric acid and its salts and the acetone-butanol compound. It is accordingly recommended that a citric acid plant be installed at the Providencia mill, since the latter has no distillery.

The outlay for a factory for a yearly production capacity of six thousand tons is estimated at approximately US$ ten million.

Some sixty jobs would be created.

Acetone-butanol is of considerable commercial interest. It is reported that in 1990 two Japanese experts on behalf of JICA carried out a study on the feasibility of producing five thousand tons of a solvent consisting of 63.5% butanol, 30% acetone and 6.5% ethanol. The conclusions of the study were positive. Here, as proposed earlier, it is recommended that the project be carried out at the Concepción mill.

The outlay for the project is estimated at approximately US$ two million.

Some thirty jobs would be created.

Yeasts:

Given that there are two factories in Argentina producing yeasts by the molasses fermentation process, one of them being located in Tucumán province, the recommendation has been made that production be put in hand of instantaneous-action dry yeast (AIDY). The two factories supply local demand. A more detailed study is needed now that thought is being given to producing AIDY for export.

Torula yeast; fodder yeast:

From a technical report one learns that several years ago an experiment was successfully carried out on the production of torula yeast from vinasse fermentation. The product contained 30-35% protein. It was mixed with presscake and cane tops and used for livestock feeding. The animals showed a growth increment of 1 kg/day. The recommendation is accordingly made here that the experiment be repeated and evaluated, with due regard to the fact that a certain outlay will be needed to prevent river water pollution and to introduce certain modifications in order to dry the excess yeast output for packaging and sale on the local or export markets.

e. Carbon dioxide as a fermentation byproduct for the beverages industry

Tucumán has a factory producing carbon dioxide for the beverages industry. A market study, however, concludes that there is no need to increase production.

2.7.5 CONCLUSIONS

Although the Tucumán sugar mills at one time began to diversify their cane byproducts, with the manufacture of pulp for paper, paper, and particle board, production was not always consistent and was sometimes interrupted as a result of the financial crises.

Now that there is a greater need for these items supplementing sugar production, it is essential to keep to a minimum the economic repercussions of the crisis in the world sugar market precisely by promoting these byproducts and in so doing diversify the sugar industry's activities and eliminate its dependence on a single commodity.

Unlike what is happening with the industrial processing of bagasse, production continues with ethyl alcohol from molasses fermentation. Even now it is possible to start up production of denatured alcohol without any additional outlay being called for. There is considerable interest among all the mill owners, official institutions and even one of the petroleum companies.

The programme could be put in hand at the same time as the programme for acetic acid and citric acid at the two of the mills which do not have their own distilleries. Acetone-butanol could be produced at the Concepción mill, given its high production capacity and the ample space available there

2.7.6 RECOMMENDATIONS

The measures proposed for analysing and solving the problems faced by the paper and particle board factories are a matter of urgency.

The original diversification programme should be taken up again and pursued seriously, and similar programmes with short-,medium- and long-term objectives.

A further recommendation concerns the manufacture of machinery and other equipment in Tucumán. This sector needs strengthening, and a start could well be made with the industrial alcohol programme. The requisite know-how and technology should be purchased from the principal producer countries, so that the various types of alcohol derivatives could be produced and a strategy formulated for a future expansion in the production and export of these commodities.

CHAPTER 3

THE MARKET FOR SUGAR PRODUCTS AND BYPRODUCTS

3.1 INTRODUCTION

In Argentina, the principal product of the sugar sector is the commodity sugar, though experiments have been conducted on the use of the byproducts of milling.

The principal byproduct is ethyl alcohol, in most cases obtained in distilleries attached to the mills. Molasses is used to obtain consumer-grade leavening agents.

Bagasse goes mainly to the production of energy in the mills themselves, though there are other mills producing pulp and paper that use it as their raw material. At the moment, the Papel Tucumán plant, which used to make newsprint, is bankrupt and has ceased production. Attempt has also been made, albeit with little success, to produce fibreboard from bagasse.

The Tucumán provincial government in 1989 brought in its BAGADIET Project, where the purpose is to examine the possibilities of calf fattening with autohydrolysed sugar cane bagasse and brewers' yeast. A demonstration module was arranged at the La Florida mill.

This chapter describes the production and marketing of the main derivatives of sugar cane, and attempts to evaluate the possibility of diversifying, and of reducing this agro-industry's dependence on a single commodity, namely, sugar.

3.2 BYPRODUCTS ANALYSED

Bagasse and molasses are the principal byproducts of the milling of sugar cane. Bagasse contains 60-65% fibre, with which it is possible to develop a wide range of products. At this point, an analysis will be made of the market situation for the following derivatives:

- Paper pulp, paper and board
- Particles and fibreboard
- Livestock feed

Melasse is mainly used for fermentation and distillation with which many derivatives are obtained. The main one is ethyl alcohol used as raw material for the production of different alcohols, acids and derivatives. Here follows the market analysis of the following derivatives:

Alcohols:
- Ethyl alcohol
- Isopropyl alcohol
- Butanol

Acids and derivatives:
- Acetic acid and derivatives
- Lactic acid
- Citric acid and derivatives
- Gluconic acid and derivatives

Other:
- Acetone
- Leavening agents

3.2.1 SECTOR CELULÓSICO-PAPELERO

According to information supplied by the Group of sugar exporting countries of Latin America and the Caribbean (GEPLACEA), it is possible to obtain from bagasse various types of pulp used in the manufacture of newsprint, printing paper, stationery, bond paper, and continuous stationery. The raw material can be blended with other pulps for making packaging and wrapping paper, corrugated cardboard, tissue paper and other items.

In this section, special reference will be made to newsprint, letterpress and stationery paper, since these offer better technical feasibility and account for a large proportion of both consumption and international transactions.

Paper pulp production in Argentina was estimated at 759.400 tons in 1992, making a 13.6% increase on the previous year (Table 3.2.1).

Table 3.2.1 - Product: total pulp ('000 tons).

	Production	Exports	Imports	Apparent consumption
1990	722.1	117.7	17.0	621.4
1991	668.6	69.7	34.0	632.9
1992*	759.4	106.8	37.0	659.6

**: Estimated*
***Source:** AFCYP*

Paper production from bagasse in 1991 came to 85.400 tons, representing 12.6% of the country's output (Table 3.2.2).

Table 3.2.2 - Product: mechanical wood pulp ('000 tons)

	Production	Exports	Imports	Apparent consumption
1990	5.9	0	3.4	9.3
1991	4.5	0	5.8	10.3
1992*	5.0	0	7.0	12.0

**: Estimated*
***Source:** AFCYP*

Prior to 1992, there were factories using bagasse fibre for paper. One such factory, Ledesma, in Jujuy province, is an integral part of the sugar mill, and has an annual production capacity for 45.000 tons pulp and 32.000 tons paper. The other factory, Papel Tucumán, purchased the bagasse from mills in the Tucumán province for newsprint manufacture (using 75% of the bagasse pulp for this purpose). It is one on the largest scale and has the most modern technology in the country. It has an output capacity of 100.000 tons pulp per year. In 1992, Papel Tucumán initiated bankruptcy proceedings and to date has ceased production. This is tantamount to nearly 11% of the country's installed capacity for pulp and to the closure of the biggest user of bagasse as raw material for making paper.

Paper and board production in 1992 reached 1.035.000 tons, a 5.2% increase over the 1991 figure (Table 3.2.3), newsprint and printing paper accounting for 20.9% and 18.2%, respectively.

Table 3.2.3 - Product: paper and cardboard ('000 tons)

	Production	Exports	Imports	Apparent consumption
1990	935.9	135.2	41.8	842.5
1991	984.1	31.2	193.0	1145.9
1992*	1035.0	14.0	260.0	1281.0

**: Estimated*
***Source:** AFCYP*

Argentina's installed capacity for pulp stands at 900.000 tons, and for paper and board at 1.300.000 tons (1990 estimates) (Table 3.2.4; 3.2.5 and 3.2.6). There are 100 plants producing paper and board and 25 producing pulp for paper, with an average capacity of 14.000 tons/year and 36.000 tons/year, respectively.

Table 3.2.4 - Product: newsprint paper ('000 tons)

	Production	Exports	Imports	Apparent consumption
1990	208.0	63.7	8.3	152.6
1991	201.5	9.6	24.0	215.9
1992*	203.1	9.7	84.0	277.4

**: Estimated*
***Source:** AFCYP*

Table 3.2.5 - Product: printing and writing paper ('000 tons)

	Production	Exports	Imports	Apparent consumption
1990	170.0	56.5	15.9	129.4
1991	175.8	16.8	34.7	193.7
1992*	s/d	-	-	-

**: Estimated*
***Source:** AFCYP*

The gap between the country's scale of production and the scales met with in the international sector is very wide. If one takes 200.000 tons/year as the optimum scale for newsprint, about 300.000 tons/year for liner and 500.000 tons/year for kraft, Argentina's scales for these commodities are between eight and fifteen times smaller than those of Brazil, Finland, Sweden or the United States.

Much of the paper industry has operated over the last 20 years or so at a serious level of structural inefficiency, and has shown a general lack of dynamism in investment, technology and quest for markets.

Table 3.2.6 - Installed Capacity - 1990

	Installed Cap. Prod. ('000 tn/y)		No plants (units)		Average cap. (1000 tn/y)		Use
	Pap. & Board	Pulp	P & B.	Pulp	P & B.	Pulp	
Brazil	5800	5200	141	38	40	140	81.087
Chile	500	1000	10	8	50	125	7.049
Argentina	1300	900	100	25	14	36	20.000

***Source**: See "La Competitividad de la industria celulosico-papelera argentina", N. Bercovich and M Chidiak, 1992.*

The low level of investment in the last decade has led to a deterioration in installed plant, and some of the latter is now no longer used.

Where international transactions are concerned, **paper pulp** in 1992 accounted for 14.1% of the country's output, i.e. 106.000 tons in that year (there was no international trading in bagasse pulp).

Imports rose 117.6% in 1991 and 1992, to approximately 37.000 tons in the latter year.

Historically, Argentina has been in deficit for paper and board, with fluctuating import levels. Beginning in 1991 but especially in the following year, purchases abroad showed very high rates of increase.

In 1992, **newsprint** imports rose two and a half times over those for 1991. Apparent consumption for the same period rose by 28.5% (Table No.3.2.4).

Imports of paper for printing and stationery purposes came to 34.700 tons for 1991, covering 17.8% of apparent consumption.

With the recent macro-economic changes, some of the main conditions whereby the sector was able to save - a captive domestic market, export incentives and promotion of forestry and industry - ceased to apply.

Similarly, in the early 1990s, there was a significant dollar price rise for some of the major inputs - energy, timber, scrap, labour, transport), which led to higher production costs that were not made good by lower costs of other inputs, notably chemicals.

Imported products had the effect of placing a sort of ceiling on prices on the domestic market.

The level of the exchange rate and the suspension of or curtailment in export incentives have reduced the profitability of paper exports; and these have declined markedly in the two years.

Since the customs duty reform of October 1992, cellulose pulp and paper have carried a 7.5% and a 15% import duty, respectively; and when exported, they attract an equivalent money refund (Table 3.2.7). Imports also carry a 10% statistics levy, though this is differentiated in that goods from MERCOSUR countries pay 4.8%. From 1991, quotas have applied to paper imports from Brazil. Volumes in excess of this safety level pay 12% duty.

Table 3.2.7 Nominal protection (most frequently applied import duty)

	February 1990	**February 1991**	**July 1992**	**October 1992**
Pulp	0	0	5	7.5
Paper and Board	24	12-22	13-22	15*

**: Beginning October 1992, the statistics tax on imports was raised from 3% to 10%*
***Source**: Customs Tariff Nomenclature*

The lowering of customs dues and the MERCOSUR integration agreements mean a lowering of barriers to imports and a consequent higher flow of commodities imported from Brazil (Table 3.2.8).

Table 3.2.8 - Brazil's share in Argentine imports and exports (US$).

	Import				**Export**			
	Pulp		**Paper**		**Pulp**		**Paper**	
	Value	**%**	**Value**	**%**	**Value**	**%**	**Value**	**%**
1989	6720	44	7924	37	9654	24	30677	34
1990	2640	43	14646	30	8263	11	17499	22
1991	8159	26	66860	40	4663	14	3863	15

Source: Asociación Fabricantes de Celulosa y Papel (AFCP)

Since 1990, the world market for cellulose and paper has been characterized by oversupply, a contraction in the markets of east European countries, a recession in the North American market and, added to all this, a marked downturn in prices.

At the regional level, Brazil witnessed a fall in domestic consumption in 1991, yet at a time when it is continuing to expand its installed capacity for cellulose and paper. Chile, too, has had a notable expansion in its installed capacity.

Against this background, the regional and international context is clearly unfavourable to Argentina's industry, as may be seen in the declining chances of finding outlets abroad and in the inflow of very low-priced inputs, and cases of dumping, even.

All in all, then, the sector is going through a rather critical period, with low profit levels and a marked vulnerability vis-à-vis foreign competition, especially from Brazil. Nevertheless, the home market has shown a significant rise in per capita consumption of paper from 1990 on. That being so, Argentina's paper industry must undergo conversion, with investment guaranteeing a more appropriate scale in international terms and a lowering of production costs, if it is to be able to compete with imports.

At the time of writing (July 1993), in order to protect the country's industry against the negative effect of imports, the Ministry of Economic Affairs, acting through the Secretariat of Industry and Commerce, has prescribed (Resolution N° 684/93) limits for imported paper and has prohibited imports once these limits are exceeded, namely: 20.000 tons/year for printing paper; 8.000 tons/year for structure paper; 5.400 tons/year for coated paper; and 400 tons/year for carbon paper.

The Resolution is highly innovative in that it represents a step back in the process of opening the economy completely that the Central Government has established as the rule for the productive sector.

3.2.2 PARTICLES AND FIBREBOARD

With bagasse it is possible to manufacture particle board and fibrebroad. The former comes in panels with cellulose particles held together with organic glues. Its main use is in furniture making. It is also used for partitioning, containers, doors, etc.

Fibrebroad is made from wood cellulose fibre materials which bond chiefly because the fibres interlace and because of their inherent adhesive properties. The materials in question are heat and pressure treated and have chemical additives incorporated. They have a range of uses depending on the type of board. Insulating board is used for facings and interior finishings, thermal insulation and soundproofing, as well as plain ceilings. Products made with hard fibres are used in the building industry for panelling, flooring and ceilings, and again for interior fittings for cars, and in wall panelling, and as auxiliary material in furniture making.

Argentina's production of particle board and fibrebcad makes use of wood as raw material, some 10% of the timber taken from man-made stands (500.000m^3) being used for this purpose.

Board output stands at about 264.000m^3, **particle board** accounting for 67%, **hardboard** (high-density fibre) for 23%, and **medium-density board** for 10% (Tables 3.2.9 and 3.2.10).

The production aspect of this commodity is highly skewed. There are seven **particle board** factories, and only one for hardboard (the Fiplasto plant) and one for the medium-density product (Guillermina).

Table 3.2.9 - Product: particle board (m^3)

	Production	Exports	Imports	Apparent consumption
1990	142000	5786.6	0.5	136213.9
1991	133000	838.9	873.5	133034.6
1992*	177527	571.7	3263.9	180209.2

**: Estimated*
***Source**: Statistics Dept., Division of Native Forest Resources and Federacion Argentina de laIndustria de Muebles y Afines (FAIMA)*

Table 3.2.10 - Product: Fibreboard (**) (m^3)

	Production	Exports	Imports	Apparent consumption
1990	67000	37051	180	30129
1991	80000	20509	2541	62032
1992*	86000	10958	5955	80997

**: Estimated*
***: Includes high-density and medium-density board*
***Source**: Statistics Dept., Division of Native Forest Resources and Federacion Argentina de laIndustria de Muebles y Afines (FAIMA).*

Foreign trade is relatively unimportant here, though changes have been occurring in the last two years, and particle board now takes second place to fibrebroad. Exports for the former product satisfy only 0.3% of the estimated production requirement for 1992, while imports, themselves increasing since 1991, cover 1.8% of apparent consumption.

Fibrebroad exports are declining. In 1990, they accounted for over 55% of the output but fell to about 12.7% in 1992. Imports, on the other hand, are markedly on the increase. In 1991, these covered 4.1% of apparent consumption, in 1992 rising to 7.3% (Table 3.2.10). Brazil is the chief source of supply here (60%), followed by Chile (37%).

Argentina's board exports in 1990 brought in US$ 8.41 million, representing 0.9% of world trade here (US$ 948.39 million). Between 1986 and 1990, they had a growth rate of 12.1%. The principal customers are: the United Kingdom, Germany, the Netherlands, the United States and Italy. The countries whose imports increased most over the same period are New Zealand (235%), Spain (111%), Portugal (86%), Korea (61%) and Japan(56%).

Import duty on either product is 10%, plus the 10% statistics levy. Exports benefit from a refund, also of 10%.

On the domestic market, 80% of the output is taken by the furniture industry and 20% by the building industry.

These two sectors have suffered the effects of the economic recession in the 1980s, and this explains the retrenchment in consumption and the high idle capacity in the factors. The **particle board** factories in 1992 produced 77% of the 1984 volume. The output of the **fibreboard** factories in 1992 was 17% lower than that for 1987.

The furniture industry is segmented among a group of medium-sized firms accounting for about half the output, the other half coming from a large number of small workshops. The sector has witnessed no further investment since the mid-1970s. Its production costs are high and there is much capacity lying idle.

In 1992, the building industry recovered strongly, continuing the trend emerging in the previous year. Housing construction, financed mainly from private investment, brought dynamism to this sector.

Recovery there induced an apparent growth in demand for furniture, itself a sector that began to recover during 1991 and 1992 from the low production levels to which it had sunk in the previous decade.

As a consequence of all this, demand for board products increased - at a rate of 34% for 1992 over 1991. Within the product range, it is thought that medium-density board is experiencing a higher growth. This is explained not so much by an equivalent growth in the furniture industry as by its substituting sawnwood products.

The increased demand recorded in the country is in keeping with the world trends for a greater use of particle and fibrebroad. In international terms, important technological changes are taking place in medium-density board production in the sense that there will be additional uses to which it can be put, such as in mouldings, where it would replace sawnwood.

Coming, next, to investment in this sector, one may note the setting up in Argentina (Corrientes province) of an important Chilean firm to produce particle board on a large scale.

In Tucumán, an experiment for particle board using bagasse has been undertaken recently, but the Taglosa firm in question closed after six months' activity due to technical and market problems.

If novel lines of production were to be attempted, it would first be necessary both to carry out a survey of the desired characteristics - type of board, thickness, dimensions, finish, etc. - and to allow for the size of the regional market and the place of origin of the material now used by the furniture industry that could be replaced by bagasse from Tucumán province.

3.2.3 LIVESTOCK FEED

In view of the need to diversify the uses to which cane sugar can be put and, again, of the province's shortage of meat, the Tucumán Government's Bicameral Sugar Committee in 1992 developed the BAGADIET programme.

Tucumán is in short supply for local red meat, producing only 13% of demand, the remainder being brought in from other grazing areas such as Cordoba, Santa Fé and Santiago del Estero.

The project objectives are to: (a) increase local production and supply of red meat; (b) provide the sugar cane sector with an alternative line of production; (c) diversify the uses of sugar cane and its byproducts; and (d) utilize byproducts of industry that might otherwise lead to environmental pollution.

A demonstration module was set up at the La Florida mill, with feedlots containing 166 head of cattle. The main findings are that:

- Autohydrolyse l bagasse is a suitable feed item for ruminants and can be blended into other ingredients as a feed supplement without any problems arising;
- Autohydrolysis (to render the bagasse more digestible) is a technologically simple process and can be handled by the mill itself; and
- Producing autohydrolysed bagasse production is a low-cost process but the availability of mill surpluses could prove to be an economic constraint.

The regional market needs to be analysed in great deail and allowance made for the interest likely to be shown by the private sector in livestock fattening in the area using bagasse byproducts as a feedstuff (one advantage here being the savings on freight costs). There is no potential for export to other areas, since the Pampas region produces its own forage, of excellent quality and of proven efficiency in cattle fattening, and at low cost.

3.2.4 ALCOHOL

3.2.4.1 Ethyl alcohol

Ethanol production is almost exclusively associated with the sugar mills. There are currently 20 distilleries attached to such mills, with an installed capacity of 2.130 m³ daily for a product of acceptable flavour, and 1.630/day of ethanol anhydride (Table 3.2.11).

Table 3.2.11 - Distilleries: ***Installed capacity***

Mill	M³/day	'000 litres/year
Tucumán		
Aguflores	100	30000
Bella Vista	130	39000
Concepción	330	99000
Cruz-Alta	-	-
La Corona	95	28500
La Florida	180	54000
La Fronterita	75	22500
La Providencia	-	-
La Trinidad	80	24000
Leales	58	15000
Marapa	150	45000
Nuñorco	-	-
San Juan	58	17400
San Pablo	78	21000
Santa Barbara	85	19500
Santa Rosa	170	51000
Subtotal Tucumán	**1553**	**485980**
Jujuy		
La Esperanza	130	39000
Ledesmo	280	70000
Rio Grande	100	30000
Subtotal Jujuy	**498**	**147000**
Salta		
San Isidro	-	-
San Martin	130	39000
Subtotal Salta	**130**	**39000**
Distillery del Norte	60	18000
Distillery Rio Majora	78	23400
Subtotal NEA	2311	63300
Subtotal NEA	175	52500
Country Total	**2488**	**745800**

Source: Alcohol Exchange 1987

Here, production and consumption in Argentina were affected by the changes resulting from the launching, in 1981/82, of the Plan Alconafta, where alcohol was to be blended in specific proportions in automotive petrol (gasoline). The Plan, however, ceased to all intents and purposes in 1989/90.

Alcohol for the anhydride to blend with petrol came to represent 68% of the output in 1986/87, rising to a peak of 341 million tons in that period. At the same time, there was a downturn in home consumption for the pharmaceutical, food, chemical, spirits and cosmetics industries from a peak of 93% of output in 1970/71 to a minimum of 20% in 1986/87. A partial recovery in these uses took place subsequently with the discontinuance of the Plan Alconafta and the resulting slump in petrol blending.

Ethyl alcohol processing from molasses increased in 1990/91 by approximately 19% over the previous year (Table 3.2.12). This development was linked, on the one hand, to the upturn in the domestic market and, on the other hand, to the greater availability of cane once the recovery from the consequences of the drought that devastated the plantations during the 1989/90 season began to be felt.

Table 3.2.12 - Product: Ethyl alcohol total('000 litres)

	Production	Exports	Imports	Apparent consumption
1989/1990	116904	72263	-	50230
1990/1991	139010	64426	-	59637
1991/1992*	125000	70000	-	60000
1992/1993*	120000	55000	-	60000

**: Estimated*
Source: Alcohol Exchange

Exports held to levels around the 70 million litre mark thanks to sutained demand from the Japanese market and, to a lesser extent, to sales to European countries and to the U.S.A. All this occurred against a background of rising prices (US$ 0.30-0.32/litre).

Provisional data for 1991/92 indicate a fall-off in production, with the domestic market remaining at levels similar to the previous year's. Exports were not adversely affected, however, given the abundant stocks. The bulk of demand came from the chemical industry with its 5% growth and taking 30.8% of the supply, spirits manufacturers (23%) and retailers (13.7%) (Table 3.2.13). According to the alcohol producers, the market can absorb the entire

sugar byproduct output but if cane has to be milled for alcohol, then costs rise and the market tightens.

Table 3.2.13 - Distribution of alcohol production (pure "buen gusto") within domestic market ('000 litres).

	1988/1989	1989/1990	1990/1991	Average consumption
Retailers	13686	7204	5946	17.08
Chemical industry	11416	15861	15256	27.18
Perfumeries	2092	1427	1237	3.04
Liquor manufacturers	9656	6253	11831	17.782
Pharmaceutical ind.	121	372	79	0.37
Food industry	1867	1649	2375	3.76
Distribution and Misc.	14467	13714	20091	30.85
Total	53227	46500	56815	100.00

Source: Alcohol Exchange

Exports continued at a sustained rhythm thanks to outlets on the Japanese market and the fact that producers sought out fresh markets.

Beginning in October 1992, with the customs reform, changes were introduced in export refunds. Ethyl alcohol attracts a 5% refund on the FOB value, the equivalent amount of the import duty. The statistics levy on imports was raised from 3% to 10%, and these revised rates helped to limit alcohol imports.

The outlook for the 1992/93 period is one of a slowdown in production in keeping with the possible reduction in sugar output. This will lead to a decline in exports, since the home market is now stable.

As for the regulations governing the sale of petrol alcohol, it should be noted that Alconafta Programme received its thrust from compulsory sales of the 85%/15% petrol/alcohol blend, later abandoned for fiscal considerations - the State otherwise having to forgo the fuel tax on the 15% molasses alcohol component in the blend if this was to sell at a comparable price to that of petrol.

Other measures in the fuels context introduced in 1991 were: Act N° 23966/91 to prescribe the sources of financing for the National Social Security System. This provides for the

allocation of the value-added tax on liquid fuels and natural gas, and for exemptions in proportion to the molasses alcohol content in the fuel. For its part, the Secretariat of Energy authorized (Resolution 926/91) the sale of petrol alcohol throughout the country.

At the provincial level, the Tucumán government set about promoting the use of petrol having low lead and oxygen content. This is did by Act 635/92. The relevant specifications are met by petrol/alcohol blend.

If this criterion is to be followed throughout the country, the petroleum companies will need to enter into agreements or form associations with the mills for supplies of alcohol. In April 1993, the Puma petrol company, which has 4% of the national market, contracted with the Concepción mill for supplies with which to incorporate 15% ethyl alcohol in its petrol.

Against this background, prices which to-day stand at 17 centavos per litre could be brought up to nearer 40/45 centavos, as the mills claim, by reason of the high processing costs entailed in milling sugar cane directly in order to obtain alcohol.

3.2.4.2 Isopropyl alcohol

Some 46.500 tons were produced in 1992. This was 12% down on the 1991 figure (Table 3.2.14).

Table 3.2.14 - Product: Isopropyl alcohol (tons)

	Production	Exports	Imports	Apparent Consumption
1990	45646	20136.8	14.8	25524
1991	52898	25422.2	16.0	27492
1992*	46500	8974.4	7.6	37533.2

**: Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

The Carboclor S.A. company is the only firm processing this type of alcohol, which it does from propylene-rich refining gases. It has an installed capacity of about 48.000 tons annually.

The main end use is acetone production (75%), followed in order of importance by proprietary chemicals and medicines, printing inks, etc.

Approximately 48% of the output is exported, the principal markets being China and the United States. In 1992, exports, largely following the production pattern, fell by an estimated 60%, with prices 12% lower, though earning nearly US$ 1.6 million. Exports attract a 7.5% refund on the FOB value.

3.2.4.3 N-Butanol

There are no statistics on Argentina's N-butanol production. However, according to a survey conducted by the Japanese Cooperation Agency (JAICA), output here can be estimated at 1.500 tons/year, which is insufficient to meet local demand

There are two local firms, SAIPA and CARMAL, that obtain this form of alcohol by a corn starch fermentation process. Their installed capacities are 900 and 700 tons a year, respectively.

The product is used in the manufacture of lacquers, rayon, detergents, brake fluids and amine additives for automotive petrol, and, again, as a solvent for oils and fats, waxes, resins and varnishes.

In Argentina, 60% of the output goes to the chemical industry and 40% for solvents and paints. In 1990/91, imports rose by 30% (Table 3.2.15).

Table 3.2.15 - Product: N-Butanol (tons).

	Production	Exports	Imports	Apparent consumption
1990	s/d		1481.5	
1991	s/d		1935.7	
1992*	s/d		s/d	

**: Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

From 1992 on, following the adoption of the harmonized nomenclature, no further information is to be had on this specific product. The main supplier is Brazil, with 85% of sales within Argentina. Brazil, too, has the advantage of lower prices by reason of its membership of the Latin-American Industrial Association (ALADI). Bulk imports in June 1993 fetched US$ 650 a ton. The next largest supplier is the U.S.A. Foreign purchases of N-butanol and other butanols amounted in 1992 to approximately US$ 2.5 million.

3.2.5 ACIDS

3.2.5.1 Acetic acid and derivatives

Acetic Acid

Argentina produces about 12.000 tons/year, covering home demand (Table 3.2.16).

Table 3.2.16 - Product: Acetic acid (tons).

	Production	Exports	Imports	Apparent Consumption
1990	12100	391.9	256.2	11964.3
1991	11760	219.0	308.9	11849.9
1992*	s/d	225.3	3900.0	

**: Estimated*
***Source:** INDEC and Instituto Petroquimico Argentino*

The only manufacturing firm here is the ATANOR company. Its Campana plant has an installed capacity of 15.000 ton/year.

Acetone is used mostly as a solvent for fats and oils, waxes, resins, plastic rubber, lacquer and varnishes. It is also found as intermediates in the production of synthetic resins, pharmaceuticals, etc.

On the home market, sales go to acetate production (40%), the textile industry (22%), the chemical industry (16%), pharmaceuticals (11%), tanning (8%) and minor uses besides.

This product is also imported and exported.

The principal supplying country is Mexico, whence Argentina obtains over 90% of these imports. In 1992, due to the differences between world prices (the average import price for 1992 was US$ 566/ton) and domestic prices for bulk deliveries free factory (US$ 973/ton), there was a marked rise in imports. No data are to hand for domestic production but it is thought that it has been adversely affected.

Exports remained stable over the same period, i.e., following the downturn in 1991 on 1990 figures.

Acetic acid esters

Within Argentina, ATANOR produces I-butyl acetate, N-butyl acetate and ethyl acetate.

For **I-butyl acetate**, its installed capacity is 2 700 tons/year, which is well above the national output figure (Table 3.2.17), itself clearly in decline.

The main end-use is in the manufacture of thinners (75%) and in the chemicals and paint industry. There is no evidence of any international business here.

Table 3.2.17 - Product: I-butyl acetate (tons).

	Production	Exports	Imports	Apparent Consumption
1990	520			520
1991	275			275
1992*	s/d	0.4		

*: *Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

Likewise with **N-butyl acetate**, there is an installed capacity of 2.700 tons/year, again in excess of output (Table 3.2.18), which is similarly showing negative growth.

Table 3.2.18 - Product: N-butyl acetate

	Production	Exports	Imports	Apparent consumption
1990	983	7	167	1143
1991	630	27	366	969
1992*	s/d	18	892	

*: *Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

In 1992, imports practically trebled, due to the difference between bulk deliveries free factory, at US$ 1.123/ton in January 1993, and the average import price of US$ 810/ton. The latter figure, when the surcharges in terms of import dues (75%) and the statistics levy (10%) are added, comes to approximately US$ 952/ton (Table 3.2.27).

Imports come mainly from the United States.

The market for N-butyl acetate is shared among the leather industry (48%), thinner production (34%), the chemical industry (10%) and other takers besides.

Ethyl acetate is also produced by ATANOR, at a plant with an installed capacity of 7.200 tons/year. Output rose in 1991 as compared with 1990 (Table 3.2.19). No data are available for 1992. However, from the foreign trade figures, it may be taken that the situation will be

similar to that in 1991, with a slight increase in domestic consumption, and in exports which, however, will be offset by a heavy increase in imports.

Table 3.2.19 - Product: Ethyl acetate (tons).

	Production	Exports	Imports	Apparent Consumption
1990	5330	750	76	4656
1991	6010	592	504	5922
1992*	s/d	618	1100	

**: Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

Imports were stimulated by the lower prices obtaining on the world market - 18% lower in 1991 than in 1990. In 1992, the average import price, plus the taxes and levies, came to US$ 750/ton on the domestic market, i.e., 18% lower than the US$ 916/ton payable for the same commodity in bulk, free factory, in January 1993 (Table 3.2.27).

Half the country's imports come from Uruguay, which has preferential duties and, under the CAUCE Treaty, pays no statistics levy, so that the price at which Uruguayan ethyl acetate reaches the Argentine market (FOB plus duties) is about US$ 645/ton. The other half of this country's imports come from the U.S.A. Domestic production is taken by various markets - ink 55%, thinner 30% and the chemical industry 5%, etc.

Vinyl acetate is not produced in Argentina. Imports during 1992 rose by 26% (Table 3.2.20), the U.S.A. being the main supplier. In that year, too, world prices fell by 30% (Table 3.2.27).

Table 3.2.20 - Product: Vinyl acetate (tons).

	Production	Exports	Imports	Apparent Consumption
1990	s/p		5366	5366
1991	s/p	2	5550	5548
1992*	s/p		7114	7114

**: Estimated*
***Source**: INDEC and Instituto Petroquimico Argentino*

Vinyl acetate is the ester obtained from acetic acid, which has a higher value in foreign trade. Imports in 1992 accounted for a cost of approximately US$ 4 million. The product goes to the manufacture of emulsions (water-soluble paint = 50%) and adhesives (48%).

Acetic anhydride

This is manufactured by ATANOR from acetic acid. The installed capacity here, of 2.640 tons/year, is in excess of domestic requirements. Argentina's output in 1991 was 1.470 tons, which was 19% below the previous year's figure (Table 3.2.21). Apparent consumption also fell by 4.9% in 1990 and by 12.8% in 1991.

Table 3.2.21 - Product: Acetic anhydride (tons).

	Production	Exports	Imports	Apparent Consumption
1990	1806	75	3	1734
1991	1470	131	173	1512
1992*	s/d	150	380	

**: Estimated*
***Source:** INDEC and Instituto Petroquimico Argentino*

In 1992, imports doubled in volume, while exports remained stable. Much of the foreign purchases come from Mexico, and exports go to Brazil.

Production goes mainly to the pharmaceutical industry (88%), and to a smaller extent to the chemical industry (9%).

3.2.5.2 Lactic acid

There are no data available regarding national production here.

Imports (mainly from Brazil) increased in 1992 over the previous year's, by an estimated 60% (Table 3.2.22), transactions totalling nearly US$ 700.000.

Lactic acid is used in pharmaceuticals for the typical treatment of warts and as a clotting agent. With its acidic and moistening properties, it is widely used in cosmetics and skin lotions. In the food industry, it is used as an acidulant, and as a preserving and flavour enhancing agent. Ammonium and calcium lactates have a dietary application in livestock feeding and can even have a curative function. Other applications are in tanning and in the textile industry, not to mention for certain herbicides, fungicides and pesticides.

Table 3.2.22 - Product: Lactic acid (tons).

	Production	Exports	Imports	Apparent Consumption
1990	s/d	18	130.3	
1991	s/d		228.6	
1992*	s/d		372.7	

*: *Estimated*
Source: *INDEC*

The world installed capacity ranges around the 35.000 ton/year mark, supplying a consumer demand of about 30.000 tons. The principal producers are the U.S.A., Japan and Brazil, accounting between them for 60% of the world output.

3.2.5.3 Citric acid and derivatives

Citric acid is obtained from final molasses, by fermentation.

It is not produced in Argentina. Apparent consumption for 1990 showed an increase of 45% over that for the previous year. In 1991, the rate of growth here was lower, at 4.9%. It is estimated that there was a fresh growth, of over 7%, in consumption in 1992 (Table 3.2.23).

Table 3.2.23 - Product: Citric acid (tons).

	Production	Exports	Imports	Apparent Consumption
1990	s/d	18	130.3	
1991	s/d		228.6	
1992*	s/d		372.7	

*: *Estimated*
Source: *INDEC*

Citric acid imports come from Brazil, and imports of its salts and esters mainly from the U.S.A., followed by Germany. Trade in citric acid in 1991 had a value of US$ 8.3 million.

Import prices were sustained, and rose 8.9% in 1992 (Table 3.2.27).

Citric acid is used mainly in the food industry as an acidulant, buffer, emulsifier, stabilizer for oils and fats and flavour enhancer. In smaller amounts, it has industrial applications - detergents, boiler scaling, cleaning stainless steel - and in the leather and textile industries as mordents.

In the pharmaceutical industry, it is used in syrups, digestive preparations, and in its sodium and potassium salts as preservative for blood, and in its ferrous and ammonium citrate form to control anaemia.

The main world producers are the U.S.A., Belgium, Austria, Federal Republic of Germany, Ireland, Italy, the former U.S.S.R. and Czechoslovakia, and China. Among Latin-American countries, though with a lesser output, may be mentioned Mexico, Colombia and Brazil.

3.2.5.4 Gluconic acid and derivatives

No data are available regarding Argentina's production here. Gluconic acid is imported from the Netherlands and calcium gluconate and other gluconic acid salts from Brazil. Trade in this commodity is at no significant level, since transactions did not exceed in the aggregate US$ 600.000 in 1992 (Table 3.2.24).

Table 3.2.24 - Product: Gluconic acid (tons).

	Production	Exports	Imports	Apparent Consumption
1990	s/d	0	47.9	
1991	s/d	0	69.7	
1992*	s/d	0	38.6	

**: Estimated*
Source: *INDEC*

3.2.6 OTHER CHEMICALS

3.2.6.1 Acetone

There are three firms producing acetone in Argentina. These are Carboclor Industrias Químicas, SAIPA and Carmal S.A. The first-mentioned uses isopropyl alcohol as its raw material, while the other two produce acetone from the aceto-butylic fermentation of corn starch.

By fermenting molasses, it is possible to obtain acetone-butanol, which consists of 63.5% butanol, 30% acetone and 6.55% ethanol. The national output of acetone has had a marked

growth, from 10.261 tons in 1989 to 19.175 tons in 1991 (Table 3.2.25). Domestic consumption increased by 50.7% in the same two-year period.

Table 3.2.25 - Product: Acetone (tons).

	Production	Exports	Imports	Apparent Consumption
1990	15530	2709		12821.0
1991	19175	3450	0.2	15725.2
1992*	s/d	3000		

**: Estimated*
***Source:** Instituto Petroquimico Argentino*

Again between 1989 and 1991, exports similarly showed a positive performance, achieving higher average export prices and a 138.7% increase in export value. The trend for 1992 is likely to show a decline in exports. The main foreign customer is Brazil. Acetone is used principally as a solvent for fats, oils, waxes, resins, rubber products, plastics, lacquers and varnishes. On the domestic market, its main application is in the manufacture of methyl isobutyl ketone (57%). In small amounts, it goes to proprietary medicines (10%), rayon acetate (6%), paints and enamels (5%), adhesives (4%), and agricultural chemicals (3%).

3.2.6.2 Food grade yeasts

Argentina's production rose between 1990 and 1992, from an estimated 19.800 tons to 22.200 tons (Table 3.2.26). Output goes almost entirely to the domestic market, the main customer being the bakery industry. International transactions are of little significance here. Four firms produce yeast, two of them, Calza S.A. and Destilerías del Norte S.A. accounting for 90%.

Table 3.2.26 - Product: Yeasts (tons).

	Production	Exports	Imports	Apparent Consumption
1990	19800	i/f	319.2	20119.2
1991	21100	i/f	760.0	21860.0
1992*	22200	0.3	1063.6	23263.3

*i.f: Insignificant figures - *: Estimated*
***Source:** Instituto Petroquimico Argentino*

Table 3.2.27 - Average import and export prices for selected products (US$/ton)

Item	Imports			Exports		
	1990	1991	1992	1990	1991	1992
Newsprint paper	729	890	506			
Newsprint magazine	970	920	802			
Kraft corrugated/folded		1823	1833			
Kraft (bags)	804	816	814			
Pulp, chemical, sulfite (long fibre)		477	467	457	471	471
Pulp, chemical, sulfite (short fibre)	530	481				
Semibleached pulp	693	581	544			
Ethyl alcohol (denatured)				289	388	396
Isopropyl alcohol	1261	1597	2014	344	395	353
Ter-butyl alcohol	2405	2700	s/d			
Butyl alcohol			604	621	710	
Isobutyl alcohol	681	526	s/d			
N-butyl alcohol	774	732	s/d			
Acetic acid	742	919	566	523	710	625
Sodium Acetate		1082	1036		1841	s/d
Acetic acid esters						
Isopropyl	1600	1333	s/d			
Isoamyl	3973	6370	s/d			
Ethyl	1169	782	638	880	700	684
Butyl	916	838	810	920	1273	1300
Vinyl	848	949	698	s/d	1380	
Acetic anhydride	1850	1012	1010	s/d	1000	974
Monoacetic and salts	1126	1390	1054			
Lactic acid with > 85%	1837	1969	s/d			
Lactic acid with < 85%	1472	1744	1847			
Calcium lactate	5261	5248	s/d			
Citric acid	1368	1311	1428	2069	2103	1430
Sodium citrate	1409	1467	s/d			
Citric acid esters	6942	8579	1743	s/d	2200	s/d
Gluconic acid	946	884	1046			
Calcium gluconate	3751	3744	8256	3247	3850	s/d
Sodium gluconate	1387	1488	s/d	s/d	2800	s/d
Acetone				533	581	493
Yeasts	2252	2510	2447			

Source: INDEC

3.3 CONCLUSIONS AND RECOMMENDATIONS

From the foregoing survey, it may be stated that there is a potential market for the development of novel products obtainable from diversified uses of the sugar cane (Table 3.3.1).

Table 3.3.1 - Sugar derivatives market situation.

Items	Production	Export	Import	Surplus supply	Demand not covered	Tecno-logy	Market '000 US$	Invest-ment mill.US$
Paper and pulp 1000 tn.	1.794	121	297		X	F	290.000	
Board products 1000 m³	264	12	9	X		F	940	21
Ethyl alcohol 1000 lit.	120.000	55.000	-	X		F	15.000	2
Iso p. alcohol tons	46.500	8.974	8	X		F	1.600	-
N-Butanol tons	1.500	-	1.936		X	F	2.500	-
Acetic acid and derivatives tons	20.145	971	6.536		X	F	5.920	2*
Citric acid and derivatives tons	–	6	6.900		X	F	8.514	10
Lactic acid and derivatives tons	-	-	373		X	F	688	10
Gluconic acid and derivatives tons	-	-	38		X	F	525	-
Acetone tons	19.175	3.450	0.2	X		F	2.000	(*)
Yeast tons	22.200	0.3	1.064		X	F	4	-

(*) The project investment here is for an acetone-butanol plant producing 63.5% butanol, 30% acetone and 6.5% ethanol.
F: feasible; X: yes
***Source:** Consultant's own elaboration*

In considering the installation of a plant to manufacture pulp and paper, one must bear in mind that feasibility depends on heavy investment, itself entailing the adoption of appropriate technology, if production is to be achieved at competitive cost and with materials of Mercosur provenance. Potential demand for each type of paper must be analysed in greater detail. It is also necessary to allow for possible developments in the situation created by the bankruptcy of the Papel Tucumán firm.

Where fibrebroad is concerned, domestic demand is recovering and there should be a worthwhile market here. One factor to be taken into account is the cost of freight to the area of consumption. It is accordingly recommended that an analysis be made of unsatisfied demand in the region.

Growth in the demand for ethyl alcohol is linked to reactivation in the consumption of petrol alcohol. There are laws and regulations permitting and providing incentives here, despite the persistence of alcohol price disparities among potential customers - the petrochemical industry - and the suppliers - the distilleries. Since the infrastructure for production and the laws that permit the use of petrol alcohol are already in place, it is on agreement on prices that the implementation of the programme depends.

Other products where development is possible are:

- **Acetone-butanol**: Domestic production of acetone is limited by the installed capacity. The export market is dynamic, and prices are rising. The value of exports in 1992 came to nearly two million dollars. Domestic production of butanol does not supply domestic demand. Each year, butanol and other butyric derivatives are imported to the tune of US$ 23.5 million.

- **Acetic acid and derivatives**: There is one plant at the present time but with idle capacity. Imports have increased due to the differences between the price for domestic production and world prices, which are some 40-50% lower.

  In 1992, imports had an aggregate value of approximately six million dollars. It would be possible to substitute home products for the imports if the necessary technology were to hand for producing at lower costs than those currently achieved by the local industry.

- **Citric acid**: This is not produced in Argentina, where sales amount to US$ 8 million per year.

- **Isopropylic acid, lactic acid and gluconic acid:** they are of no great interest, the market for these being poorly developed.

  Leavening agents/yeasts: an analysis would need to be made of the potential foreign market for dried yeast, since there is little foreign trade at the moment. The home market is fully supplied.

To summarize, there are several possibilities or options for diversifying the sugar growing and processing industries. The recommendation is made that a market analysis be taken to a greater level of detail for the commodities selected.

CHAPTER 4

FINANCING

A fundamental component in the diversification programme here identified is the need to assess the feasibility of identifying sources and chances of financing.

Four sources have accordingly been analysed, namely:

- official credit lines within Argentina;
- official credit lines at the international level;
- alternative financing mechanisms;
- capacity for self-financing.

At the present time, one of the greatest obstacles facing the sugar sector to carry on its normal activity is the lack of financing, whether in terms of current outlay or in terms of development capital.

The problem is reason why the harvest that could have started in early June this year was delayed at least a month. Nor is this situation new to the sector, since the problem presents itself every year at the beginning of the harvest season. Financing requirements are of two kinds: on the one hand, the mills do not have funds available to buy up the raw material, the sugar cane, and pay their operating costs (fuel, wages, transport, etc.); on the other hand, the cane growers themselves need money, because the sugar takes four or five months to produce, while marketing is spread over the whole year.

A further point to note here is that the lack of funding (due to structural problems typical of the economy of Tucumán) has had a marked effect on the ability of the mills to modernize.

In the current year, the international market has taken a change for the better where the economy of Tucumán is concerned, in that world prices have risen from US$ .18/kg to US$ .28/kg in the last four months, while domestic price levels have moved from US$ .23/kg for last year to US$ .40 - 0.44/kg.

The rise is explained by the particular case, in the international context, of the low output of Cuba, Thailand and South Africa and, in the local context, by the fact that planted areas were lower than for last year, and, again, by the fact that the warrants system has relieved some of the pressure from supply within Argentina.

4.1 OFFICIAL LINES OF CREDIT WITHIN ARGENTINA

At the moment, agricultural and industrial credit in Argentina is very tightly limited. The official agent of the Central Bank for financing the agricultural sector is the Banco de la

Nación Argentina (BNA); and this is the only body capable of supplying effective financial resources to agriculture. Institutional financing locally is in the hands of the Banco de la Provincia de Tucumán and the Savings Bank, both of these, however, being seriously undercapitalized and lacking facilities for rediscounting at preferential rates.

The provincial authorities are negotiating a foreign loan (from the U.S.A.) but this will cover no more than half the cost of the current harvest (approximately US$ 70 million). The sugar sector has resorted to alternative formulas - warrants - but the costs here are excessive (see Chapter 2).

Part of the shortage of financing from the official Bank for the sector is due to the latter's poor rating. With previous harvests, the system used by way of security for loans placed the crop as pledge in storage warehouses belonging to the mills themselves. At the time of executing the pledges, however, the sacks were found to contain less sugar than the stated amount; and this explains why the new - warrant - system (where special storage deposits are used) is satisfactory for the credit system in that the security for a loan is the product itself.

At the present time, BNA has credit lines (Table 4.1.1) available for sugar but at "wholesale" rates (16% p.a.). To this must be added the spread for the local bank (4.5%) and, with warrants, the cost of the operation itself (transport, storage, caretaking, etc.), which in this case come to a financing cost of 45% p.a. over and above the official rise in consumer prices, i.e., inflation, running at an average rate of 12%.

The private commercial banks and cooperatives in the province have no wish to risk providing loans for a sector with a high default rate.

4.2 LINES OF CREDIT - INTERNATIONAL

Over the last five years (with the exception of the IDB and IBRD credit lines), various development organizations and agencies, both bilateral and multilateral, have begun to provide financing for this sector. Despite the "critical mass" available, the procedures governing access to credit are excessively bureaucratic, being in many cases tied up with restricutions imposed by the lenders (in the form of tied loans). Loans are offered at highly promotional interest rates (1.25-6% p.a.) but the local bank - acting as intermediary here - stands in the way of the advantages reaching the borrowers.

4.2.1 LENDING ORGANISATION: I.D.B.

General conditions for financing small-scale projects:

The Bank provides loans, technical and managerial assistance, and other services besides, to groups, associations and other organizations for the benefit of persons who have limited or not access to conventional credit;

Table 4.1.1 - Current BNA loans

Line of credit	Borrower	Use	Proportion %	Term (year)	Interest rate p.a (%)	Maximum available (pesos)
To firms for working capital and investment	Firms and cooperatives	To reconstitute capital Supplement coop. capital		< 3	17	1.500.000 8.000 per member
To small and medium firms	Small and medium firms	Purchase of capital goods Working capital Acquisition tecnol.	80	< 4 <1.5 < 3	12 TEA	400.000 80.000 40.000
Costs of seasonal and non-seasonal changes	Farmers			< 1	21	1.500.000
Purchase of tractors and new machinery	Farmers	Tractors and new machinery Transport	75	< 4 < 3	17	1.500.000
IDB-IBRD Programme	Farmers Contractual services Service firms	Investment projects Machinery purchase Agricultural services	70	> 10 depen-ding on destinat.	16	< 105.000
Export prefinancing	Agric. undertak. Industries	All commodities NACE*	< 80 FOB	< 1	< 10	-
Export financing	Exporters	All commodities NACE*	< 85 FOB	< 4	< 13	-

**: Argentine nomenclature for foreign trade.*
***Source:** Banco de la Nación Argentina*

Technical assistance:

Where IDB approves a pre-credit application, which is accompanied by a profile of the applicant institution or a project profile, the intermediary agency is required to submit a complete project, comprising: a description of the agency executing the loan; technology to be brought to bear; demand analyses; intended beneficiaries, and so on. IDB may advance funds of up to US$ 30.000 to cover the cost of the application;

Financial assistance:

The credit made over to the intermediary agency may be up to US$ 500.000, with a repayment period of up to 40 years and a grace period of up to ten years, at 1% (service charge) p.a. It may come accompanied by a grant of ut to US$ 120.000 for the provision of technical assistance for such micro-holdings as may be set up.

The intermediary agency on-lends the funds to the ultimate beneficiaries at a higher rate albeit lower than the commercial one. It is required to repay the loan to IDB and takes responsibility for any arrears incurred by the beneficiaries. The programme is also intended to serve in capitalizing medium-sized organizations exercising a social function;

Eligible sectors:

The FPP moneys are made over to finance requirements in terms of working capital, the purchase of machinery, tools and other items of equipment and in terms of technical and administrative assistance extending to marketing aspects. On occasion FPP may finance the construction of productive plants in any sector;

Countervailing conditions:

The credit is granted without security of the economic kind, which means that the quality of the intermediary agency is of fundamental importance if IDB is to approve the loan. Obviously, a report on the recipient's past activities will be required. Examples of eligible bodies are: Non-governmental Organizations (NGOs) such as foundations, cooperatives, benefit societies and similar organizations having corporate status. Employers' organizations are also eligible, as in the case of the Federación Agraria Argentina, which obtained a loan for a cooperative in Salta province.

The intermediary agency may allocate a significant portion of the credit to the provision of basic equipment for a grouping of small producers. Examples would be a cold plant for a cooperative of small-scale market gardeners or a van for deliveries of confectionery made by women's groups. It is assumed that loans for small-scale enterprises would be in the region of US$ 2.000 to US$ 8.000 per family.

4.2.2 LENDING ORGANISATION: I.D.B

General: Programme for Financing Small and Medium-sized Enterprises:

The objective here is to enlarge the sources of credit for productive enterprises by the provision of sub-loans via intermediate financial institutions (IFIs) from IDB funding. Loans, technical and managerial assistance and other services are provided for low-income small-scale enterprises and the intermediate organizations that otherwise have little or no access to conventional credit.

Financial assistance:

Loans provided by the financial institution to the small-scale entrepreneur can be up to US$ 20.000. The operative financial conditions will be those of the market and the term will be a maximum of 48 months.

IDB grants loans in dollars, at a cost that is at least on a par with the management cost of obtaining funds on the market. The financial institution on-lends to the ultimate beneficiaries for a shorter term and at a higher rate of interest, though this will be near enough to the commercial rate. The on-lending institution is required to repay the loan to IDB and is answerable for any arrears incurred by the beneficiaries.

Eligible sectors:

Funds are made over to finance requirements in terms of working capital, purchase of machinery, tools and other equipment, and technical assistance for primary and industrial production and marketing.

Restrictions on the use of programme funds:

These may not be used to finance: (a) purchasing immovable property; (b) refinancing loans; (c) purchasing shares; and (d) activities not in conformity with the criteria in the environment regulations laid down by the relevant authorities.

Countervailing conditions:

The programme is addressed to individuals or bodies corporate in the private sector engaging in production, marketing or the provision of services and in the judgement of the IFIs having the technical, financial and legal capacity to carry out the activities it is proposed to finance. The IFIs may grant funds to small and micro-enterprises whether of individuals, bodies dealing with the small- or micro-enterprise sector, cooperatives and groups or associations of such enterprises.

Credit recipients must: (a) not have more than 20 employees, including the owner; (b) have sales or invoicings not in excess of US$ 200.000 per year.

Financial intermediaries:

Qualification as an IFI, in order to participate in the programme, is open to public and private bodies incorporated pursuant to the Financial Institutions Act, N° 21.526 and meeting, in the opinion of the Central Bank (BCRA), certain minimum criteria as regards solvency, liquidity, positive operational results, cover against default on loans, and the quality of its portfolio, etc.

Again, IFIs must undertake to ensure that the average aggregate of on-lending with programme funds shall not exceed on equivalent of US$ 10.000, and that the total outstanding from each person receiving a sub-loan shall not be greater than US$ 20.000.

Technical Assistance Agencies:

These are public or private non-profit bodies legally established in Argentina whose task is to provide small- and micro-entrepreneurs with an entire range of support services, such as training, technical assistance, consultancies and credit or support in handling IFI credits.

4.2.3 LENDING ORGANISATION: IFU (DENMARK)

General:

IFU was originally subsidized by the Government of Denmark but is now self-financing from loan repayments. It promotes the setting up of joint ventures between Danish firms and local firms in developing countries, through technical and financial assistance and capital injections.

The projects may be of any kind, provided they serve the economic development of the country concerned and are careful about the environmental impact. There must always be a Danish person participating, though the capital assembled need not necessarily be Danish.

IFU may take part in setting up new enterprises or in helping those undergoing rehabilitation, or may expand ongoing projects provided that at appraisal time a given project is commercially viable.

Technical Assistance:

Finding the Danish partners: Through its contacts with interested Danish firms and the regional development agencies, IFU exchanges information with a view to bringing Danish and local enterprises into contact with each other.

Financing for the technical and economic feasibility study:

At the preliminary contact stage IFU may finance a pre-appraisal mission for the Danish firm(s) concerned, thereafter granting a low-interest loan for the feasibility study.

Financial Assistance:

In addition to possibly taking a minority share in the capital of the proposed joint venture, IFU may grant loans directly or take part in obtaining additional financing from other sources or the banks.

Type of assistance:

- Medium-term loans.
- Security of loans by third parties.
- Management of alternative sources of financing.

Conditions governing IFU loans:

Market interest rates; three or four years usual grace period; repayment over seven or eight years for medium-term loans.

Capital contribution:

IFU may supply up to 30% of the share capital and up to 25% of the outlay called for, including loans up to a maximum of DKK 35 million (approximately US$ 6 million);

Eligible sectors:

All sectors of interest to the development of the Argentine economy -agriculture and related industry; wood and wood products; transport; mines; building construction and machinery; equipment, basic and instrumental; technology for the environment and alternative sources of energy. The food industry is a priority client, given the development of this sector in Argentina.

Conditions imposed by IFU:

A Danish firm or firms must have up to a 30% share in the capital of the joint venture.

Conditions in respect of the local counterpart:

The latter must put up at least 40% of the share capital.

Special conditions:

Equipment must be purchased from the lowest bidder, who need not necessarily be Danish.

4.2.4 LENDING ORGANISATION: SWEDFUND/SWEDCORP (SWEDEN)

General:

More or less as with IFU, this organization promotes joint-ventures among Swedish firms and developing countries, via technical and financial assistance and through providing a share of the capital. It also promotes exports to Sweden from local firms or from these joint ventures;

Procedure:

SWEDECORP acts as a link between local and Swedish enterprises. Once the joint venture has been planned, it takes a share in the capital or the enterprise itself, or both;

Technical Assistance:

Two-way furnishing of information in order to identify the Swedish partner:

- share in financing the feasibility study, through a loan to the Swedish firm;
- management of technical assistance through the agency of Sweden's BITS.

Financial Assistance:

- medium-term loans;
- security for loans by third parties;
- Export credit EKN/SEK, EXIMBANK;

Conditions:

Interest at market rates, grace period normally up to the moment the project gets under way; repayment up to ten years for medium-term loans;

Capital:

SWEDECORP contributes to the formation of the capital to the tune of 25%;

Eligible sectors:

All sectors of interest to the development of the Argentine economy: agriculture and related industry; mines; building construction and manufactures, provided there is a Swedish firm technologically developed and competitive at the international level in the sector. SWEDCORP promotes the association of medium-sized and small enterprises, on the assumption that large enterprises have no need of promoting;

Conditions relating to the external partner:

This partner must be a Swedish firm, as far as possible with experience in foreign trading and take a 25% share in the capital of the joint venture.

Conditions relative to the local counterpart:

This can be a private firm or a state cooperative and must put up at least a 50% share in the capital - including land and all local costs.

4.2.5 LENDING ORGANISATION: E.C.I.P. (EEC)

General:

This body promotes the setting up of joint ventures between firms in the European Community and developing countries through technical and financial assistance and taking out shares in the capital.

Kind of aid available by type of operation.

Identification of projects and potential partners.

Beneficiaries:

Only financial institutions, chambers of commerce, trade associations and public agencies intending to mount a specific investment project are eligible. Individual firms are not eligible;

Form of aid: Subsidy.

Amounts available: Up to 50% of the cost.

Financial ceiling: ECU 100.000 (approximately US$ 120.000).

Beneficiaries:

Local or European enterprises, whether singly or several together, which intend to invest in a joint venture.

Form of aid: Interest-free advance.

Amounts available: Up to 50% of the cost.

Financial ceiling: ECU 250.000 (approximately US$ 300.000).

Financing capital requirements.

Beneficiaries:

Joint ventures formed by EC partners and partners of any eligible country. The European sponsor must provide at least 10% of the capital;

Forms of aid: Subscription of a share of the capital, or loan for this purpose.

Amounts available: Twenty percent of the joint venture capital.

Financial ceiling: ECU 1.000.000 (approximately US$ 1.200 000).

Training and staff backstopping.

Beneficiaries: Joint enterprises formed by EC partners and partners of any eligible country.

Forms of aid: Interest-free advance.

Amounts available: Up to 50% of the cost.

Financial ceiling: ECU 250.000 (approximately US$ 300.000).

Ceiling per project:

The aggregate EC contribution per project, including capital contribution and facilities "b", "c" and "d", may not exceed one million ECU (approximately US$ 1.2 million).

Special conditions:

The EC may undertake cofinancing operations only through the agency of, or as a joint venture with, some preselected local financing institution, and its contribution for funding the capital may not exceed that of the institution in question in the case of capital contribution or in the case of cadre training and related advisory services. Where Argentina is concerned, the only financial institutions selected by the EC at the present time for this type of operation are the Banco Roberts and the Banco de la Provincia de Buenos Aires.

The maximum aggregate contribution, except for subsidies, is ECU one million per investment project.

4.2.6 LENDING ORGANISATION: JAIDO (JAPAN)

General:

JAIDO is a Japanese private foundation financed by the Chamber of Commerce of Japan. Its purpose is to provide technical assistance and to finance the projects of its associates in developing countries. The projects are normally implemented as joint ventures between Japanese enterprises and those of the developing country concerned.

JAIDO also offers services prior to the contract between the country's enterprises and their prospective Japanese counterparts with a view0 to forming joint ventures suitable for funding. The intensity of subsequent technical assistance and the level of financing are negotiated case by case.

Where Argentina is concerned, JAIDO has expressed interest in promoting joint ventures, and has sent a delegate to the last two meetings of the Argentine-Japan Joint Committee.

Argentine private (or even State) enterprises may initiate negotiations with JAIDO by presenting a draft, in not more than three pages, summarizing the proposed operation, and the capital contribution and offer of the Argentine enterprise, together with the participation and the monetary amounts requested of the Japanese partner in its line of business. It is not necessary to have prior contact with a Japanese firm, since JAIDO will take the necessary action in this respect.

In principle JAIDO's concern is to handle the investment in small- and medium-sized enterprises in any sector where Japanese firms have an interest.

4.2.7 LENDING ORGANISATION: INSTITUTO DE COOPERACIÓN IBERO AMERICANO (I.C.I.) (SPAIN)

General:

Spain's International Cooperating Agency (AECI), acting through its Latin-American Directorate, namely this Instituto de Cooperación Ibero Americano, is carrying forward a General Entrepreneurial Cooperation Programme for Development, targeted on small- and medium-sized enterprises. The programme in question takes effect, in the case of Argentina, under the General Cooperation and Friendship Treaty between the Kingdom of Spain and the Argentine Republic.

The overall objective of the programme is to strengthen the entrepreneurial fabric of Argentina's small- and medium-size undertakings. One line of cooperation here is that of promoting associations between Argentine and Spanish enterprises.

The Programme is addressed to:

- Argentine firms that have reached their growth limit either as a result of obsolescent technology, productive capacity, financial capacity, markets, non-liquid capital, or other causes;

- Spanish firms which thanks to their dynamic growth are in a position to offer financing, technology, capital and trading connections.

The purpose of this type of cooperation may be summarized in terms of:

- dynamizing Argentina's entrepreneurial fabric;
- supporting the internationalization of small- and medium-sized productive enterprises;
- facilitating the exchange of technology, capital and trading connections, etc.;
- facilitating the maximum possible processing of raw materials in the country of origin;
- bringing production costs into line with world prices and thus render Argentine products competitive;
- providing customs advantages through the association of small- and medium-sized enterprises of both countries vis-à-vis the European Community (January 1993) and MERCOSUR (January 1995).

Procedure:

Any Argentine enterprise interested in associating with a Spanish opposite number must apply to the Spanish Chamber of Commerce for Argentina, with project proposals.

Once the project has been appraised the desired profile of the Spanish party will be determined and the entire file will be forwarded to Spain for the purposes of identifying the right partner.

Once potentially interested Spanish firms have thus been identified, they will be put into contact with the Argentine enterprise in order that they may learn more about each other.

Meanwhile, in Buenos Aires, a meeting will be arranged at one or other Trade Association between the Argentine entrepreneurs and the potential Spanish party, in the expectation that easy relations and a high degree of trust may be engendered. Upon the conclusion of the meeting under Trade Association auspices the ensuing relations become strictly private between the parties.

Eligible sectors:

All industrial sectors where it is possible to intensify competitiveness and international marketing.

Conditions referring to the Argentine party:

This must be a small- or medium-sized enterprise. As a tentative figure, it should not have more than 400 employees.

Conditions referring to the Spanish party:

This, too, should be a small- or medium-sized enterprise.

First Contracts: Through the Spanish Chamber of Commerce for Argentina.

4.3 ALTERNATIVE FORMULAS FOR FINANCING

Among currently available formulas for financing the diversification of this sugar sector the following have been identified:

- sugar futures market;
- stock exchange quotation;
- issuance of Medium-Term Notes;
- self-financing.

4.3.1 FUTURES MARKET

So far no futures market, i.e. where sugar can be sold for delivery at some stated time in the future, has been organized. Conceivably, a similar market functioning through a Commodity Exchange could inject greater confidence and certainty into this sector, notably for the small operators who prefer to sell off their surplus at the start of the season rather than wait to see their product depreciate as time passes.

It is for this reason that Mercozucar could take upon itself to organize a sugar futures market. Its statutes place it in a position - technical position - to embark on operations to bring order into the market in the medium term.

4.3.2 STOCK EXCHANGE

Tucumán province's industrial sector needs to be reorganized - by reducing the number of mills and by rationalizing its operation to enable it to take part in the capital market.

There are already some mills such as Ledesma (Jujuy) that are issuing shares. In this way, it should be possible to achieve an increase in operating capital for the mills by attracting the savings of the public and, who knows?, capital from foreign investors.

4.3.3 MEDIUM TERMS NOTES

Among the novel financial instruments that are finding their way into Argentina is that of issuing Government-backed Notes.

Buenos Aires province, for example, is currently seeking to place a US$ 500 million issue on the international market.

As a general rule the issues have a term of ten years, with a yield of not less than 7.5%, guaranteed by the value of United States Treasury Papers (4.5%) plus a 3% rate representing the country's solvency rating.

It should be remembered that Argentina's debt is currently being negotiated on the New York market at 70% of its face value. Two years ago it scarcely reached 39%.

In the context of risk ranking, one may note that some Argentine industries, e.g. the Alto Parana cellulose pulp factory in Misiones province, have issued certificates of this kind. These are negotiated at a nominal value of 9.5% per year.

4.3.4 SELF-FINANCING

Hitherto, the sector has had a very low level of investment in the production process. Recently - in 1992 - it has had to come to terms with a free market policy and production and prices that are entirely deregulated.

Obviously, where the market is protected and production quotas are guaranteed, the mills had no great need to be efficient and gave no thought to ploughing back their profits into the production process.

To-day, things are different, and the industrial units have no choice but to adopt innovative technology for their products and for the way they go about producing them if they are not to be edged out of the market.

The analysis of the need to adopt technology and to bring themselves up to date (Chapter 3), shows that in order to modernize eleven mills an aggregate outlay of US$ 26 million is called for, i.e. an average of US$ 2.3 million per mill.

In the first two years the mills will need to invest a total of US$ 15 million (or US$ 1.3 million per mill or US$ 650.000 per year).

A typical mill produces an average of 50.000t/yr, for a weighted average for the last two seasons of US$ 300/t. Half of this figure goes to the grower, the remainder being the equivalent of an average return for the mill per harvest of US$ 7.5 million. The outlay required (US$ 650.000) is less than 10% of the gross returns.

That being so, many of the present mills should be able to sustain the outlay necessary for achieving an efficient processing set-up. The outlay envisaged for energy saving and a better utilization of sugar cane byproducts are by themselves sufficient to generate a 15% rise in productivity and a saving, say, of US$ 416.000 a year (Annex 5).

4.4 FINANCING DIVERSIFICATION FOR MINIFUNDIO FARMING

Rationalizing this sector could make for producing more cane per unit area (from the minimum acceptable of 40t/ha to a maximum of 80t/ha). Accordingly, if the present trend in terms of area planted continues there will inevitably be problems of finding an outlet for overproduction.

In this process, which it is anticipated will be carried through in the next five years, marginal growers - in particular those working minifundio holdings edged out of the market, since, given the exiguous size of their plots, they can scarcely adopt the requisite technological packages. And this is the vicious circle that drives them into a worse poverty than is their present lot. The 5 ha-and-under bracket comprises 32% of growers in the province, i.e. 3.160 growers, or approximately 15.000 persons, who, however, account for only 4.6% of the planted area.

As a general rule when in the province one speaks of a sugar grower one has in mind a holding of up to 20 ha, representing 70% of growers and 15% of the planted area.

The present financing proposal, therefore, consists in bringing into play a mechanism whereby it will be possible to fund the conversion of these small (up to 5 ha) growers by diversifying their production in the direction of other crops and on-farm activities such as:

- to guarantee their food self-sufficiency
- to raise/supplement family incomes.

The proposal would be implemented gradually in order not to give rise to conflicts in the cropping strategy with local production patterns where these have for years past consisted exclusively in sugar cane monoculture. The objective therefore is to raise rural incomes by introducing other crops along with the minifundio grower's activities but without for the moment eliminating his sugar cane growing.

Nowadays, a 4 ha production unit generates and average monthly income of US$ 156 for five months of the year, as in Table 4.4.1.

Cuadro 4.4.1 - Average monthly income

Production unit	Cane output (tn/ha)	Equivalent sugar (tn)	Income 50% maquila 300US$/tn	Equivalent labour costs US$ (65%)	With 2 family members work (US$/each)	Average monthly income for 5 members (US$)
< 3 has	40	12	1800	1170	585	117
< 5 has	40	20	3000	1950	975	195
Average	40	16	2400	1560	780	156

Source: Consultant's own elaboration

The cost of a day's wage, of US$ 7, when social security payments (Mill Workers' Fund) are added, comes to US$ 12, following the increase of 15 July 1993.

At the moment the Government has provided, via the Social Aid Fund, an extraordinary bonus of three supplementary payments for the between-harvest period equivalent to US$ 150 per month. Some 60% of the Fund is allocated to the small grower and 40% to the mill worker. The Fund provides what is in effect an unemployment benefit.

Under this scheme, the Government advances funds to the equivalent of the next two years, each family unit receiving US$ 900. This amount will be supplemented with the equivalent of two non-repayable quotas (US$ 1.800), thanks to international cooperation so as to arrive at a critical mass of financing of US$ 2.700 per family.

With this capital-for-change and with the technical assistance received from the Obispo Colombres Experiment Station and INTA, and building on the experience gained under such programmes as Cambio Rural (Rural Change) and Pro Huertas (Homestead Gardens), it will be possible to carry through a conversion plan for small-scale grower production.

The financing proposal (Table 4.4.2) contemplates the following:

- Availability of the Social Aid Fund for two years (totalling six months equivalent) for providing capital;
- Availability (donation) from international cooperation for supplementing this capital;
- Funding for contracting 40 extension workers for two years;
- International technical assistance for: organizing the growers; production technology; plant-pest/disease control; biological control; marketing; and equipment (motor vehicles; spraying equipment; etc.).

Table 4.4.2 - Financing proposal

ITEM	Number	Unit outlay US$	Total US$
Families	3.160		
Governement		900	2.844.000
Social Aid Fund			
Sub total			2.844.000
International Agency			
Capital supplement		1.800	5.688.000
Local techn. assistance	40 extensionists	700/month	672.000
Intern. techn. assistance	40 experts/month	10.000/month	400.000
Equipment, vehicles			400.000
Sub total			7.160.000
TOTAL			10.004.000

Source: Consultant's own elaboration

Each group of 20 families will form a production cooperative or a farmers' association, which will benefit from the services of one extensionist per four such groups.

The extensionists themselves will be coordinated by INTA and the Obispo Colombres Experiment Station between them.

Growers agreeing to join the conversion plan will give a signed undertaking not to plant sugar cane for a period equivalent to four years on land intended for new crops.

Among the activities that have been identified as feasible for promotion and for their exemplary value, several have been proposed by the Tucumán Government's Microproject Promotion Unit, as in the Table 4.4.3.

Table 4.4.3 - Activities identified by Tucuman's Governement's Microproject Promotion Unit

Item	Area ha	Outlay US$	Income per ha/year US$
Japanese mint	1	500	2800
Lemon grass	1	330	1400
Marjoram	1	380	2500
Malva	1	400	2500
Thyme	1	300	2600
Rosemary	1	260	1000
Aniseed, cumin, coriander	1	500	300
Small fruits	1	16000	22000
Poultry raising		3500	8700
			kg/ha
Vegetable	1	445	8000
Cucumber	1	700	24000
Chick pea	1	910	3300
Maize (cob)	1	245	5000
Lettuce	1	570	9000
Beet	1	630	9800
Spinach	1	700	12000

Source: Unidad de Promoción Microproyectos del Gobierno de Tucumán

4.5 FINANCING STRUCTURE FOR THE PROPOSED INVESTMENT

The following table 4.5.1 indicates the scheduling of the proposed investments and the sources of financing each case.

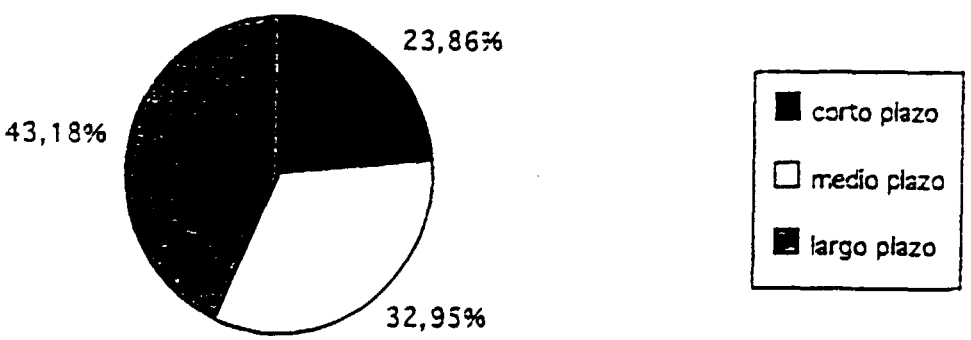
The graph 4.5.2 illustrates the distribution over time of the proposed investments. It will be noted that 23.86% are concentrated in the short term (i.e. prior to Year 2), 32.95% in the medium term (Year 3 to Year 5) and the remainder committed from Year 5 on.

Table 4.5.1 - Scheduling of the proposed investments and sources of financing

Project	Investment '000 US$	Financing requirement short term	medium term	long term	Type of financing local	intern.	total '000 US$
Reducing energy consumption	15.500	x			15.500		15.500
Reducing sugar losses	57.000			x	10.600	46.400	57.000
Utilisation of lees	10.500		x		10.500		10.500
Bagasse plant	21.000		x			21.000	21.000
Fodder plant	2.000	x			500	1.500	2.000
Acetic acid plant	4.000	x			1.500	2.500	4.000
Citric acid plant	10.000		x		10.000		10.000
Butanol/acetone plant	2.000		x		500	1.500	2.000
Minifundio conversion	10.000	x			2.840	7.160	10.000
Total	132.000				51.940	80.060	132.000
%					39,35%	60,65%	100,00%

Source: Consultant's own elaboration

Graph 4.5.2 - Distribution over time of the proposed investments



Source: Consultant's own elaboration

CHAPTER 5

CONCLUSIONS REGARDING THE POSSIBILITIES FOR DIVERSIFYING THE SUGAR SECTOR AND PROPOSED PLAN OF ACTION

5.1 THE PROBLEM SUMMARIZED

Sugar cane is an annual crop, the harvest extending over four months, while demand is year round for consumption, thus requiring storage space and money for holding stocks.

Cane growing is a major activity in Tucumán province, accounting for over half agricultural GDP and equivalent to about 30% of industrial GDP.

The recurrent crises in the sugar sector in Argentina, especially in Tucumán, the main producer province, are due to:

- oversupply on the international market for sugar (cane and beet) and surpluses sold at subsidized prices, with the result that in international terms the price for the commodity is generally lower than the cost of producing it;

- national surplus production, given the level of domestic demand, depresses prices;

- the fact that there are no production alternatives where sugar surpluses can be utilized

- the low level of competitiveness of both the agricultural and industrial sectors,aggravating costs and thus depressing profits

- the lack of financing, with the result that growers are obliged to dispose of their output at an early stage and at a low price. This problem is aggravated by overproduction, which depresses prices even further;

- the fact that in many cases there are no direct marketing channels availablewhere it would be possible to bypass the middleman. The latter, in possessionof financial resources and ready trade channels, can buy up the sugar early inthe season at a low price and make considerable profit in resale;

- minifundio farming when sugar is the crop. Though this segment representsonly 15% of the province's output, it is the cause of a major social problem, in the condition of extreme poverty in which these farmers live.

Of all the aspects listed here the most serious is oversupply. This is evidenced by the fact that in years when there was no oversupply, and a good price could be had, the other aspects were of little consequence.

Even so, a lasting solution calls for the mounting of an integrated programme comprising a series of measures designed to reduce or eliminate altogether the problems besetting the sector.

Accordingly, where the aspects here described are concerned, it should be possible to take action in any of the following contexts:

5.1.1 INTERNATIONAL PRICES

Since Argentine sugar production is of no great consequence on the world market, there can be no hope of influencing prices there, though these still have to be taken into account as a fact of life.

Even so, it is possible to take steps to protect domestic production from subsidized imports. Here, the Central Government is currently enforcing price equalization measures, and it seems that the expedient has functioned satisfactorily so far.

5.1.2 DOMESTICE OVERSUPPLY

It is possible to reduce domestic surpluses by:

- reducing cane production;
- placing surpluses abroad;
- diversifying domestic sugar consumption by developing the firms using sugar as an ingredient;
- adopting any comibination of the above.

In the past, adjustment was achieved when output was lower (as a result of climaticfactors, of a deepening crisis, of regulatory measures), by marketing surpluses abroad (when international prices were rising) and by the operation of the petrol-alcohol plan.

For the future, and in consideration of the alternative solutions suggested, the scope for action reduces to containing output or diversifying the uses for sugar, or both this because it is impossible to infiuence world prices and because there is a limit to increases in domestic consumption.

Containing output could be achieved in the medium term if the market were allowed to operate, because in this way the inefficient growers would gradually disappear with a deepening crisis. Even so, the social problem arising from the ensuing unemployment would need to be tackled in a province that already has a rate half as high again as the national average.

Diversification, on the other hand, calls for an integrated plan of action, a concertationof the public and private sectors. It is this option that is the basic assumption of the Report, as being the most justifiable on social and economic grounds because it calls for a higher level of production than previously and should help to raise the standard of living of the poor.

5.1.3 RAISING PRODUCTIVITY AND LOWERING PRODUCTION COSTS

There are problems specific to productivity in agriculture and in industry, though there are others besides that call for coordinated action by both sectors.

Poor productivity in agriculture is the result of, among other things, the failure to adopt novel varieties; plantation renewal frequency; and inadequate network practices. By taking action on these points it should be possible to achieve considerably higher yields of cane per unit area.

Over and above this, costs of harvesting could be kept down by encouraging greater mechanization among small and medium-sized growers.

Productivity can also be enhanced within the industrial phase by containing operating costs, achieving a better energy balance, containing sugar losses at the molasses and bagasse stages, refurbishing boilers and installing machinery incorporating modern technology.

Productivity problems associated with the lack of coordination between growers and mills arise mainly from the time elapsing between harvesting and milling, with the result that about10% (even 20% sometimes) of the sucrose is lost. The underlying causes are the harvesting method, transport and the circumstances in which the mills take delivery of the crop.

In the light of what is said here, it is necessary to promote measures designed to enhance productivity at both the agricultural and the industrial phases. And this not only to achieve greater competitiveness in sugar processing but also as a means of facilitating other projects for the diversification of industry where sugar is used as a raw material.

Similarly, measures to raise agricultural yields should be accompanied by measures to diversify as well. In this way increases in supply could be avoided, and growers would not be dependent on a single commodity.

The diversification thus recommended could be achieved with lines of production that are complementary to strictly sugar activities.

5.1.4 PRODUCTION ALTERNATIVES

There are presently several lines of production that derive from the sugar cane though they have this peculiarity that the manufacturing process uses by-products from the milling ofcane for its sugar, and not the cane directly.

The chief examples of such by products are bagasse, which are used for energy generation and papermaking; and molasses, used in the food industry, and molasses by-products, alcohol figuring among the most important of these.

The industrial process also yields residual products such as press ca .e and lees, which can be used as agricultural fertilization (but in fact are not so used as yet).

Again on the subject of diversification, one may note the petrol-alcohol plan, which was launched in 1981 but discontinued in 1989 for various reasons.

The present Report contains a technical analysis and market analysis both relating to the potential for manufacturing items different from those produced so far. The purpose of these analyses is to assess alternatives for the utilization of sugar surpluses and by-products.

The technical analysis assesses on the one hand the outlay that each mill would need toface in order to make its sugar processing more competitive and, on the other hand, the product range with which to mount a programme for industrial diversification exploiting sugar cane derivatives.

As regards the first aspect, the analysis found a poor level of competitiveness due to:

- high losses of energy in practically all the sugar mills;
- depressed sugar yields from the final molasses and from the bagasse.

By way of example it may be noted that one approach recommended is that of economizing on the amount of bagasse used, by reducing its moisture content. The saving, of up to 15%, translates in monetary terms into some US$ 416.000 per year per standard mill with a processing capacity of 500.000 t. For this to be feasible, an aggregate outlay is called for to the tune of US$ 400.000. Likewise, with an outlay of US$ 650.000, sugar losses at the molasses stage could be avoided and a yearly return of about US$ 600.000 obtained. In either case the outlay could be recouped from the returns on the first harvest so processed.

Coming, next, to the question of diversification, one may note the possibility of obtaining products from bagesse and molasses.

Bagasse consists of 60-65% fibre, the rest being pith. The fibre can be used for making pulp, paper, particle board, and furfural and its derivatives, and feed for livestock.

Molasses offers a wide range of possible uses as raw material for other industries, among them for the product of alcohol and its derivatives, and, again, products from the fermentation of molasses.

5.1.5 TECHNICAL AND ECONOMIC VIABILITY OF ANY DIVERSIFICATION PLAN

To complete these analyses, a forward appraisal was made of the technical, economic and institutional viability of the investments identified in Chapter 3, and in consideration of the potentialities offered by the market. The conclusions of this appraisal, and of conversations with industrial operators, investors and public authorities, are brought together in the table below (Table 5.1.1) showing the options that are feasible for an action programme for the diversification of the sugar sector.

From the above range of options two possibilities for diversifying sugar cane derivatives emerge:

1. accept the present situation in the sense of not producing denatored alcohol and promote novel activities for diversifying;
2. produce denatured alcohol, since, except for three mills, the province's sugar ndustry in the aggregate has valid experience here and possesses the right sort of distilleries, so that no fresh outlay or equipment would be needed.

The alternative to that of producing alcohol would be to develop a number of industrial processes which, though with less individual impact, could together absorb surplus cane; and this would in any case depend on what the private sector decides. It could decide, for example:

- to rehabilitate the Papel Tucumán factory. This is indeed a private mill but in this particular case the public sector would need to be involved as well;

- to set up a particle board factory, with an eye to world demand here and to the fact that it is cheaper to produce these wares with woody waste and other materials such as bagasse than to obtain resources from wooded stands;

- to set up a factory making feedstuffs for poultry and cattle. This would utilize the pith,which has a nutritive value and is basically a readily assimilable source of carbohydrate (in the sugar) and digestible fibre. Protein, mineral and vitamin supplements would still be necessary, as governed by the animal to which it would be fed.

The project could be pursued together with the process of diversification towards livestock activities, since meat production would find a worthwhile regional market, when about 70% of Tucumán's consumption is supplied from other provinces.

- Set up a chemical industry to produce alcohol derivatives for use on the domestic market. These derivatives would include acetic acid and butyl alcohol, which are imported in great quantities each year;

- Manufacture novel products of molasses fermentation, such as citric acid, and acetone-butanol. These are not produced in Argentina yet have a significant demand within the country.

Table 5.1.1 - Technical and economic viability criteria governing diversification options

Derivatives	Technical viability	Outlay millons US$	Jobs gene-rated	Project. Output Tn	Lack of local dem.	Potencial demand int.	ext.	Recomendation
Bagasse								
Paper	yes	-	-	-	yes	yes	no	Reactivate Papel Tucumán plant
Particleboard	yes	21	150	40.000	yes	yes	yes	Conduct market study
Feedstuffs (experiment. plant)	yes	2	20	15.000	yes	yes	no	
Molasses								
Denatured alcohol	yes							Utilize existing capacity
Chemical industry acetic acid	yes	4	30	4.000	yes	yes	no	
Molasses fermentat.								
Citric acid production	yes	10	60	6.000	yes	yes	no	Investors available
Acetone/ butanol compound	yes	2	30	5.000	yes			
Total		39	290					

Source: Consultant's own elaboration

The lines of action described above could help to overcome the crisis caused by overproduction of sugar cane, but it must be understood that all of them taken together would never achieve the same results as the production of denatured alcohol.

Quite apart from this, it is possible to increase current levels of consumption for sugar, by the processing industries, especially the food industry, where Argentina has comparative advantages and is in a position to become competitive.

In this connection, mention should be made of the possibility of increasing exports of confectionery, with the largest firm in the sector taking a leading role. With sugar taken up by this type of industry, and with the rising exports achieved by it in recent years, it is reasonable to suppose that indirect increases in the sale of sugar abroad would be possible via such industries as use this commodity as raw material.

Even though it appears more promising as a means of overcoming the crisis in the sector, the second possibility here contemplated, if it is to succeed, depends on a political decision rather than on technical or economic considerations.

Alcohol production, additional to that of the sugar itself, implies taking up the entire volume of cane and an enhanced productivity in terms of sugar - this because it would facilitate an approximately 10% saving in energy thanks to the elimination of the final crystallization phase (phase C of the boiling process), the most laborious and most expensive part and where, moreover, less sugar is extracted.

The possibility of producing alcohol as a fuel additive has two aspects worthy ofconsideration:

- ecology policy where the domestic market is concerned (i.e. national policy and the policy of the petroleum companies). Here, the ecological petrol fuels, with the alcohol admixture, do much to reduce the polluting effects of these fuels;

- production costs. These would be governed by the outlets that the fuel finds onthe home and foreign markets.

As regards the first - ecological - aspect, representatives of the private sector in the foreign countries making up MERCOSUR (Argentina, Brazil, Paraguay and Uruguay) proposed that their Governments enter into a sectoral agreement providing for the adoptionof a common ecological fuel consisting of a blend of basic petrol fuel and of ethanol in a proportion between 10% and 22%.

The proposal, however, was turned down by the Governments of Argentina and Uruguay, the former sustaining that, "the deregulation process under way provided for no means of action whereby the private sector might be obliged to use this or that formula for the fuels that it places on the market. If the decision is taken to use alcohol for fuel, then this decision is one for the entrepreneurs to take and not for imposition under special programmes to that effect, where rigidity stands in the way of efficient resource allocation."

The petroleum companies, for their part would be prepared to utilize alcohol in their blends against a determinate production cost. In this connection, the PUMA firm began a trial in July 1993 by installing in the province distribution points for fuel containing 15% cane alcohol at a price slightly below that of the normal petrols.

The experiment is being conducted using the current output of alcohol, obtained from molasses as a byproduct of sugar refining. However, any expansion in this particular market would necessitate milling sugar cane specifically for alcohol, the difficulty here being the higher cost of production.

If the cost problem were solved, then the denatured alcohol for use in fuels could not only have a domestic market but would be in a position to supply Brazil, which uses this fuel and has to import nearly 500.000 m^3; but this figure is much higher than the total volume that could be produced in Argentina with the normal level of sugar cane surpluses.

If the international price proved to be an economic one, it would be necessary to examine this possibility. Making an agreement with Brazil, within the ambit of MERCOSUR, similar to the agreement covering other commodities - wheat, flour, petroleum - whereby Brazil, acting through Petrobras, could accord priority to purchasing Argentine products; but for this it would be necessary to guarantee supplies at international prices.

Even though Brazil has covered part of its alcohol deficit by importing methanol (a petroleum byproduct), the Government has decided to eliminate methanol from its blends and replaceg it entirely with alcohol.

The viability of the project to produce 90% proof denatured alcohol in order to supply Brazil would meet with only one serious constraint, namely that of producing it at a cost where it would be possible to sell at international prices, currently US$ 0.30/per litre FOB (see Statistical Annex to Chapter 5).

5.1.6 FINANCING

Since the sugar production is a four-month-long process whereas the marketing takes place all the year round, it is necessary to finance the holding of stocks.

In view of the crises through which this sector is passing and the latter's indebtedness, there are very few growers or firms in a position to obtain the necessary credit.

Beginning with the 1992/93 crop year the matter has been settled in part by recourse to the warrant formula. Even so, to date the formula has proved to costly, amounting to an aggregate of 22% per six-month period. In thepresent crop year, the cost was amply repaid by the marked rise in the sugar price. If, however, a way is not found to reduce these costs the entire system would be at risk.

5.1.7 MARKETING CHANNELS

The fact that there are no direct marketing channels for the grower has reduced the possibility of his obtaining a better price for his product at the time of the first sale. A solutionhas begun to emerge for this state of affairs with the setting up of MERCOZUCAR S.A., with its

membership of representatives of mills and marketing cooperatives accounting for about half the sugar output of Tucumán.

In addition to supplying the mills, supermarkets and wholesalersdirect, MERCOZUCAR has tried to regulate the volume of sugar placed on the market by laying down quotas, per enterprise, together with agreements for the export of surpluses.

In this way it has helped to recover the price but it met with several operational problems, and its scope for taking action is closely bound up with the prospects for the warrants system, which explains why MERCOZUCAR has still not been strengthened.

5.1.8 MINIFUNDIO GROWERS

The sugar sector has a major social problem in the significant number of minifundio growers, with their extremely low standard of living.

Any plan, therefore, aiming at an integrated solution for the sector must comprise a series of measures to improve the present situation.

Among such measures, thought must be given to the possibility of having sugar cane growing supplemented with other lines of production which should be capable, first of increasing the food supply and, in a second stage, of generating surpluses such as might raise incomes derived from this activity.

5.2 ACTION PLAN TO IMPLEMENT THE DIVERSIFICATION STRATEGY

In order to stabilize incomes at reasonable levels, safeguard the consumer's interests, attenuate the vulnerability of the minifundio cane growers and raise employment opportunities and incomes in the province, the proposal is now made for a Plan of Action to be taken - and in a coordinated fashion - by both public sector officials and operators in the private sector.

The proposal contemplates a series of strategies and measures, to be carried forward in an integrated approach, that are designed to maximize objectives achieved conjointly, one with the other, since the pursuit of some and without the rest might lead to an aggravation of the crisis.

The underlying strategy is comprised within a plan for diversifying the use made of sugar cane and channelling the material to the manufacture of other products than sugar. In this way it is hoped to solve the problem of oversupply and attenuate the depressive effects of sugar prices at critical periods on the sector's earnings.

Even so, the first thing to do in order to succeed with industrial diversification is to be sure of the availability of raw material that is competitive in both cost and quality. The first step, therefore, is to enhance productivity at the growing stage.

5.2.1 AGRICULTURAL PRODUCTION

The first measure to enhance productivity at the cane growing stage is to obtain higher yields per unit area planted.

This is possible because there are tried and tested varieties available that could raise average yields from the present 60t/ha to 80t/ha. Assuming plantation renewal at a rate of 20% each year, it should be possible to achieve a significant increase in production in the space of five years. For this to be, the introduction of new varieties must be accompanied by the requisite tillage practices - weed control, use of herbicides, raising irrigation intensity and the use of fertilizer.

Extension and the dissemination work carried on by such bodies as INTA and EEOC have a fundamental role here, in making more widely available planting material of these new varieties and encouraging varietal renewal.

If harvesting costs are to be kept down, machinery will be needed. Given the small average size of holdings and the economic resources of small-scale growers, these costs can be reduced by strengthening the role of farmers' associations that provide harvesting services and by coordinating harvesting operations in such a way that the most efficient use will be made of the machines.

A further need is to reduce the high percentage losses of sucrose caused by the time taken between cane harvesting and milling. To do so requires coordinating cane deliveries with such other factors as:

- the daily processing capacity of the mill in question;
- transport capacity;
- supply volume;
- days when milling is done.

The task of coordinating here could be entrusted to growers' cooperatives.

Transport costs - a heavy item in the overall agricultural price pattern - could be reduced by changing the practice of piling the crop in the mill forecourt and that of bulk loading, so that the number of vehicles for transporting the cane from field to mill can be kept to a minimum.

All these measures designed to enhance productivity in agriculture generally make for a higher cane output as well. At the same time, for fear of aggravating the crisis, these measures must be accompanied by others offsetting the negative effect of a more abundant supply on prices - measures, again, that are conducive to other objectives such as improving the province's food supply.

The proposal is accordingly made that an agricultural diversification strategy be adopted whereby sugar production may proceed from a smaller area under the crop than at present. By way of example, the following possibilities could be considered:

- Tobacco: The Burley variety could be grown in southern Tucumán. This variety is competitive in terms of production costs in that it uses family labour for a 1-2 ha plot, and harvest time lasts from January to May, once the sugar harvest is itself finished;

- Fruit and vegetables: These, too, could be grown on a smaller area. Tests have been conducted in the Litoral region;

- Poultry and barnyard animals: Consumption of poultry meat, etc., together with that of vegetables has the advantage of appealing to a region-wide market. According to estimates made by various bodies, among them the Universidad Nacional del Tucumán, a high proportion of consumption is accounted for by other provinces.

If this is so, then production here could help not only to cover family food needs but also to supply the main consumer centres in the province, creating an additional source of income in the process. Again, if early fruits and vegetables can be grown, these too will enhance the likelihood of placing them in large volumes in these same consumer centres.

In mounting such a strategy, once again, the work of the institutions providing extension and similar services is vitally necessary, with the advice they give on novel products, appropriate varieties, sowing dates, tillage practices, etc. Action along some of these lines has already been taken under the Cambio Rural and Prohuerta programmes.

When one considers that sugar cane growing has been carried on in the province for over a century and that the personal characteristics of the farmers here are not best conducive for introducing the kind of diversification proposed, expedients must be brought to bear to persuade them of the need to convert. One such expedient could be tax relief for those of them agreeing to go along with the programme.

Recent experience in introducing new varieties has made it clear that the product must reach the market in time and in the desired form. The means that supply needs to be organized and that marketing channels must be assured. It is here that the farmers' associations have a fundamental role to play.

5.2.2 INDUSTRIAL PRODUCTION

Enhanced agricultural productivity needs to be backed up by productivity of industry, too; and both are attainable by reducing costs.

This demands bringing technology up to the desired standard and raising its level of efficiency. The technical analysis based on visits to the respective mills reveals certain aspects common to all of the latter. These have to do mainlywith energy consumption and the severe losses of sugar from both bagasse and molasses

The proposal is therefore made that the processing cycle be modified and the insulation system be brought up to standard, that the evaporation stages be redesigned and the boilers and piping be refurbished.

Containing losses and rendering mills more efficient requires that the harvest begin in early June and be complete by late October, i.e. before the rainy season sets in with the losses in supply that the rains give rise to.

Competitiveness for the end product is bound up with, among other things, the question of quality. Incentives are needed so that those concerned will produce sugars of better quality. One means to this end would be the introduction of a differentiated assessment of sugars coming under the warrant system on the basis of quality, and the production of liquid sugars for the processing industry.

Coming, next, to marketing, it will be seen that, if sugar buyers were to take a smaller share of the proceeds, this would make for a reasonable price level for the consumer and for a greater share for the other sectors entering into the production process. For this it will benecessary for MERCOZUCAR and cane growers' cooperatives marketing the sugar under the maquila system to increase direct sales to supermarkets and wholesalers.

An indispensable condition here is that the sector's financial capacity and income stability be improved. This can be achieved by bringing order into the supply side, failing which one will be back again in situations where those with the financial strength (e.g. the bulk buyers) corner a large share of the final price of the product. One mechanism making for order in the domestic supply situation is resort to a futures market, which could operate with the warrants system as basis.

Side by side with rationalizing domestic supply it is necessary to coordinate foreign market sales with the producers in other provinces in such a way that the exportable surpluses shall be proportionate to the production.

Demand has declined due to competition from other sweeteners; and a publicity campaign is called for emphasizing the food qualities of sugar. The campaign must be accompanied by improvements in product quality; and the approach further supported by the way retailers go about their task.

An indirect approach offers a further means of increasing consumption, namely that of exporting more products that make use of sugar (solid, liquid, coarse or refined) as raw material.

Of the various commodities that can be produced from or with sugar, those have been judged to be viable that emerge from the technical and market analyses reported in earlier chapters. The recommendation accordingly is made here that the following courses of action be explored:

- rehabilitating the Papel Tucumán plant;
- installing a plant for exportable sugar-using products (sweets, beverages, etc.);
- producing denatured alcohol for fuel blending;
- installing a plant for the manufacture of particle board using bagasse;

- installing a feedstuffs plant;
- installing a plant to produce citric acid and its salts;
- installing an acetone-butanol plant;
- installing a biogas plant.

5.2.3 THE ENVIRONMENT

In order to keep to a minimum any negative effects on the environment from cane processing residues, it is proposed that a system be adopted whereby press-cake and lees can be recycled for use as fertilizers. For this there must also be a campaign to promote this type of utilization and to strengthen public control here in order to enforce the environment protection regulations.

5.2.4 THE INSTITUTIONAL CONTEXT

The dispute that arises every harvest time between growers and industrial processors creates uncertainty, disperses effort, embitters relationships and leads to operational problems.

For this reason the sector as a whole must be given a context of transparency and stability. A suitable way of ensuring this would be to set up a body for conciliation between all parties concerned - a forum where all aspects of the grower/processor relationship may be thrashed out and the sharing in the respective stages - sugar, molasses, bagasse, lees, transport - may be determined once and for all.

A further matter to be decided concerns the formula and system for pricing and the method for analysing the raw material, and stimulate the production of high quality cane by applying bonuses and penalties to an agreed base price.

Once the basic parameters for the sharing process have been decided upon, in order to ensure that what has been agreed will be respected in the respective operations, the relevant agreements will need to be set out in formal contracts to be recorded in the public register as a means of protecting the interests of the parties against non-performance by any of them. At the moment, contracts of this kind are neither entered into or are entered into but not registered in order to avoid payment of stamp duty. As a means of encouraging people to register their contracts, it might be appropriate to waive this duty in their case.

The public sector, too, must play its part as a clearing house for information and thus guarantee market transparency.

While the adoption of the proposed plan will place Argentina's output in a more competitive position - it being reasonable to suppose that the situation of an international market where sales are subsidized at prices lower than the costs of production will continue - there is need for a flexible mechanism such as the present price equalization levy, to protect the country's production against unfair competition.

5.2.5 THE MINIFUNDIO

Cane growing on holdings less than 20 ha in size accounts for 15% of the province's output and for approximately 7.000 growers.

That being so, while the impact on production is of no great magnitude, any change in market conditions seriously affects a significant segment of the grower community - the minifundio growers, that is.

A central objective of the action plan accordingly is to raise the levels of income of these growers. The proposed agricultural diversification programme must not be implemented at the cost of the grower, while the attempt to bring down production costs by the adoption of new varieties and mechanization must be pursued making special allowance for the needs of this particular class of producers.

The relevant measures should be supported by a system of differential treatment for the cane and the sugar produced by these growers in such a way as to secure the best price for them on the market.

There follows a chart summarizing the strategies proposed for the respective factors, the measures suggested for implementing these strategies, the constraints and potentialities obtaining in each case, the persons/institutions whose task it will be to do the implementing (public sector "PS"; private sector - "PRS"), the short- medium- and longer-term time spans, and the financing requirements.

AGORA 2000

OVERVIEW OF PROPOSED PLAN OF ACTION

Proposed action strategy	Proposed measures	Impact of measures		Responsible		Implement time			Financing needs
		Restrictions	Potentialities	Private sector	Public sector	short term	med. term	long term	millions US$
I) AGRICULTURAL PRODUCTION									
1. Enhance productivity per unit area of cane grown	Increase availability of planting material Pre-harvest financing Extension and dissemination	F	Yr	X	X	X	X		---
1.1 Plantation renewal (20% yearly)	Coordination of activities INTRA - Obispro Colombres								
1.2. Introduction of new varieties	Strengthening "Cambio rural" and "Pro-Huerta" Programmes								
1.3 Improvement in cultivation pratices									
2 Reduce harvesting costs	Increase use of machinery Coordinate harvesting schedule	F	Yr		X	X	X		---
3 Improve Province's food balance sheet	Incorporation of items produced to meet regional food needs.								
	marketing of early products in major centres of consumption	F	Yr	X	X		X		---
4 Reduce sucrose losses	Plan of Action bringing together mills and growers' associations to coordinate cane deliveries and to reduce time between harvesting and milling	Mg	Cp		X	X			---
5 Generate fiscal policy conducive to diversification	Introduce fiscal mechanisms as incentives for diversification		Yr	X		X			
6 Organize marketing channels for novel products	Strengthen coordination among growers, supply and coordinate marketing channels	Mg	Yr		X	X			
II) INDUSTRIAL PRODUCTION									
7 Reduce production costs through process innovation									
7.1. Reduce excessive energy consumption in every mill	Insulate equipment. Redesign evaporation station	F	Cp		X	X			8,50
	Installation of bagasse dryers	F	Cp						
	Modification of processing approach and re-equipment	F Mg	Cp		X		X		7,00
7.2 Reduce sugar losses in molasses and bagasse	Start harvesting early June and complete it by end October	Mg	Pl		X	X			---
7.3 Rehabilitate boilers in every mill		Mg	Cp					X	57,00
8 Improve sugar quality									
8.1. Increase refining capacity	Re-equipment	Mg-F	(1-2)		X	X			
8.2 Improve control to secure compliances with technical standards of food quality									
	Introduce quality control	Mg	(2)		X	X			
	Incorporate quality control in warrant arrangements	Mg	(2)		X	X			

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Proposed action strategy	Proposed measures	Impact of measures		Responsible		Implement time			Financing needs
		Restrictions	Potentialities	Private sector	Public sector	short term	med. term	long term	millions US$
9. Marketing									
9.1. Reduce middleman share in marketing chain between mill consumer/wholesaler	Increase direct sale by Mercozucar within the major organized marketing arrangements	Mg	Yr		X	X			---
	Growers to undertake retailing	Mg	Pl						
9.2. Promote increase in national consumption of sugar	Publicity campaign to meet competition from other sweeteners	Mg	Yr-(2)		X	X			
9.3. Introduce quality/origin label	Publicity campaign		(2)	X	X	X			
9.4. Coordinate with other prov. producers to find outlets for sugar surpluses outside Argentina	Territorial allocation of exportable surpluses								
9.5. Create a secondary futures market by resort to warrant arrangements	Establish a sugar exchange within Tucumán's Securities Exchange	Mg	Yr	X	X	X			
10. Diversification									
10.1. Plant to produce exportable items using sugar	Market study Feasibility study	F	Mo-1)		X	X	X		
10.2. Alcohol (denatured) as fuel	Introduce mechanisms to guarantee a costs-mix for alcohol as fuel additive	Cp	Mo-1)		X	X			---
10.3. Plant to produce particle board	Market study Financial feasibility study		Mo		X		X		21,00
10.4. Feedstuffs plant	Market study		Mo		X	X			2,00
10.5. Acetic acid plant	Financial feasibility study Market study		Mo		X	X			4,00
10.6. Papel Tucuman mill	Reactivate	F	Mo	X	X	X			
10.7. Plant for Acetic acid and salts	Market study Financial feasibility study		MO		X		X		10,00
10.8. Acetone-butanol plant	Market study Financial feasibility study		Mo		X				2,00
III) ENVIRONMENT									
11. Introduction of a system for utilizing lees for biogas	Equipment	F-Mg	Ma		X		X		10,50
12. Utilization of presscake and lees for fertilizers	Plan for dissemination of this approach	F-Mg	Ma	X	X	X			---

Proposed action strategy	Proposed measures	Impact of measures		Responsible		Implement time			Financing needs
		Restrictions	Potentialities	Private sector	Public sector	short term	med. term	long term	millions US$
IV) INSTITUTIONS									
13. Set up organ for concertation between growers and millers	Creation of an official and honorary advisory body on which millmillers, growers and the Povincial Government (the later to coordinate) would be represented	Mg		X	X	X			
13.1. Establish definitive percentage share in sugar process between growers and mill	Obligatory registration of contracts between growers and mills			X	X	X			
13.2 Establish grower/mill ratios regarding other aspects (molasses, bagasse, freight, etc.)	Waive stamp duty on these contracts			X		X			
13.3. Establish formula & system for determining the amount of sugar produced from the cane delivered									
13.4. Establish quality control									
14. Strenghten the role of the Provincial Government as promoter of sectoral policies	Propose to the private sector an integrated strategy to develop the sugar sector		Mg	X	X	X			
	Guarantee transparency and the collection & dissemination of information of interest to the sector			X					
	Strengthen the role of the Provincial Sugar Directorate as institutional interlocutor			X					
15. Protect national production from subsidized sugar imports	Maintening of the present system of price equalization duty on similar systems			X					
V) MINIFUNDIO PRODUCTION									
16. Define special measures for small growers		F-Mg	Yr	X	X	X			
16.1. Determine volume of production below which a grower is deemed to be "small"									
16.2 Establish measures for small growers	Establishment of higher percentage shares in grower/mill ratio in favour of small growers								
	Priority for sugar on domestic market via MERCOZUCAR								
	Exclude small growers from the free market export quota								
	Freight to be charged to mill								
17. Raise incomes of minifundio growers	Incorporation of complementary lines of production for small farming units (e.g. tobacco, poultry, fruit & vegetables) covering food self-sufficiency	F	Yr	X	X		X		...
	Pre-harvest financing								
	Extension								

Proposed action strategy	Proposed measures	Impact of measures		Responsible		Implement time			Financing needs
		Restrictions	Potentia-lities	Private sector	Public sector	short term	med. term	long term	millions US$
VI) FINANCING									
18. Institute non-returnable funds for diversifying production	Subsidy from Social Aid Fund	F		X		X			10,00
19. Institute lines of financing for diversification and re-equipping of the rest of primary producers and processors	Promotional lines	F		X		X			

Mo: incremental workforce
Ma: environment
Yr: incremental rural incomes
Mg: management capacity
Cp: reduce costs of production
F: availability of financing
Mk: marketing capacity
Pi: incremental industrial production
Other: 1) availability of advanced technology industrial machinery
2) market expansion

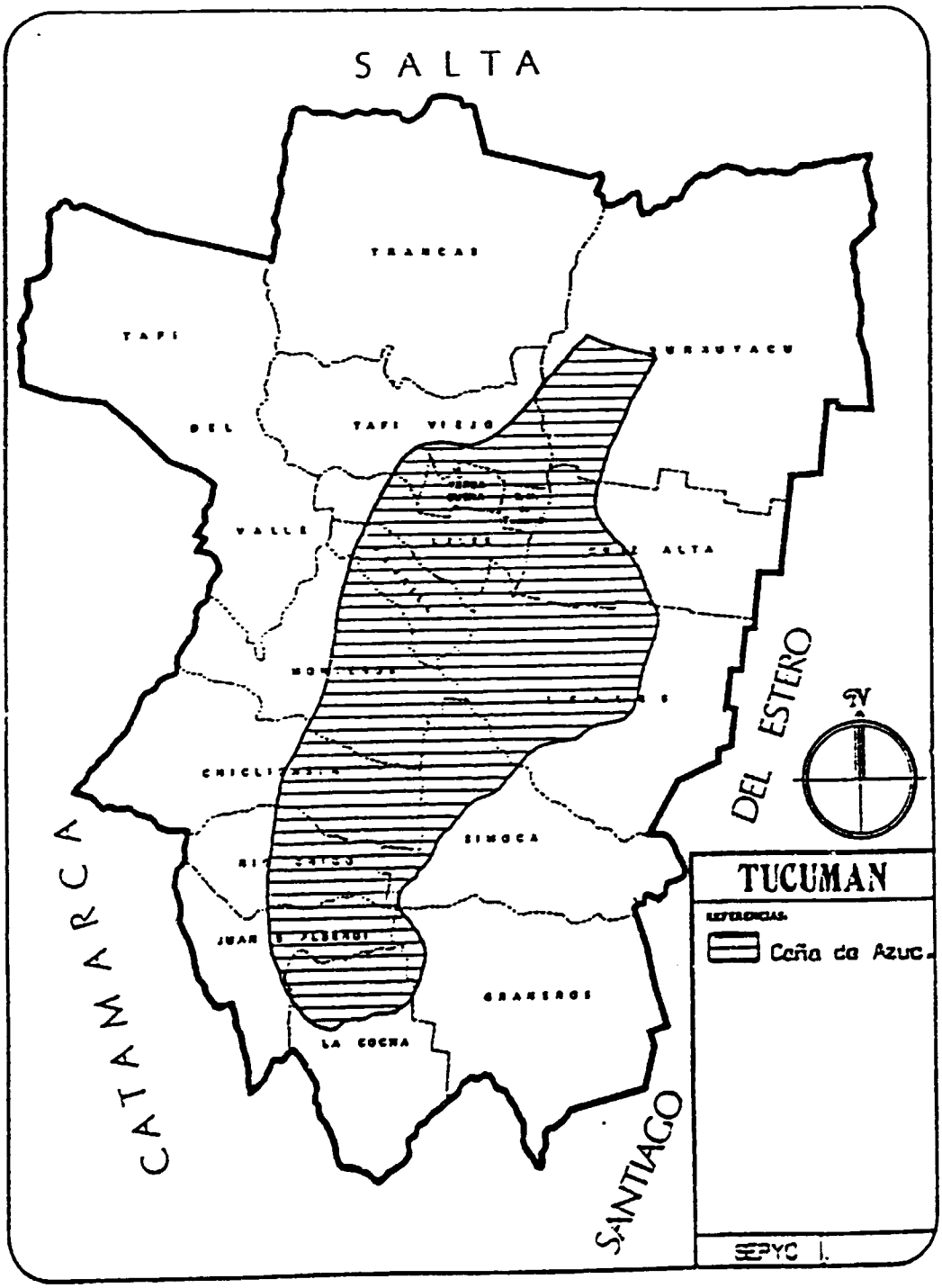
TECHNICAL ANNEXES

ANNEX 1

Location of Tucumán Province in the Northwestern Provinces Region

UBICACION DE LOS INGENIOS AZUCAREROS DE LA REPUBLICA ARGENTINA

CULTIVO DE CAÑA DE AZUCAR



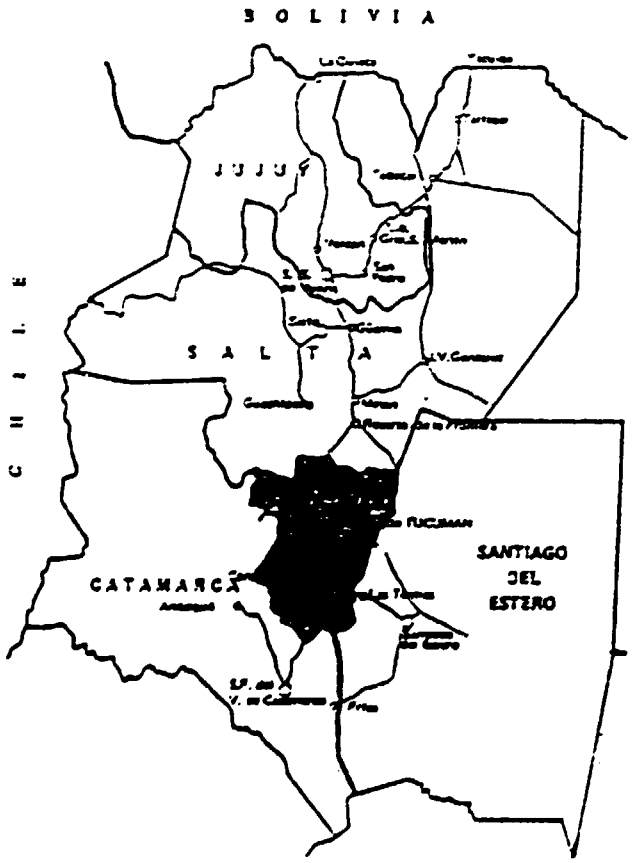
RELACION DE SUPERFICIES. TUCUMAN, NOROESTE ARGENTINO Y PAIS

(en Kms^2 y %).

SUPERFICIES (en Km^2)				RELACIONES %		
TUCUMAN *	N.O.A. *	P A I S **		TUCUMAN / N.O.A.	TUCUMAN / PAIS	N.O.A. / PAIS
		1	2			
22.524	465.590	2.791.810	4.027.024	4,33	0,30	16,57

Fuente: * INDEC - Censo Año 1970
** Información Argentina - Junio 1970 - Ejemplar Nº 30
1. c/área Continental
2. Incluído Sector Antártico

UBICACION DE LA PROVINCIA DE TUCUMAN EN LA REGION NOA



ANNEX 2

Technical sheet analysis of the technical functionality of sugar mills in Tucumán Province

Boiler Station Operating Conditions during the last three years (1990, 1991, 1992).

FACTORY NAME	UNIT	1990	1991	1992	NOTES
- Boiler year built and operation					
- Type of boiler					
- Name of manufacturer					
- Number of Boiler					
- Designed capacity / boiler	Tons/hour				
- Produced steam specification. pressure and temperature	bar - C°				
- Actual operating capacity	Tons/hour				
- Total quantity of steam produced	Tons/hour				
- Operating days / season	day				
- Factory crushing capacity / year	Tons/year				
- Average daily capacity	Tons/day				
- Bagasse in cane	%				
- Total quantity of bagasse produced / season	Tons				
- Average bagasse moisture	%				
- Sugar content	%				
- Calcrific value	Kcal/kg				
- Quantity of bagasse consumed in steam generation	Tons				
- Total quantity of steam produced	Tons				
- Quantity of steam produced per Ton of bagasse	Tons/Ton				
- Excess or shortage of bagasse	Tons				
Other fuel consumption:					
- Wood Quantity - CalValue	T/h-kcal/kg				
- Gas Quantity - CalValue	m^3/h - $kcal/m^3$				
- Fueloil Quantity - CalValue	T/h - Kcal/kg				
- Boiler efficiency	%				
- Quantity of steam consumed in the process	Tons/hour				
- Quantity of steam consumed for moving equipment	Tons/hour				
Flue gas analysis:					
- Co2 in the flue gases	%				
- Co in the flues gases	%				
- Ash continuation	gm/m^3				
- Temperature of flue gases	C°				
- Boiler is equipped with ash catcher	yes or no				
Boiler feed water analysis:					
- pH					
- Temperature	C°				
- Dissolved solid	gm/m^3				
- Hardness					
- Conductivity					
- Quantity used	m^3/hour				
- Using of vapour condensate coming from Evaporation Pan boiling station	yes or no				
- Quantity of condensate used	Tons/hour				
- Condensate used from the total feed water	%				
Steam Reduction Stations:					
- Capacity	Tons/hour				
- Pressure reduction	bar/bar				
- Type of control of steam desuperheating	man.-aut.				
- Steam produced Pressure - Temperature	bar - C°				

Electrical production and consumption during the last three years

FACTORY NAME	UNIT	1990	1991	1992	NOTES
Specification of electric current used:	Voltage Ampers Frequency				
- Date of erection and operation of factory steam turbine					
- Name of manufacturer					
- N° and type of steam turbine					
- Back pressure					
- Condenser					
- Back pressure condenser					
- Power factor					
- Capacity of the steam turbine at full load and 75% load	K.w.h., K.w.A				
- Actual capacity and efficiency	K.w.h., %				
- Quantity of steam consumed per k.w.h	Tons./k.w.h				
- Equipped capacity ratio	Kw /T.c.h.				
- Exces or deficiency of electrical current					
Possibility of power cogeneration:					
- Electrical consumption of the sugar factory and other utilities	kwh				
- Electrical consumption of the town	kwh				
- Available excess bagaze	Tons				
- Corresponding generated electrical power	kwh				

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
- Date of erection and start up					
- Design crushing capacity T.C.P. based on 22 hours/day	Tons/hour				
- Actual working capacity					
- Period of crushing					
- Average daily crushing rate	Tons/day				
- Total cane crushed / season	Tons/year				
- Process equipment factory area	m^2				
- Layout of the sugar factory	drawing				
- Available free area	m^2				
- Source of energy. bagasse. gas or wood					
- Steam consumption as well as electrical consumption per ton Cane	kg/ton c.h.				
- Type of cane cultivated					
- Type of sugar cane harvested	man./aut.				
- Means of cane transportation: trucks. railways. lorries. vehicles and others					
- Quantity of cane transported by each mean	%				
- Distance between sugar cane farmers and sugar factory					
- Time spent between cane harvesting and sugar delivery					
- Means of control of cane supply	Factory Emgineers Farmers Other organization				
Sugar cane analysis					
- Sucrose % cane	%				
- Pol % cane	grado				
- Fibre % cane	%				
- Brix % cane	Bx				
- Ash % cane	%				
Raw juice analysis					
- Bx	Bx				
- Pol	degree				
- Reducing sugar	%				
- Ash	%				
- pH					
Extraction					
- Corrected reduced extraction (reduced mill extraction at 12.5% fibre)	%				
- % inhibition % cane	%				
- % inhibition % fibre	%				
- Preparation index					
Cane preparation system					
- Cane knives sets					
- N° of sets					
- N° of blades in each set					
- Drivenhorse power					
Shredders					
- N° of hammers					
- R.P.m and drive					
- Horse power					

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
System of juice extraction					
Cane crusher and mills					
- Type					
- N° of rollers					
- Dia	m/m				
- Length	m/m				
Mills					
- N° of mills					
- Dia of roller	m/m				
- Length of roller	m/m				
Drive steam turbine or steam engine					
- Normal horse power	kg/cm²				
- Backpressure					
- Life steam pressure	kg/cm²				
- R.P.m.					
Cane diffuser					
- N° of diffuser					
- Width	m				
- Total length	m				
- Crushing capacity / day	T.C.D.				
Mill tandem and bagasse diffuser - Juice screening					
- Type of screening: cash-cash. D.S. Mor Rotex					
- N° of screening stages (single or double stage)					
- Screening area of each stage and hole dia	m², mm				
- Screen area per m³ mixed juice or ton	m²/m³				
Purification station					
- Type					
- Phospho - Defecation					
- Phospho - Sulfitation					
- Double sulfitation					
- Carbonatation					
Heating station					
- N° of heating stages					
- N° of heater and heating surface of each stage	m²				
- Heating surface per Ton/Cane of each stage	m²/t.c.h.				
Clarifiers					
- N° of and type					
- Capacity per unit	m³				
- Total capacity	m³				
- Volume / t.c. h.	m³/t.c.h.				
- Sedimentation surface per ton cane / h.c.					
- retention time	hr				
Clear juice analysis					
- Bx. purity. R.S. turbidity. pH					
Muddy juice analysis					
- Bx. purity. pH					

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
Filteration station and accessories:					
- Type of filter and n°					
- Filtering surface of each unit	m^2				
- Total filtering surface	m^2				
- Filtering surface per Ton / cane	m^2/t.c.h.				
- Cane mud % cane	%				
Evaporation Station					
- N° of evaporation groups and type					
- N° of effects in each group					
- Evaporation surface of each individual effect	m^2				
- Total evaporation surface of each group					
- Total working evaporation surface of the different groups					
- Evaporation surface / t.c.h.	m^2/t.c.h.				
- Means of cleaning					
- Manual by chemical means					
- Adding anti scalent					
- Period of working after cleaning	days				
- Inlet and outlet Bx of each effect (Bx-Curve)					
Analysis of the Concentrated Syrup					
- Bx, purity, R.S.					
- Vapour bleeding from the different effects from the:					
- pre-evaporator	kgs				
- first effect	kgs				
- second effect	kgs				
- Steam consumption for concentration of clear juice	kgs				
- Bx of clear juice and bx of concentrated syrup	Bx				
Pan Boiling Station					
- Pan boiling scheme					
- 3 phase, 4 phase, 5 phase					
- Solid balance of pan boiling scheme	drawing				
Technical specification of the vacuum pans					
- Eg B-boiling scheme					
A - Pans (Seed and Massecuite)					
- Volume and N° of	m^3				
- Heating surface	m^2				
- S/V ratio of heating surface to working volume of Massecuite	m^2/m^3				
- Purity of the strike	degree				
- Time of boiling of the seed and the strike	hr				
- Difference in purity between mother liquor and massecuite (drop in purity) and exhaustion	degree				
- % crystal content	%				

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
B-Pans (Seed and Massecuite)					
- Volume and N° of	m^3				
- Heating surface	m^2				
- S/V ratio of heating surface to working volume of Massecuite	m^2/m^3				
- Purity of the strike	degree				
- Pan boiling time	hr				
- Difference in purity between mother liquor and Massecuite (drop in purity) and exhaustion	degree				
- % crystal content	%				
C-Pans (Seed and Massecuite)					
- Volume and N° of	m^3				
- Heating surface	m^2				
- S/V ratio of heating surface to working volume of Massecuite	m^2/m^3				
- Purity of the strike	degree				
- Time of boiling of the seed and the strike	hr				
- Difference in purity between the mother liquor and the Massecuite (drop in purity and exhaustion)	degree				
- % crystal content	%				
- Purity of final Molasses	degree				
Analysis of final molasses and quantity					
- Total quantity produced / day	ton/day				
- Total quantity produced / season	ton/season				
- Tons produced % cane	%				
- Sucrose	%				
- Brix	Bx				
- Purity					
- Final molasses produced at bx 85% cane	Tons				
- Tons produced at Bx 85% cane	%				
- Boiling house recovery	%				
- Overall recovery	%				

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
Cooling Crystallisation Station					
a. For A - Massecuite					
- Type and n° of					
- Year of erection and operation					
- Volume of each unit	m^3				
- Cooling surface per unit	m^2				
- Ratio S/V	m^2/m^3				
- Total volume	m^3				
- Rate of cooling - drop of purity	C°/hr				
b. For B - Massecuite					
- Type and n° of					
- Year of erection and operation					
- Volume of each unit	m^3				
- Cooling surface per unit	m^2				
- Ratio S/V	m^2/m^3				
- Total volume	m^3				
- Rate of cooling - drop of purity	C°/hr				
c. For C-Massecuite					
- Type and n° of					
- Year of erection and operation					
- Volume of each unit	m^3				
- Cooling surface per unit	m^2				
- Ratio S/V	m^2/m^3				
- Total volume	m^3				
- Rate of cooling - drop of purity	C°/hr				
- Means of Massecuite preparation before purging, heating or dilution					
- Drop of purity due to crystallisation					
- Total cooling period	hr				
- Total heating period	hr				
- Total cooling and heating cycle	hr				
Centrifugation Station					
a. For A - Massecuite					
- Year of erection and start up					
- Type of centrifuge and n° of					
- Capacity of each including charge capacity, number of charges per one hour					
- Type of curving single or double					
b. For B - Massecuite					
- Year of erection and start up					
- Type of centrifuge and n° of					
- Capacity of each: charge capacity, n° of charges per hour					
- Type of curving single or double					
- Total capacity					
c. For C - Massecuite					
- Year of erection and start up					
- Type and n° of	ton/hr				
- Capacity / hour					
- Purity of C-Sugar produced					
- Difference in purity between final molasses and mother liquor					
- Filtering area / m^3 massecuite	cm^2/m^3				

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
b- C After worker					
- Year of erection and start up					
- Type and n° of					
- Capacity /hour	Tons/hr				
- Purity of sugar produced					
- Purity c - liquor produced					
- Filtering area / m^3 Massecuite	cm^2/m^3				
Sugar drying stations					
- Means of feeding the sugar dryer (Grasshopper, belt conveyor, bucket elevator)					
- Year of erection and start up					
- Type of dryer and n° of					
- Capacity of each unit	tons/hr				
- Total drying capacity	tons/hr				
Specifications of air heater					
- Heating surface	m^2				
- Temperature of heated air	C°				
- Quantity and specifications of steam used for heating	tons/hr				
Suction fan					
- Capacity	m^3/hr				
- r.p.m. and H.P.					
Sugar screening					
- Type of					
- Screen area	m^2				
- Capacity					
Bagging and weighing stations					
- Type of weighing scale and n° of					
- Year of built and operation					
- Capacity / hr	Ton./hr				
- Sewing machines n° cf and capacity					

Results of operation of the sugar factories during the last three years.

FACTORY NAME	UNIT	1990	1991	1992	NOTES
Quality of sugar produced					
1. Refined sugar					
- Pol	%				
- Moisture	%				
- Colour (Icumsa)	%				
- Ash	%				
2. White sugar					
- Pol	%				
- Moisture	%				
- Colour (Icumsa)	%				
- Ash	%				
3. Raw sugar					
- Pol	%				
- Moisture	%				
- Colour (Icumsa)	%				
- Ash	%				
- Starch p.p.m.					
- % fines					
- Type of report for quality control and quality assurance					
- Daily					
- Each 10 days					
- Monthly					
Sucrose balances					
- Pol in sugar % pol in cane					
- Pol lost % pol in cane					
- in bagasse					
- in filter cake					
- in final molasses					
- undetermined					
- Total losses (a+b+c+d)					
Uses of cane mud					
- As fertilizers					
- Dilution and canal or river disposal					
Chemical consumption					
- Cao % cane					
- Sulphur % cane					
- Phosphoric acid % cane					
- Floculant p.p.m. on mixed juice					
- Antiscalent p.p.m. on clear juice					
- Soda % syrup for evaporators cleaning					
- Bactericide					

ANNEX 3

Technical remarks on the findings from visits to sugar mills in Tucumán Province and investment proposals for the respective mills

INTRODUCTION

The purpose of the study was to evaluate: (a) the present conditions of the sugar mills;(b) degree of obsolescence there; and (c) requirements in terms of innovation, in order (i) to enhance productivity; (ii) to map out the main thrusts of an investment programme geared to modernizing the basic production phases of the sugar industry; and (iii) hereafter to identify novel technological approaches in order to promote the production of cane derivatives inTucumán province. There follows a description of the technical findings emerging from:

A- Personal visits to the respective mills

B- Conversations with the mill managers

C- Responses to questionnaires

BELLA VISTA

This mill was designed to produce white sugar. It has a cane intake capacity of 4,000 t/day. It has a distillery with a daily output capacity of 600.000 l alcohol (86%). There follows technical remarks on the main sections of the mill.

Tandem mill:

This mill is well fitted out but has no cane washing facility, which sometimes reduces the milling capacity and creates several problems at the processing stage.

Processing equipment design:

The equipment is of appropriate design, except as regards:

- Lack of steam piping, of various items of the processing equipment; of the waste steam piping; and of all piping conveying hot fluids;
- Inappropriate design of the evaporation station;
- Filtration surface area of the vacuum rotary filters is less than is normal (0.24 m^2/t/cane/hour, when it should be at least 0.6 m^2/t/cane/hour);
- There are no cooled water crystallizers for massecuite

Steam and electricity generating plant

The steam generator plant consists of seven low-pressure and five 12 kg/cm^2 and two 18 kg/cm^2 boilers. They are over 50 years old, and have a very low thermal efficiency. The owner has decided to deal with this problem by purchasing anew boiler with a 60 t/hour steam capacity at 20 bar pressure. This is being installed at the time of writing. It appears that a new and more suitable turbine will next be purchased;

As an experiment, a bagasse dryer has been installed. Good results have been obtained so far, since apparently the moisture content of the bagasse has been reduced from 52 to 42%.

Investment required for these recommendations over the next three years

A - Investment in the mill

Item	Outlay (US$)	Remarks
- Insulation processing equipment and steam piping	100.000	
- Installation of cane washing equipment	300.000	
- Installation of bagasse dryer	300.000	
- Installation of vacuum rotary filter	120.000	
- Modernization of evaporation equipment	800.000	
- Installation of a cooled water crystallizer for massecuite C	250.000	
- Installation of lees utilization system	1.500.000	N 3,4 millons
Total	**3.370.000**	

B - Investement in the programme for rehabilitating the steam and electricity generating plant (this follows on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers 60 t/h and 20 bar	4.000.000	
- 2 steam turbines 4 MW each	2.000.000	
Total	**6.000.000**	

Recommendations

- Continue with the rehabilitation of the steam and electricity generating stations;ensure adequate insulation for the processing equipment and the piping, and avoid excessive use of steam at present represented in the high energy losses;
- Install a bagasse dryer;
- Redesign the evaporation station on modern lines, i.e. by increasing the evaporation area in the various in order to raise as high as possible the steam and cover processing requirements, and

those of the vacuum boiling station, and the respective heating .This should also make for a larger amount of condensate to return to the boiler (about 30% excess water);

- Install another rotary filter (37.4 m^2) in order to bring the filtration area up to that accepting one ton of cane per hour;
- Install a fermentation system for the production of biogas and for the production of torula yeast from the distillery.

LA FRONTERITA

This factory is modernised and designed for production of refined sugar and white sugar. Its daily average crushing capacity is 5.800 tons cane. It uses automatic control for the evaporation operation and pan boiling stations as well as bagging stations. The result of operation of this factory is one of the best in Tucumán as it has steam consumption of 580 kg/t.c.h. although its pan boiling station is working on the principal of 6 boiling stages. The total sugar losses is 2.6 and the sugar losses in the final molasses is the lowest in Tucumán sugar factories; it is 1,26 % cane and in bagasse the sugar losses is 0,9% cane which can be reduced. This factory is equipped with a distillery of daily production capacity of 60.000 lit. alcohol of 96°. According to information, this alcohol is selled to a company in Buenos Aires for manufacturing of acetic acid. "La Fronterita" can manufacture this product and sell acetic acid instead of alcohol taking in consideration that the cost of transport of one m^3 alcohol from Tucumán to Buenos Aires is US$ 40 (transport means is tankers) and the cost of selling of one liter alcohol handled over in the factory at Tucumán is US$ 0,30.

The paper mill in Tucumán has installed in the factory La Fronterita vertical depithers with installing capacity of 1.000 tons/day bagasse fibre for the purpose of supplying the paper mill in Tucumán. The transport of this bagasse fibre from the sugar factory to the paper mill is loose and high % losses and high transport costs are expected.

Technical discussion

From the results of operation of the sugar factory La Fronterita, it is appreciated to study the possibility of modernising some other old sugar factories in the province of Tucumán for production of refined sugar and white sugar and using modern techniques with automatic control to get the benefit of high selling price of sugar; but this decision is subject to the result of the feasibility study as these modernisation and rehabilitation need high investment which cannot be advised in the present situation of sugar price crisis.

Recommendations

- It is proposed to install balling presses station for producing bagasse fibre bales for the purpose of easy handling and minimising losses of fibre as well as cost of transportation.

- It is necessary to install bagasse dryer or to sell the whole depithed bagasse fibre to the paper mill and burn bagasse pith and use gas as the sugar factory Providencia does. This shall increase the thermal efficiency of the stema boilet to above 85%. It is necessary to start a rehabilitation programme for changing the low pressure steam boiler to a medium pressure steam boiler as the normal praxis in the sugar industry, this shall result in good economical energy and steam balances.
- It is necessary to build a system for fermentation of vinasse to produce torula fodder yeast.

This yeast cream product can be dryed and sold alone or mixed with cane mud and some cane tops and sold as a paste for the animal breeder in Tucumán province as the previous experiment which has bben done in Factory La Corona. It is appreciated to build a line for production of cattle feed.

Investment required for these recommendations over the next three years

A - Investment in the mill

Item	Outlay (US$)	Remarks
- Bagasse balling presses station	200.000	
- Bagasse drying station (in case of not selling the whole bagasse to the paper mill)	400.000	
- Production of torula yeast and cattle feed	300.000	
Total	**3.600.000**	

B - Investement in the programme for rehabilitating the steam and electricity generating plant (this follows on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers of 60 t/h and 20 bar	4.000.000	
- 2 steam turbines 4 MW each	2.000.000	
Total	**6.000.000**	

LA CORONA

The mill is designed for 40% refined sugar and 60% white sugar for consumption tel quel.

Its daily milling capacity is 5.000 t cane. There is a distillery with a daily capacity for100.000 l alcohol (92.000 l 96° and 8.000 l 94°). Apparently, in 1992, the mill conducted feeding experiments (fermentation of lees and the production of torula yeast with an approximately 35% protein content, and a blend of torula CREMA with presscake and certain other ingredients, such as cane tips). The animals had a weight gain of 1 kg daily. Since the mill has changed ownership, it is not known whether or not the trials have been discontinued.

The construction is now under way of a plant to produce biogas from lees. Biogas ignites in contact with air. Among the results o this experiment needing to be evaluated, special attention will need to be given to the way the gas can be used.

The Trinidad, Santa Rosa and La Corona mills are bearing the cost of the experiments.

There follow a series of notes on the various sections of La Corona mill.

Tandem mill

There is no plant for washing the cane.

Design of processing equipment

- The design of processing equipment is good and proper except for the following items:
- The steam and processing equipment piping are not insulated. The same is true of the escape steam and hot liquids.
- There is a deficit in the condensed water from the evaporation and boiling stations. This is because these use escape steam superheated to 180°C without there being any desuperheating in the boiling and evaporation stations. As a result, the condensed water covers about 80% of requirements for the steam boiler. This situation can be remedied by installing, before next season, a desuperheating station to cool the escape water to a temperature of 125°C.
- The design of the evaporation station is unbalanced.
- Some of the vacuum condensers for boiling massecuite C have an insufficient heating surface area (in no case with a ratio than 4,4 ($S/V=m^2/m^3$), while in other cases, the ratio is about 5:6, which is lower than wha tis considered normal (6). The lower S/V ratio entails a longer boiling time, and this leads to a high retention time and sucrose inversion, not to mention the destruction of the invert sugar and the formation of compounds of a high colouring potential.
- There is a batch centrifuge which performs well in purging massecuite C.
- There are no cooled water crystallization facilities for massecuite C.

Steam and electricity generation plant

- There is a low-pressure boiler operating at 14 kg/cm^2, resulting in an inadequate energy balance.
- There is no bagasse drying plant.

Recommendations

Measures are needed urgently to insulate the processing equipment, the steam piping, the escape steam piping, and any pipes conveying hot fluids, e.g. condensed water, juice, syrup, massecuite, magma and various molasses liquors.

- Redesign the evaporation station observing the criterion - i.e. along modern lines- indicated in the general recommendations.

- Replace the inefficiency heaters with more modern ones of multiple two-way or vertical design.

- Replace the batch centrifuges used to purge massecuite C with a more modern and efficient (continuous) type (five for massecuite C and two for refining sugar C.).

- Instal a cooled water crystallization station for massecuite C.

- Instal a cane washing system.

- Instal bagasse bagging equipment.

- Rehabilitate the vacuum boiling station for massecuites B and C.

- Continue with the evaluation of the experimental plant for the production of biogas from lees.

- Rehabilitate the low-pressure boiler and the electric turbine generator by installing a new medium-pressure steam generator and a steam turbine.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Insulation for processing equipment and steam piping	100.000	
- Installation of cane washing system	300.000	
- Replacement of horizontal heat exchangers	200.000	
- Modernization of evaporation station	600.000	
- Replacement of batch centrifuges	400.000	
- Rehabilitation of vacuum boilers for massecuites A & B	200.00	
- Installation of cooled water crystallization station for massecuite C	250.000	
- Construction of bagging plant for bagasse	400.000	
- Installation of a fermentation system for producing biogas	1.500.000	
Total	**4.050.000**	N 4 millons

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan).

Item	Outlay (US$)	Remarks
- 2 boilers 60 t/h and 20 bar	4.000.000	
- 2 steam turbines 4 MW each	2.000.000	
Total	**6.000.000**	

TRINIDAD

Trinidad produces white sugar for consumption tel quel, with a daily milling capacityof 5.800 t. It has a distillery capable of producing about 40.000 t molasses yearly (about 30.000 t of its own and about 10.000 t bought in from the Santa Rosa mill).

The distillery's alcohol output consists of 97% rectified and 7% natural.

It sells half the rectified alcohol on the local market and, like other mills in Tucumán province, exports half to the European and Japanese markets, at a price of 0.21 cents/litre net after tax, whereas the local selling price ranges between US$ 0.3507 and 0.415/l, according to information obtained locally.

Technical notes on this mill now follow.

Tandem mill

- There is no defibering plant offering a desirable level of preparation of the cane.
- The washing plant has an insufficient capacity for washing the entire cane harvest semi-mechanically.

Design of processing equipment

The processing plant is of appropriate design, except as regards the following:

- Condensed water pumping system supplying the steam boiler is inadequate. This results in the water being brought down to a temperature of 85° C, thus requiring more fuel to bring it up to 100° C, which is the normal temperature of the water condensate feed for the steam boiler.
- There is no insulation on the processing equipment, steam piping, escape steam pipes and all other piping conveying hot fluids.
- The evaporation station needs to be modified along modern lines, as indicated in the general recommendations.
- Some of the two-way heat exchangers need to be replaced.
- The sulfitation tower needs to be modified to render the ejector system more efficient.
- The mill has no cooled water crystallizing equipment for massecuite C.
- The mill does not have enough water available and has accordingly installed a regeneration plant.-

Steam and electricity generation plant

- There is no bagasse dryer.

- They have only one steam boiler of medium pressure (20 bar) and 60 tons steam/hr capacity. Some of them were built in 1938 with manual bagasse feeding and ash removal.

Recommendations

- Installation of a cane shredder for increasing efficiency of cane preparation.
- Increasing the capacity of the existing cane washing system to cover all the semi-mechanical harvested cane.
- The mill's technical staff has carried out some modifications for the condensate water pumping system but it needs a new effective system.
- Complete isolation of all process equipments, steam pipes and others.
- Redesign of the evaporation station on a modern concept to act as one train with sufficient surfaces for vapour bleeding as it is clarified under item general recommendation.
- Replacement of the double pass horizontal heat exchangers by vertical multi-pass type.
- Increasing the capacity and efficiency of the water regeneration system.
- Installing a bagasse dryer.
- Installing a water cooling crystallization station for massecuite C.
- Utilization of vinasse from the distillery.
- Making a rehabilitation programme after the 3 years plan for the steam boilers and steam turbines.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Defibering plant 750 hp	300.000	
- Increase capacity of pumping plant for condensed water for steam boiler	50.000	
- Modification of condensate water pumping system feeding steam boiler	100.000	
- Insulation for processing equiopment and steam piping	100.000	
- Modernization of evaporation station	600.000	
- Replacement of two-way horizontal heat exchanger	50.000	
- Increased capacity for water regeneration system	50.000	
- Installation of bagasse dryer	400.000	
- Installation of a cooled water crystallization station for massecuite C	250.000	
- Lees recovery	1.500.000	
Total	**3.400.000**	

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers 60 t/h and 20 bar	4.000.000	
- 1 steam turbine 4 MW each	1000 000	
Total	**5.000.000**	

SANTA ROSA

This mill produces white sugar for sale direct to the consumer. It has a milling capacity of 4.000t/day. It has a modern distillery producing denatured alcohol (120.000 litres daily) by continuous fermentation. The distillery was set up with Brazilian technology. For the last three years work has stopped and the owner sells the molasses to La Trinidad and La Corona, which are also his property.

The mill is adversely affected by the shortage of raw water supply, especially during the dry (summer) season, largely because three other mills (Ñuñorco, Santa Rosa and La Providencia) withdraw their supply from the same watercourse. They recycle 40-50% of the water after cooling. The Santa Rosa mill is considering using a 300 m^3/hour groundwater source. Conclusions and technical recommendations regarding this mill now follow.

Tandem mill

- There is no plant for cane washing (due to the shortage of water).
- There is no defibering equipment.

Processing equipment design

The design of the processing equipment is adequate, except as regards the following points.

- There is no insulations for the processing equipment, steam piping and other piping conveying exhaust steam and hot fluids.
- It is necessary to bring the heating surface areas in the various effects in the evaporation group up to standard in order to maximize steam efficiency.
- The vacuum boiling station needs to be modified, since the boiling elements for A massecuite are on one floor and those for C massecuite are on another, causing difficulties for control.
- There is no cooled crystallizing equipment for C massecuite.

Steam and electricity generating station

The mill has four steam boilers. One of them has been in operation since 1924 and has a poor output - about nine tons steam per hour at a pressure of 12 bar. Of the other three, two date from 1954 and together have an output of 50t/hour (30t/h and 20t/h, respectively) at a pressure of 12 bar.

The fourth steam boiler was installed in 1979. This has an output of 70 t/h at a pressure of 21 bar. The mill also has a steam turbine electricity generator of 3.5 MW rating, which was installed in 1985.

Recommendations:

It is recommended that the mill:

- Instal defibering equipment;
- Insulate the processing equipment, steam piping and other piping conveying hot fluids;
- Correct the heating surface areas of the various evaporation units along up-to-date lines in order to maximize steam take-off;
- Modify the layout of the boiling station in order to facilitate control and inspection;
- Instal a bagasse dryer;
- Instal a cooled crystallizer unit for the water used in connection with C massecuite;
- Make use of the vinasse, if it is decided to set up a distillery.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Installation defibering equipment	300.000	
- Insulation of processing equipment and steam and other piping	100.000	
- Modernizing evaporation unit	400.000	
- Instalallation of a bagasse dryer	300.000	
- Installation of cooled crystallizer for C-massecuite water	250.000	
Total	**1.350.000**	N 1,4 millons

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers 60 t/h and 20 bar	4.000.000	
- 1 steam turbine of 4 MW	1000.000	
Total	**5.00.000**	N 5

CONCEPCION

This is the biggest mill in Argentina and has a maximum daily capacity of 23.000t cane. It has three tandem mills. It produces 60-65% refined sugar and has 30-35% white sugar, in addition to refined and coarse sugar for export. There is a distillery capable of producing 300.000 litres of alcohol daily, the owner having bought fresh plant from Brazil to place alongside the one he has already. Technical comments on the various parts of the mill now follow.

Tandem mill

The mill and auxiliary equipment are of appropriate design

Processing equipment design

Design and installation are correct, as are those of the steam piping. The following characteristics may be noted:

- The mill has six pre-evaporators and 17 evaporators operating as separate effects in communication one with the other and forming a group. However, if they were arranged to form a different sort of group, in accordance with up-to-date principles (where the evaporation surface area of each effect is designed in such a way that it can satisfy the amount of steam required for the next following effect in addition to the amount required for the vacuum boiling station and the various heating stages) the consumption of steam could be reduced.
- The rotary filter has a smaller surface area than is usual. It should measure 0.6 m^2 per ton of cane per hour. It is now 0.51 m^2. This could be made good by installing a new filter with an area of 121 m^2.
- The coarse sugar is brought to the dryers by means of conveyors which are located below ground level. The technical staff indicated their intention to modify the layout.

Steam and electricity generators

The mill has low pressure boilers which reduce the thermal efficiency and give rise to a heavy consumption. These are the only boilers in Tucumán that have ash collectors which obviate pollution of the air from unburnt bagasse and pith.

There is no bagasse dryer.

Recommendations

It is recommended that:

- A new rotary vacuum filter be installed;
- Bagasse dryers be installed (where the bagasse is not to be used as raw material in paper making); and
- A rehabilitation programme be undertaken to replace the low pressure steam boilers by others of medium pressure rating, and to replace the steam turbines.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Installation of rotary vacuum filter	350.000	
Total	**350.000**	0,35 millons

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 6 steam boilers 60 t/h and 20 bar	12.000.000	
- 1 steam turbine of 4 MW	3.000.000	
Total	**15.000.000**	

SANTA BARBARA

This mill is designed to produce white sugar for consumption without further processing. It has a daily output capacity of 4.800 tons. There is a distillery capable of producing 60.000 litre of alcohol per day, though the effective capacity is only 45.000 litres. Findings and technical recommendations follow.

Tandem mill

This has cane defibering equipment.

Processing equipment design

The design of this equipment is satisfactory and appropriate. There is an automatic control device for the boiling station and mechanical circulators in some of the vacuum boilers. This is the only mill in Tucumán that has such boilers fitted with multiple individual water jets. Losses of bagasse and molasses and steam consumption are heavy, despite the fact that a bagasse dryer was installed last season.

It is reported that the mill burns the entire amount of bagasse produced - in addition to 12 m^3 per ton of cane per hour.

The mill regenerates 90% of the water condensate as boiler feed, which it uses along with 10% cold raw water.

Steam and electricity generators

There are low pressure steam boilers, with a 15 kg/cm^2 rating, which could be raised to 20 kg/cm^2, with the exception of one boiler where the heating surface is too small.

Recommendations

It is recommended that:

- The steam piping be insulated and the lack of insulation be made good on the processing equipment;
- The evaporation group be redesigned in order to increase the steam take off and the water condensate for the boiler feed;
- The bagasse dryer that functioned last year be evaluated; and
- Vinasse utilization equipment be installed.

Investment required in order tc implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Insulation of steam piping, processing equipment surfaces and other piping	20.000	
- Modernizing the evaporation group	400.000	
- Utilization of vinasse	1.500.000	
Total	**1.920.000**	N 2 millons

ÑUÑORCO

This mill produces white sugar for consumption direct. It has a milling capacity of 5.500t/day. There are two mills in tandem, one with a 4.200t capacity the other with 15.000t. The mill was established with contributions from the provincial government and from the cane growers' cooperatives, while the mills own workers were later brought into the shareholding, the present composition being: provincial government 45%; workers 2%; and the cooperatives 52%.

There is no distillery. De-pithed bagasse is sold to a paper mill in amounts ranging from 5.000 to 20.000 tons.

Tandem mill:

- There is need here for defibering equipment to improve cane preparation and to reduce sugar losses in the bagasse.

- There is no cane washing plant.

Processing equipment design

The processing equipment unit is of good design and appropriate for its purpose except as regards the following:

- There is not insulation on this equipment or the steam piping or that for the exhaust steam or the rest of the piping conveying hot fluids.
- Some of the horizontal two-way heat exchangers are not functioning properly.
- The mill layout is unsatisfactory. Extra staff are needed to control the processing cycle, and this raises production costs.
- Batch centrifuges are used for purging C massecuite.
- There is no cooled crystallizing equipment for C massecuite water.

Steam and electricity generator plant

Last season the mill installed, by way of experiment, a bagasse dryer, which gave good results by reducing the moisture content from 52% to 38%.

Recommendations

It is recommended that:

- Defibering equipment be installed;
- Cane drying equipment be installed;
- The defective heat exchanges be replaced with others of a modern, higher-yielding type;
- The processing equipment, steam and other piping be insulated;
- The batch centrifuges be replaced with others of the continuous type;
- The bagasse dryer installation be completed;
- Cooled crystallization equipment be installed for C massecuite water;
- The mill layout be modified.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Installation of defibering equipment	300.000	
- Installation of cane washing system	300.000	
- Insulation for processing equipment and steam piping	100.000	
- Modernizing evaporation station	600.000	
- Replacing horizontal heat exchangers	150.000	
- Replacing batch centrifuges with continuous type	300.000	
- Installation of bagasse dryer	200.000	
- Installation of cooled crystallizer for C-massecuite water	250.000	
- The mill layout may be modified	150.000	
Total	**2.350.000**	

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 1 steam boiler 60 t/h and 20 bar	2.000.000	
Total	**2.000.000**	

PROVIDENCIA

Providencia produces white sugar for consumption direct, and has a daily milling capacity of 6.500 tons. There is no distillery. Owing to financial problems and the recent change of ownership, maintenance work was put in hand for this year's (1993) season only on 12 April. The daily bagasse output is sold, de-pithed, to the Papel Tucumán. Providencia has installed five vertical de-pithing machines. It burns the pith, which accounts for about 30% of the bagasse, and sells the fibre at US$ 4.75 per ton. Gas consumption ranges between 3.2 and 3.5% of the value of the cane.

The equipment is suitably insulated, except as regards a certain amount of damage to the insulation on the heat exchangers and vacuum pans, and some of the exhaust steam piping and that for other fluids.

Tandem mill

- There is no defibering equipment.
- The mill washes about 70% of the cane that has been harvested semimechanically.

Processing equipment design

This is adequate, except as regards:

- The rotary vacuum filter surface area is too small and may cause a certain piling up of the material when the mill is working at full pressure, i.e. at its maximum daily capacity of 6.500 tons (270t/hour). The surface area in question measures about 0.53 m^2, whereas it should normally be 0.6 m^2 per ton of cane per hour.
- The evaporation surface are measures 32 m^2 per ton of cane per hour and could be extended to 36 m^2, but the heating area of each of the effects needs to be revised as suggested in the general recommendations.
- The mill uses raw cold water as boiler feed.
- Certain items of equipment for mixing C magma and some of the pumps are located 3 m below ground level. This fact, in addition to causing heavy sugar losses, makes it difficult to control and clean the apparatus in question.

Steam and electricity generator plant

- The mill has four low pressure (14-16 kg/cm^2) steam boilers, offering poor thermal efficiency.

- There is no bagasse dryer, since a gas-fired boiler has been installed which no longer uses bagasse as fuel.

Recommendations

It is recommended that:

- The damaged parts of the equipment and piping insulation be repaired;
- Cane defibering equipment be installed;
- An additional rotary vacuum filter be installed having a filtering area of 37 m^2, that the material issuing from the filters be purged using the scum flotation process and then conveying it directly to the evaporation station. This technique offers the following advantages, in that it:

    - raises the clarification capacity at least 15%;
    - eliminates at least 85% of the suspended solids, colloids and muds;
    - saves chemicals and reduces the consumption of steam, since the filtered fluid is conveyed directly to the evaporation station and does not become mixed again with the juice from the milling section (the saving is in the order of 15%);
    - reduces syrup viscosity and enhances the drainage of the final molasses;
    - the floating debris is mixed with the presscake. It contains certain coagulating elements that do not become consumed in the Talo process, whereby the muds in the rotary vacuum filters, since it is possible to add further water in order to keep down the amount of sugar los in the final presscake;
    - produces better quality sugar thanks to the reduced ash content;

- The evaporation station be redesigned in order to increase the amount of steam as much as possible and obtain sufficient water condensate for the boiler feed;
- A rehabilitation programme be mounted to provide for the replacement of the low pressure boilers and steam turbines with apparatus of modern design offering 20 bar pressure;
- The equipment at present 3 m below ground level be re-sited.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Repairs to damaged parts of equipment and steam piping insulation	10.000	
- Installing defibering equipment	300.000	
- Installing rotary vacuum filter	120.000	
- Installing Talo-filter plant	60.000	
- Modernizing the evaporation station	600.000	
- Re-siting the equipment that is presently 3 m below ground level	50.000	
- Installing a bagasse dryer	300.000	
Total	**1.440.000**	N 1,44 millons

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers 60 t/h and 20 bar	4.000.000	
- 1 steam turbine of 4 MW	1.000.000	
Total	**5.000.000**	

MARAPA

Marapa was designed to produce white sugar for consumption direct, and has an average daily cane milling capacity of 3.500 tons. It has a distillery with a maximum daily capacity of 20.000 litres alcohol, though the actual output is more in the region of 60.000-70.000 litres.

Tandem mill

- Equipment has been installed capable of washing 80% of the semimechanical harvested cane. This capacity will need to be raised to 100%.
- The processing equipment, steam piping and other apparatus are not insulated.
- The juice heating station is of lower capacity at 4.51 m^2/t/h cane than the normal design figure of 7 m^2/t/h.
- The effective surface area of the rotary vacuum filter measures 0.51 m^2 per ton of cane per hour, whereas the normal figure is 0.6 m^2.
- There is no cooled crystallization station for the C massecuite water.
- The fact that the evaporation station offers a total surface area per ton of cane per hour is reasonable but the "ratio" between the heating surface and the various effects is insufficient to bleed off the maximum amount of steam, and therefore needs to be corrected.
- The mill has used superheated (180° C) steam for vacuum boiling and evaporation purposes. The recommendation has been made that an automatic desuperheating station be installed for generating steam at temperatures of 125°-130°C.
  The design relationship between heating surface area and vacuum boiler volume is in accordance with the norm but some of the pans that have a floating cylinder and heating coils (information supplied by the technical manager).

Steam and electricity generator plant

There are three 20-bar boilers, two of them having a capacity of 50 /h, the third 30 /h; and there is also a low pressure (12 bar) boiler with a 10 /h output. Again according to information supplied by the technical manager, the mill, in addition to the electricity that it generates, obtains supplies, against payment, during the harvest season from the local grid. It does so because the output of the turbines is rather poor. All the bagasse produced is used as fuel, in addition to 0.8% of the combustible oil obtained from the cane.

Recommendations

It is recommended that:

- The cane washing equipment capacity be raised as planned;
- Defibering equipment be installed to improve yields from the cane preparation process;

- The milling process and the entire operation of the factory be brought to maximum operating efficiency and thus reduce aggregate sugar losses and energy consumption;
- The insulation of the processing equipment, steam piping, and the piping for exhaust steam and hot fluid transport be repaired;
- The effective surface area of the vacuum rotary filters be increased by the installation of a new 37 m^2 filter and of a system for treating the clean juice filtered through the flotation process (Talo-filter method) and thus improve the performance of the clarifying station;
- The evaporation station be modified along modern lines as described in the general recommendations;
- The defective vacuum pans be replaced with others of more modern design;
- The vinasse be utilized;
- A bagasse dryer be installed;
- The steam turbine modernized;
- A cooled crystallization station be installed for the C-massecuite water.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Increasing cane washing capacity	20.000	
- Installing defibering equipment	300.000	
- Insulation for processing equipment and piping	50.000	
- Installing a rotary vacuum filter	120.000	
- Modifying evaporation station	600.000	
- Modifying specified vacuum pans	120.000	
- Vinasse utilization	1.500.000	
- Installing a bagasse dryer	200.000	
- Installing cooled crystallization station for C-massecuite water	250.000	
Total	**3.160.000**	N 3,16 millons

B - Outlay for the programme for rehabilitating the steam and electricity generation station (to follow on the three-year investment plan)

Item	Outlay (US$)	Remarks
- 2 steam boilers 60 t/h and 20 bar	4.000.000	
- 2 steam turbines of 4 MW each	2.000.000	
Total	**6.000.000**	

CRUZ ALTA

This mill produces white sugar and has an average daily capacity for milling 3.000 tons of cane. It is the only mill in Tucumán that has a bagasse diffuser. There is no distillery.

Tandem mill

- This has no defibering equipment that might improve the preparation of the cane.
- The cane washing equipment has not been completed, due to lack of funds.

Processing equipment design

The design is satisfactory, except that:

- The insulation on parts of the processing equipment and steam piping needs to be repaired.
- The effective surface area of the vacuum rotary filter at 0.3 m^2 per ton of cane per hour is smaller than the design amount, which is normally 0.6 m^2.
- The evaporation station needs to be redesigned on modern criteria, as described in the general recommendations.
- The layout of the vacuum boiling station and the centrifuge station needs modifying since the latter is presently located in a separate building, behind that of the A and B centrifuges.

Steam and electricity generation plant

The mill has a modern steam boiler (20 bar), with 30t/h output, and capable of burning 45t/h bagasse, as well as gas. There are two 3MW steam turbines in good condition.

Recommendations

It is recommended that:

- The installation of the cane washing equipment be completed;
- The insulation be repaired where it is damaged;
- A new rotary vacuum filter be installed;
- Grinding equipment be installed;
- The evaporation station be redesigned;
- A bagasse dryer be installed.

Investment required in order to implement the foregoing recommendations over the next three years

A - Investement in the mill

Item	Outlay (US$)	Remarks
- Repairing of some insulations	15.000	
- Installing a new rotary vacuum filter	120.000	
- Modernizing evaporation station	400.000	
- Installing defibering equipment	300.000	
- Installing bagasse dryer	200.000	
Total	**1.035.000**	N 1 millon

TECHNICAL OBSERVATIONS ON LEALES S.A. SUGAR MILL

The milling capacity is of 3.200 tons per day, or 500.000 tons per season. There is a distillery capable of producing 33.000 litres of alcohol (96 ° proof), and the anhydride as well.

Kraft paper is manufactured from the mill's own paper works and waste from the Papel de Tucumán plant. The output comes to 40 tons daily, and can be used for making cardboard and bags. No bagasse is used because the owners find it cheaper to use waste paper for Kraft manufacture.

The mill is going through a serious financial crisis due to the low price of sugar on the local market. Last season this stood at 20 cents per kilogram of white sugar.

Again last season, several firms rented the plant for sugar cane processing. Once the harvest was over, the mill closed and nobody took charge of maintenance of the equipment since there was no knowing whether operations would start again in the 1993 season.

ANNEX 4

Technical comments on the findings of the visits to factories in Tucumán province making machinery and equipment

Provision was made for visiting the factories producing machinery and equipment with a view to examining the possibility, and technical capacity for manufacturing some of the equipment needed in order to rehabilitate mills. The following firms were visited:

1. INDUSTRIAS METALURGICAS DI BACCO Y CIA

This factory has the following production lines and services:

- Special belt conveyors;
- Forged chains for all types of conveyors, feed trays, etc.;
- Defibering and crushing plant;
- Sand sorters and washers;
- Portable sand and gravel handling plant;
- Plans, drawings, manufacture and putting in operation of industrial plant, with own technology or under licence, such as:
  - distilleries;
  - factories making prefabricated concrete items;
  - dehydration plant for various products.

Besides being the largest supplier of the various types of chain used by the sugar industry, the firm has contracts with other firms in Latin America where its modern plant and excellent technical capabilities are much in demand.

2. METALURGICA SALEM:
Sociedad Argentina Limitada Establecimientos Metalúrgicos S.A.

This company makes steam turbines of up to 3 MW rating and also manufactures under licence from AEG-KANIS the following equipment:

- Batch and continuous centrifuges (under licence from Bukau-Wolf, the German firm that supplies mills in Argentina and other Latin-American countries);
- Mill rollers, windings, chevrons and other sugar milling accessories;
- Pumps of various types for massecuite, syrup, molasses and other fluids; and vacuum pumps;

- Evaporators, vaccuum boiling pans and other equipment for the sugar and other (petroleum, mining, food processing, etc.) industries.

It has modern installations and a high technical capacity for turnkey projects.

3. RUSCO HNOS S.A.

Rusco manufacturers reduction gearing for sugar cane mills. It has its own design for centrifugal pumps and manufactures batch and continuous centrifuges under licence from Bukau-Wolf. It is in a position to manufacture:

- Various types of special gearing;
- Various types of special pumps;
- Complete sugar mills

CONCLUSIONS

From visits to the three main equipment manufacturers it is clear that these are in a position to make any equipment needed for a sugar mill. Besides these, there is also another firm in Argentina, Salcor Caren, that makes complete steam boiler equipment for other industrial sectors in Latin America.

ANNEX 5

Calculation of energy loss assuming a cold water feed is used for the steam generator

One kilogram of water at 20° C requires 80 kilocalories to bring it up to 100° C, which is the temperature of the condensed water fed into the generator. One ton or one cubic metre of water at 20° C therefore needs 1.000 x 80 Kcal in order to be brought up to 100° C. The necessary heat must be obtained by burning bagasse.

Bagasse from a sugar mill has a 52% moisture content (the normal level for most mills inTucumán province). Bagasse has a thermal value of 1.750 Kcal per Kg. From responses to questionnaires and conversations, the thermal yield of the mill boilers/generators ranges between 62 and 60% (assuming the moisture level here mentioned).

The extra heat called for has to be obtained from 80.000 x 1.750 x 100/66 = 69.26, i.e. approximately 60kg bagasse, meaning that for every cubic metre of cold water in its natural state there is need for a further 69kg bagasse in order to pass from 20° C ambient temperature to 100° C, which is the normal temperature for generator feed water.

Calculation assuming the steam generator is fed with condensed water at 85° C instead of 100° C

Condensed water leaves the evaporation or vacuum boiling stations at 85° C and not 100° C due to heat loss because the insulation is defective or lacking altogether. In this case, for a cubic metre of water the following additional amount of bagasse needs to be burnt:

$$\frac{1 \times 1.000 \times 15}{1.750} \times \frac{100}{66} = 12.98 \text{ N } 13 \text{ kg}$$

Calculation for losses in the case of a mill processing 4.000t cane per hour and consuming 110t steam per hour (or 63% cane) to manufacture refined, white sugar

With a polymerzation of 12.5% and a 14% fibre content, and bagasse 30%, a fibre imbibition level of 200%, and assuming 20% cold water in addition to the condensed water at 85° C, one has:

$$\frac{110 \times 20 \times 1.000 \times 80 \times 100}{100 \times 1.750 \times 66} = 1.523{,}81 \text{ kg/h bagasse}$$

Additional bagasse necessary to bring condensed water temperature from 85° C to 100° C.

$$\frac{(110 - 20) \times 1.000 \times 15 \times 100}{1.750 \times 66} = 1.168{,}83 \text{ kg/h bagasse}$$

Total additional bagasse consumed per hour:

$$1.523,81 + 1.168,83 = 2.692,64 \text{ kg/hr bagasse}$$

$$\text{N } 2,7 \text{ tons/hr bagasse}$$

If the same mill processes 500.000 t cane per season lasting 125 days, the additional bagasse consumed per season will come to:

$$\frac{2.692,64 \times 24 \times 125}{1.000} = 8.077,92 \text{ tons/season}$$

$$\text{N } 8.078 \text{ tons/season}$$

The percent loss this additional amount of bagasse consumed divided by the total bagasse produced, will be:

$$\frac{8.077,92 \times 100}{500.000 \times 0,3} = 5.385\%$$

$$\text{N } 5.4\%$$

Calculation of steam and electricity generated assuming the foregoing amount of bagasseis saved

The 725 Kcal steam that it is possible to generate assuming the above saving on bagasse and a steam generator efficiency of 66%:

$$0,66 = \frac{Q \times 725}{8.077,92 \times 1.750}$$

$$Q = \frac{0,66 \times 8.077 \times 1.750}{725}$$

Q = 12.868,802 tons steam
(rounding: 12.689 t steam per season)

The electricity (kw) that it is possible to generate with the above quantity of steam, assuming a 14 kg steam consumption to produce one kilowatt (the situation in most mills in the Tucuman province), one has:

$$\text{kw produced} = \frac{12.868,802}{14} = 919.200,14 \text{ kw}$$

N 919 MW.

With a high performance steam turbine electrical generator, the output will be:

$$\frac{12.868,802}{12} = 1.072.400,1 \text{ kw} \quad \text{N } 1.072 \text{ MW}$$

ANNEX 6

Energy saving through bagasse drying

Two of Tucuman's mills have installed experimentally a bagasse drying plant, one, Bella Vista, the other Ñuñorco, which is adjacent to the Santa Bárbara mill. The latter, one is given to understand, possesses an industrial-type dryer capable of drying 70% of the bagasse produced. No precise technical evaluation is available because this, one was told, was impossible due to the mechanical and technical problems arising.

Calculation of additional steam generated when bagasse is dried and its moisture content reduced from 52% to 48%

The net thermal value of bagasse with 52% moisture is approximately 1.750 kcal/kg, whereas that of bagasse with 40% moisture is about 2.269 - 1.750 = 519kcal/kg. Therefore, if the bagasse is dried, the thermal efficiency is increased by 80%.

This increase in enthalpy measured in kilocalories is sufficient to generate approximately 0.573kg steam, thus:

$$\frac{519}{725} \times 0{,}8 = 0{,}573 \text{ kg steam}$$

total enthalpy of the steam so generated.

Therefore, in the case of a mill with a cane milling capacity of 4.000t/day, where the cane bagasse content is 30 percent, the incremental steam produced following drying will be

$$\frac{4.000 \times 1.000 \times 0{,}3 \times 0{,}573}{1.000} = 687{,}6 \text{ t/day steam}$$

this is,

28,65 t/hour steam N 29 tons/hour

If, after the bagasse has been dried, there is an approximately 35% of this increment remaining in kcal that can be used for the drying equipment then the net increment in steam production obtainable by drying the bagasse will be 18.6t/h (28.65 x 0.65 = 18.63t/h).

Calculation of bagasse that can be saved per season by drying it and using it in a diversified industry

Taking the volume of cane milled each season at 500.000 tons, with a 30% bagasse content in the cane, the total bagasse that can be saved per season by drying will be:

$$\frac{500.000 \times 1.000 \times 0\,3 \times 0{,}573 \times 725 \times 0{,}65 \times 1.000}{1.000 \times 2.269 \times 0{,}8} =$$

22.313.759 kg/season bagasse, or
22.313,759 tons/season bagasse,
N 22.314 tons/season bagasse.

This amount represents about 15% of the bagasse produced, thus:

$$\frac{100 \times 22.313{,}759}{0{,}3 \times 500.000} = 14{,}876\% \quad \text{N } 15\%$$

Calculation of gas that can be saved by drying the bagasse - costs

Normally a mill with the milling capacity referred to above consumes about 4 million m³ gas - in addition to burning the entire bagasse that it produces (as is the case with most mills in Tucumán).

* average cost of the gas = US$ 0.07636/m^3

* additional cost of energy per year, in addition to the bagasse, where the latter is burnt, and not dried, and has an average moisture content of 52%:

$$4.000.000 \times 0{,}07636 = \text{US\$ } 305.440 \text{ per year}$$

Calculation of gas that can be saved when the bagasse is dried

The net thermal value of gas is 9.300 kcal/m^3. That of bagasse at 40% moisture is 2.269kcal/kg. The amount of gas saved, therefore, will be:

$$\frac{22.313.759 \times 2.269}{9.300} - = 5.444.077{,}2 \text{ m}^3 \text{ gas}$$

N 5.4 millons m³ gas

This is higher, by 1.444 077,2 m^3 (say 1.4 million m^3), than the amount of gas used plus the bagasse produced in the milling process.
For this reason, where bagasse drying equipment is installed in a mill having an average milling capacity of 50 000t/year or 4.000t/day, the cost will be approximately US$ 400.000. The amortization period will be:

$$\frac{400.000}{5.444.077{,}2 \times 0{,}07636} = 0.92 \text{ years}$$

In other words, the outlay can be recouped in a single season.

ANNEX 7

Value of bagasse when used as raw material for paper

Value of bagasse when used as raw material for paper manufacture as compared with its value when sold on the basis of its thermal properties:

$$1\ m^3 = 4{,}71\ kg\ bagasse$$

$1m^3$ gas costs about US$ 0.08

$$1\ kg\ bagasse = \frac{0{,}08}{4{,}71} = 0{,}01699 \quad N\ US\$\ 0{,}017.$$

then 5.6t bagasse yields 1kg bagasse yields 0.1786kg paper.

The cost of one ton of paper at July 1992 prices (international) of US$ 710-760 as imported from Brazil plus taxes of US$ 775-832 per ton selling in Argentina at US$ 950/t.

Taking the average price of US$ 750 per ton of paper and pulp as representing 33% of this figure, one has the value of 1kg bagasse as follows:

$$\frac{750 \times 0{,}33}{1.000} \times 0{,}1786 = US\$\ 0{,}044$$

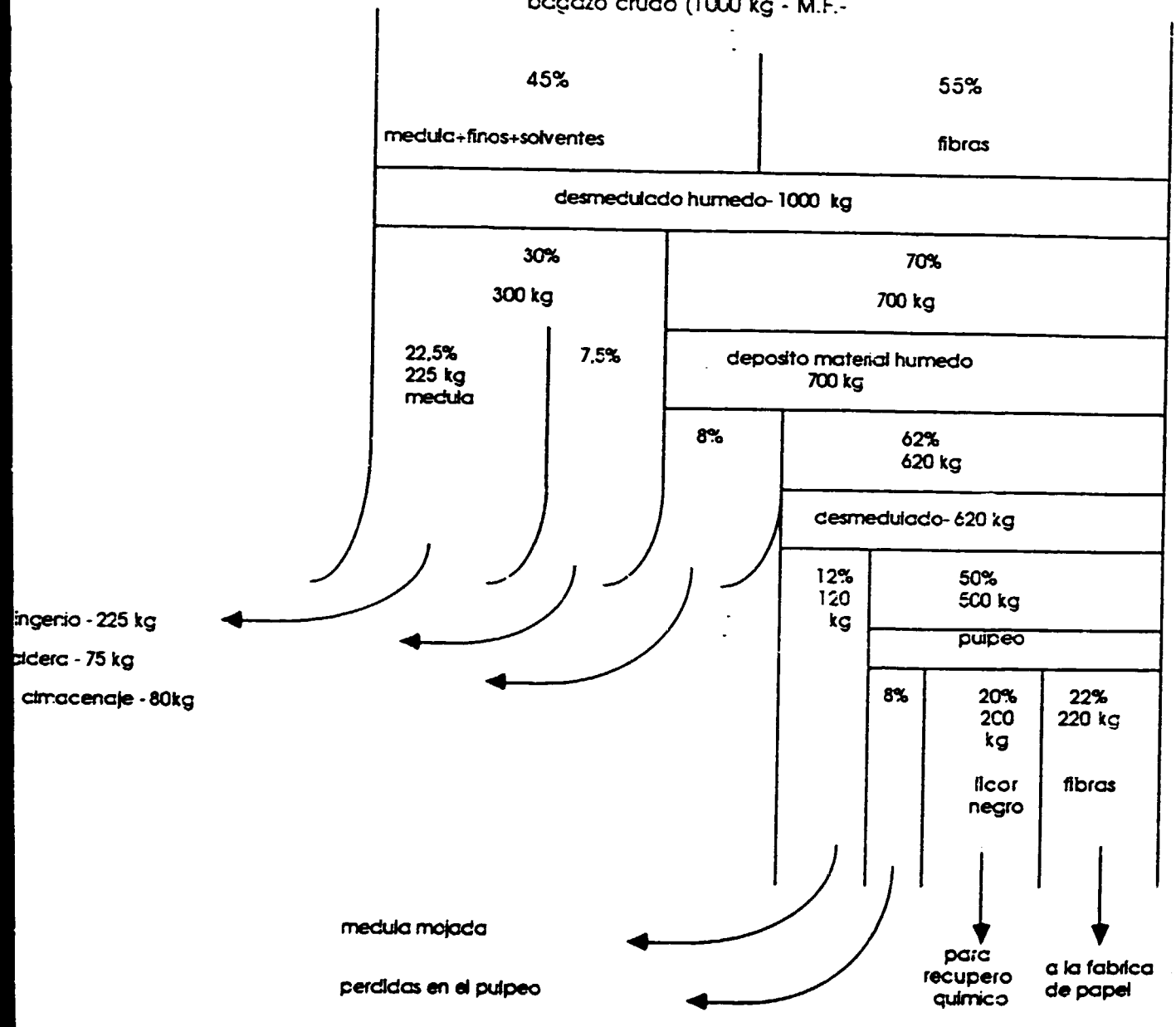
Therefore, the value of bagasse as raw material for paper manufacture is 2.6 times higher than its value as fuel, thus:

$$(0{,}044\ \ 0{,}01699 = 2{,}60)$$

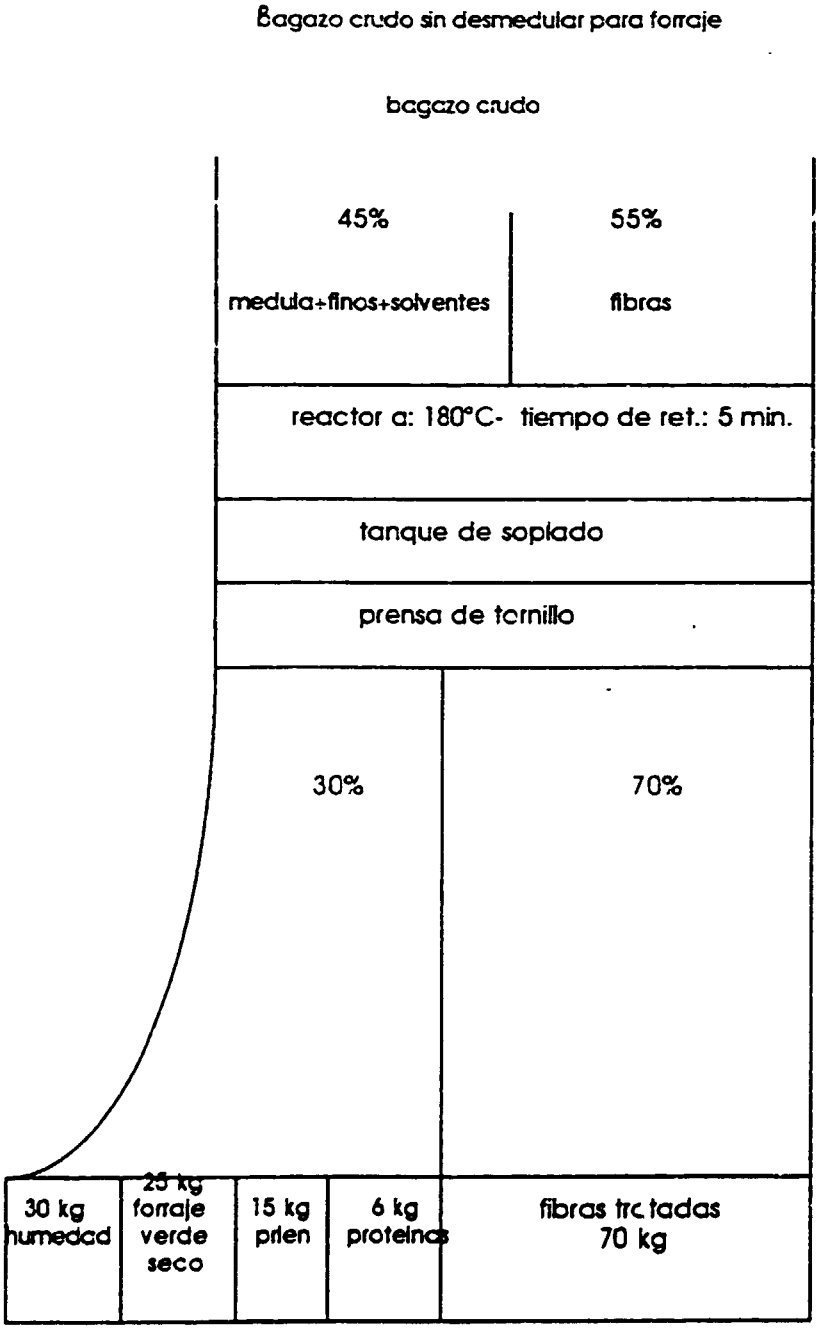
ANNEX 8

Materials balance sheet

Bagazo desmedulado para pulpa química



Bagazo crudo sin desmedular para forraje



AGORA 2000

STATISTICAL ANNEXES

ANNEX TO CHAPTER 1

CUADRO NRO: 1

EL AZUCAR EN ARGENTINA

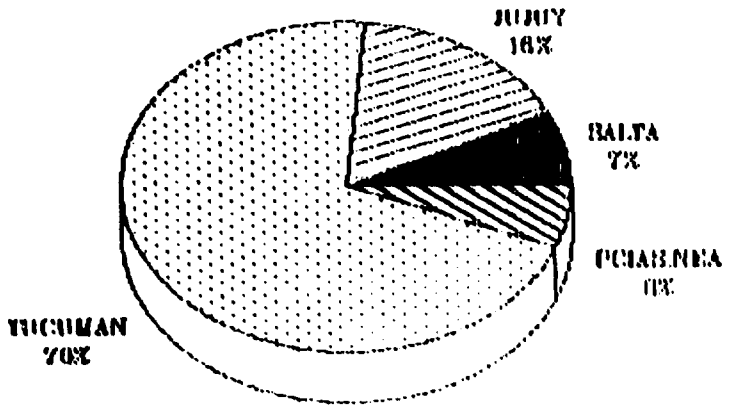
CAMPAÑA	S.SEMBRADA (HAS)	S.COSECHADA (HAS)	RENDIMIENTO (TON/HA)	PRODUCCION CAÑA MOLIDA TON.	PRODUCCION AZUCAR TON.	RENDIMIENTO AZUCAR/CAÑA %
1980/81	351.300	319.300	48,47	14.384.198	1.531.227	10,29
1981/82	349.300	308.500	48,77	14.449.663	1.530.683	10,59
1982/83	353.300	313.400	48,09	14.904.437	1.537.184	10,31
1983/84	357.500	317.600	48,61	15.305.255	1.447.197	9,45
1984/85	355.000	287.550	49,05	13.984.702	1.087.937	7,78
1985/86	356.000	296.250	48,83	13.345.612	1.037.796	7,50
1986/87	358.300	290.200	49,89	9.527.734	980.655	10,29
1987/88	358.300	276.700	50,38	10.464.816	1.048.148	10,00
1988/89	358.700	229.300	47,01	10.605.729	944.129	8,90
1989/90	358.700	12.300	48,3	12.506.300	1.245.929	9,94
1990/91	360.300	14.300	49,3	14.323.300	1.472.346	10,28

FUENTE: Elaboracion propia en base a datos de la SENG, Centro Azucarero Argentino, y Bolsa de Cereales.

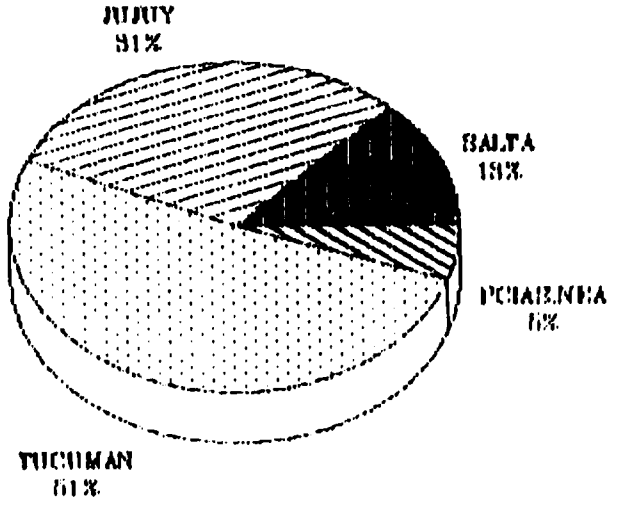
ARGENTINA: PRODUCCION DE CAÑA DE AZUCAR POR PROVINCIA

– Campaña 1988/89 –

SUPERFICIE SEMBRADA



PRODUCCION



Fuente: SIAG.

CUADRO NRO: 2

PRODUCCION ARGENTINA DE CAÑA DE AZUCAR
- En Toneladas -

PROVINCIAS	CAMPAÑA 1990/91	PARTICIP. %	CAMPAÑA 1995/96	PARTICIP. %	CAMPAÑA 1998/99	PARTICIP. %
SALTA	1.515.600	9,78	1.447.000	10,00	1.371.800	12,77
JUJUY	3.694.000	23,83	3.904.000	26,99	3.321.500	30,81
TUCUMAN	9.465.000	61,06	8.654.000	59,83	5.500.000	51,02
SUB-TOTAL NOA	14.674.600	94,67	14.005.000	96,82	10.193.300	94,58
MISIONES	107.200	0,69	72.000	0,50	156.100	1,45
CORRIENTES	6.200	0,04	5.300	0,04	3.000	0,03
CHACO	110.900	0,72	114.000	0,79	58.000	0,54
FORMOSA	1.100	0,01	2.100	0,01	1.400	0,01
SANTA FE	600.000	3,87	266.100	1,84	366.200	3,40
SUB-TOTAL RES	825.400	5,33	460.000	3,18	586.700	5,44
TOTAL PAIS	15.500.000	100,00	14.465.000	100,00	10.780.000	100,00

FUENTE: Elaboracion propia en base a datos de la BCBA.

CUADRO NRO: 3

ARGENTINA: SUPERFICIE SEMBRADA DE CAÑA DE AZUCAR
- En Hectareas -

PROVINCIAS	CAMPAÑA 1980/81	PARTICIP. %	CAMPAÑA 1985/86	PARTICIP. %	CAMPAÑA 1986/87	PARTICIP. %
SALTA	25.500	7,26	26.000	7,30	25.000	7,31
JUJUY	51.000	14,52	57.000	16,01	58.000	16,30
TUCUMAN	250.000	71,16	250.000	70,22	250.000	70,24
SUB-TOTAL NOA	326.500	92,94	333.000	93,54	334.000	93,85
MISIONES	5.700	1,62	5.900	1,66	7.725	2,17
CORRIENTES	220	0,06	225	0,06	200	0,06
CHACO	3.300	1,08	3.300	1,07	2.400	0,67
FORMOSA	80	0,02	75	0,02	75	0,02
SANTA FE	15000	4,27	12000	3,63	11.500	3,23
SUB-TOTAL NEA	24.300	7,06	23.300	6,46	21.900	6,15
RESTO	0	0,00	0	0,00	0	0,00
TOTAL PAIS	351.300	100,00	356.300	100,00	355.900	100,00

FUENTE: Elaboración propia en base a datos de la SENG.

CUADRO NRO: 4

ARGENTINA: SUPERFICIE COSECHADA DE CAÑA DE AZUCAR
- En Hectáreas -

PROVINCIAS	CAMPAÑA 1980/81	PARTICIP. %	CAMPAÑA 1985/86	PARTICIP. %	CAMPAÑA 1988/89	PARTICIP. %
SALTA	22.300	6,97	22.300	7,53	21.000	9,15
JUJUY	47.200	14,76	49.400	16,68	48.000	20,93
TUCUMAN	228.300	71,39	203.000	68,52	142.100	61,97
SUB-TOTAL NOA	297.800	93,12	274.700	92,73	211.100	92,06
MISIONES	3.400	1,06	4.650	1,57	6.505	2,84
CORRIENTES	220	0,07	225	0,08	175	0,08
CHACO	3.300	1,03	3.600	1,22	1.360	0,31
FORMOSA	80	0,03	75	0,03	60	0,03
SANTA FE	15.000	4,67	13.000	4,39	9.600	4,19
SUB-TOTAL NEA	22.000	6,88	21.550	7,27	18.200	7,94
RESTO	0	0,00	0	0,00	0	0,00
TOTAL PAIS	319.800	100,00	296.250	100,00	229.300	100,00

FUENTE: Elaboración propia en base a datos de la SENG.

CUADRO NRO: 5

RENDIMIENTO AGRICOLA DE CAÑA DE AZUCAR
- En Kilogramos por Hectáreas -

PROVINCIAS	CAMPAÑA 1980/81	CAMPAÑA 1985/86	CAMPAÑA 1988/89
SALTA	67.964,13	64.887,89	65.333,81
JUJUY	78.262,71	79.028,34	69.197,92
TUCUMAN	41.458,61	42.630,54	38.705,14
SUB-TOTAL NOA	49.280,00	50.980,00	48.290,00
MISIONES	31.529,41	15.483,87	23.996,93
CORRIENTES	28.181,82	25.777,78	17.142,86
CHACO	33.606,06	31.666,67	31.182,80
FORMOSA	13.750,00	28.000,00	23.333,33
SANTA FE	40.000,00	20.469,23	38.354,17
SUB-TOTAL NEA	37.520,00	21.350,00	32.240,00
TOTAL PAIS	46.467,79	46.827,00	47.012,63

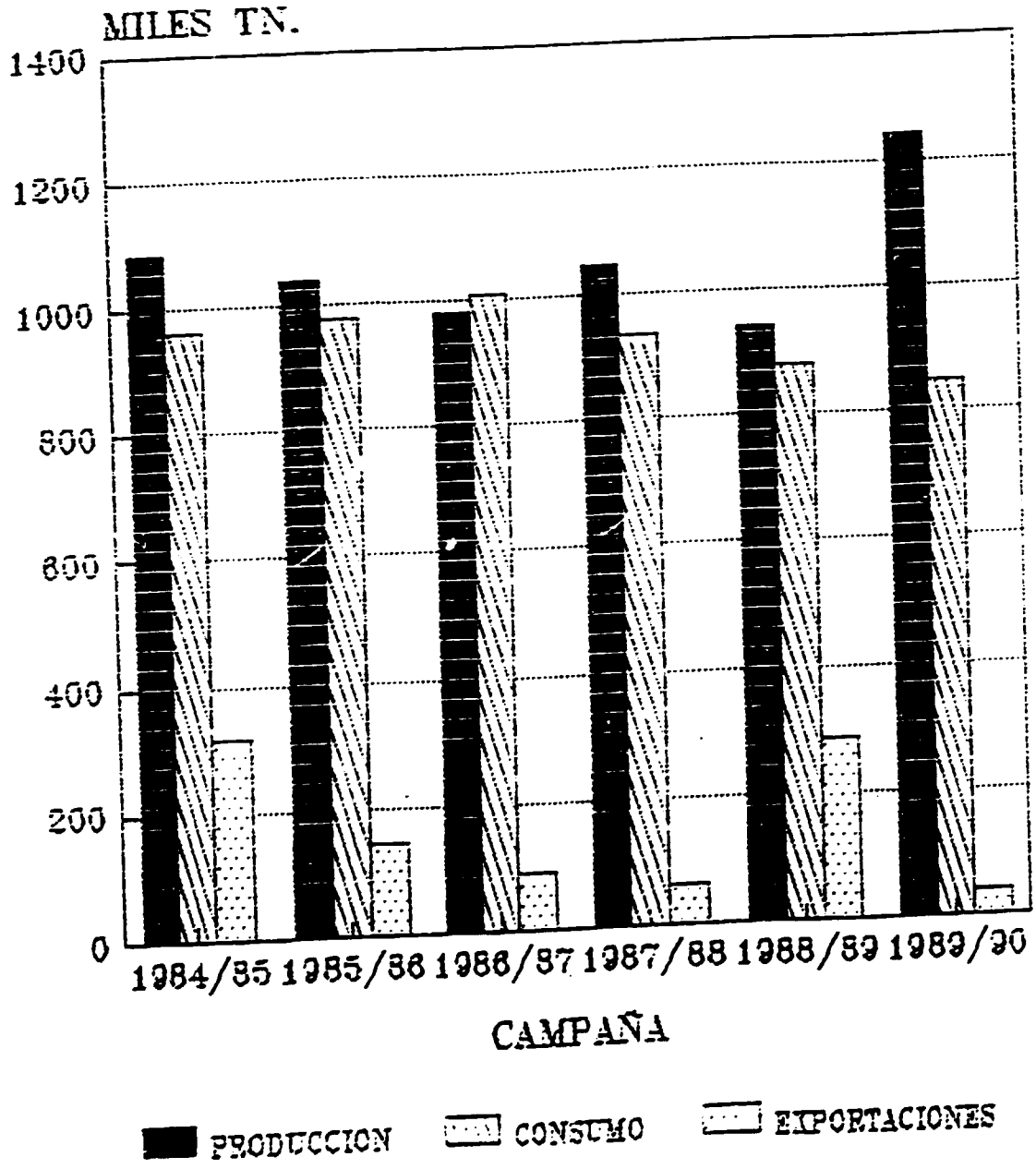
FUENTE: Elaboración propia en base a datos de la SEAG.

TOTAL AZUCARES FABRICADOS (kgs.)

INGENIOS	BLANCOS	CRUDOS	T O T A L	RENDIMIENTO
[illegible]	33.770.780	2.134.280	35.913.010	8.010
[illegible]	34.073.400	15.086.600	49.160.000	9.995
[illegible]	105.314.000	28.383.490	133.697.490	7.322
[illegible]	32.063.050	3.103.000	35.166.050	9.019
[illegible]	43.638.500	4.574.000	48.212.500	9.349
[illegible]	41.409.000	4.867.000	46.276.000	9.365
[illegible]	60.409.502	3.717.600	64.127.102	9.231
[illegible]	27.652.930	6.452.540	34.105.470	9.530
[illegible]	55.164.250	18.738.370	73.902.620	9.865
[illegible]	17.622.030	3.421.011	21.043.041	11.857
[illegible]	36.680.050	5.367.000	42.047.050	10.197
[illegible]	33.644.900	1.362.360	35.007.260	8.963
[illegible]	37.058.070	4.797.360	41.855.430	9.614
[illegible]	11.102.000	0	11.102.000	8.599
[illegible]	42.934.522	44.554.200	87.389.522	9.154
[illegible]	36.609.400	1.225.660	37.835.460	10.115
TOTAL TUCUMAN	651.154.534	105.685.499	756.840.033	9.435
[illegible]	80.507.000	14.208.000	94.715.000	10.877
[illegible]	211.884.000	36.253.000	248.137.000	10.643
[illegible]	96.494.000	3.737.000	100.231.000	10.235
[illegible]	46.004.000	1.382.000	47.766.000	11.171
[illegible]	20.533.000	666.000	21.219.000	9.382
TOTAL NORTE	455.522.000	56.546.000	512.068.000	10.054
[illegible]	3.942.927	0	3.942.927	11.876
[illegible]	5.190.150	0	5.190.150	10.225
[illegible]	3.979.780	0	3.979.780	10.331
TOTAL LITORAL	13.112.857	0	13.112.857	10.717
TOTAL DEL PAIS	1.119.789.391	162.231.499	1.282.020.890	9.919

FUENTE: Centro Azucarero Argentino.

ARGENTINA: PRODUCCION Y DESTINO DEL AZUCAR



Fuente: Centro Azucarero Argentino

CUADRO NRO: 7

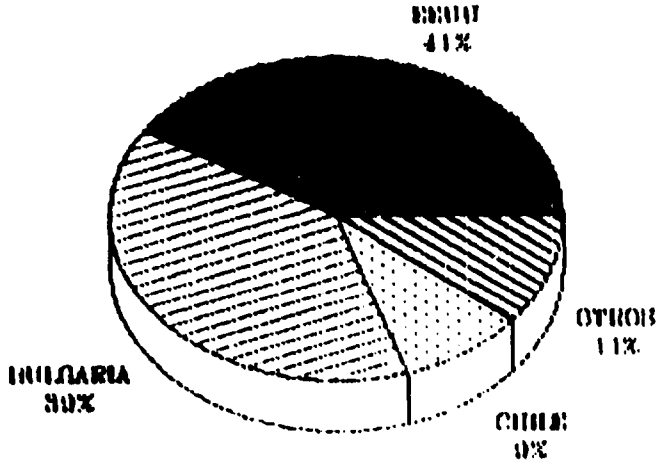
ARGENTINA: PRODUCCION Y DESTINO DEL AZUCAR POR CAMPAÑA Y POR EJERCICIO INDUSTRIAL

CAMPAÑA	PRODUCCION TN. (1)	CONSUMO TN. (2)	EXPORTACIONES EN TN.V. (3) BLANCO	CRUDO	TOTAL	(2) PA. % PORC. (1)	(3) PART. % PORC. (1)
1984/85	1.087.937	962.198	55.940	261.355	317.295	88,44	29,16
1985/86	1.037.996	977.219	26.351	116.798	143.649	94,14	13,84
1986/87	980.655	1.009.784	15.941	74.750	90.691	102,97	9,25
1987/88	1.048.148	934.445	10.782	53.460	64.448	89,15	6,15
1988/89	944.129	878.557	8.585	275.436	284.021	93,05	30,06
1989/90	1.245.029	849.640	37.815	90.220	130.053	68,35	10,46

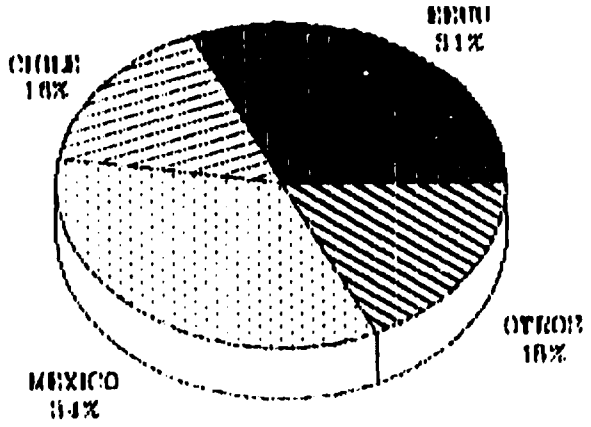
FUENTE: Elaboración propia en base a datos del Centro Azucarero Argentino.

EXPORTACIONES ARGENTINAS DE AZUCAR POR DESTINO

AÑO 1987



AÑO 1990



Fuente: Centro Azucarero Argentino

CUADRO NRO: 9

EXPORTACIONES ARGENTINAS DE AZUCAR
- En US$ y Toneladas -

	1985	1986	1987	1988	1989	1990	1991
I)AZUCAR EN BRUTO							
CANTIDAD	123.132	92.134	70.015	221.291	154.548	140.361	150.541
PARTICIPACION	85,06%	77,21%	84,98%	97,94%	93,92%	36,35%	75,98%
VALOR	24.869	24.372	18.470	54.646	45.158	51.084	44.362
PRECIO PROMEDIO	0,20	0,30	0,26	0,25	0,29	0,36	0,29
II)AZUCAR SEMI-REFINADA							
CANTIDAD	21.747	22.201	11.976	4.137	3.225	108.768	24.256
PARTICIPACION	14,67%	20,87%	14,54%	1,83%	1,96%	28,17%	11,92%
VALOR	2.425	5.169	1.339	940	1.251	37.485	5.381
PRECIO PROMEDIO	0,11	0,14	0,15	0,23	0,38	0,34	0,24
III)AZUCAR REFINADA							
CANTIDAD	3.373	2.340	400	510	6.769	137.313	28.686
PARTICIPACION	2,28%	1,92%	0,49%	0,23%	4,12%	35,48%	14,10%
VALOR	376	331	76	99	1.920	45.204	7.033
PRECIO PROMEDIO	0,12	0,16	0,19	0,19	0,28	0,33	0,25
IV)TOTAL							
CANTIDAD	148.252	106.375	82.391	225.938	164.553	386.142	203.483
PARTICIPACION	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
VALOR	27.713	27.872	20.385	55.685	48.319	133.773	57.196
PRECIO PROMEDIO	0,19	0,26	0,25	0,25	0,29	0,35	0,28

FUENTE: Elaboracion propia en base a datos del INDEC.

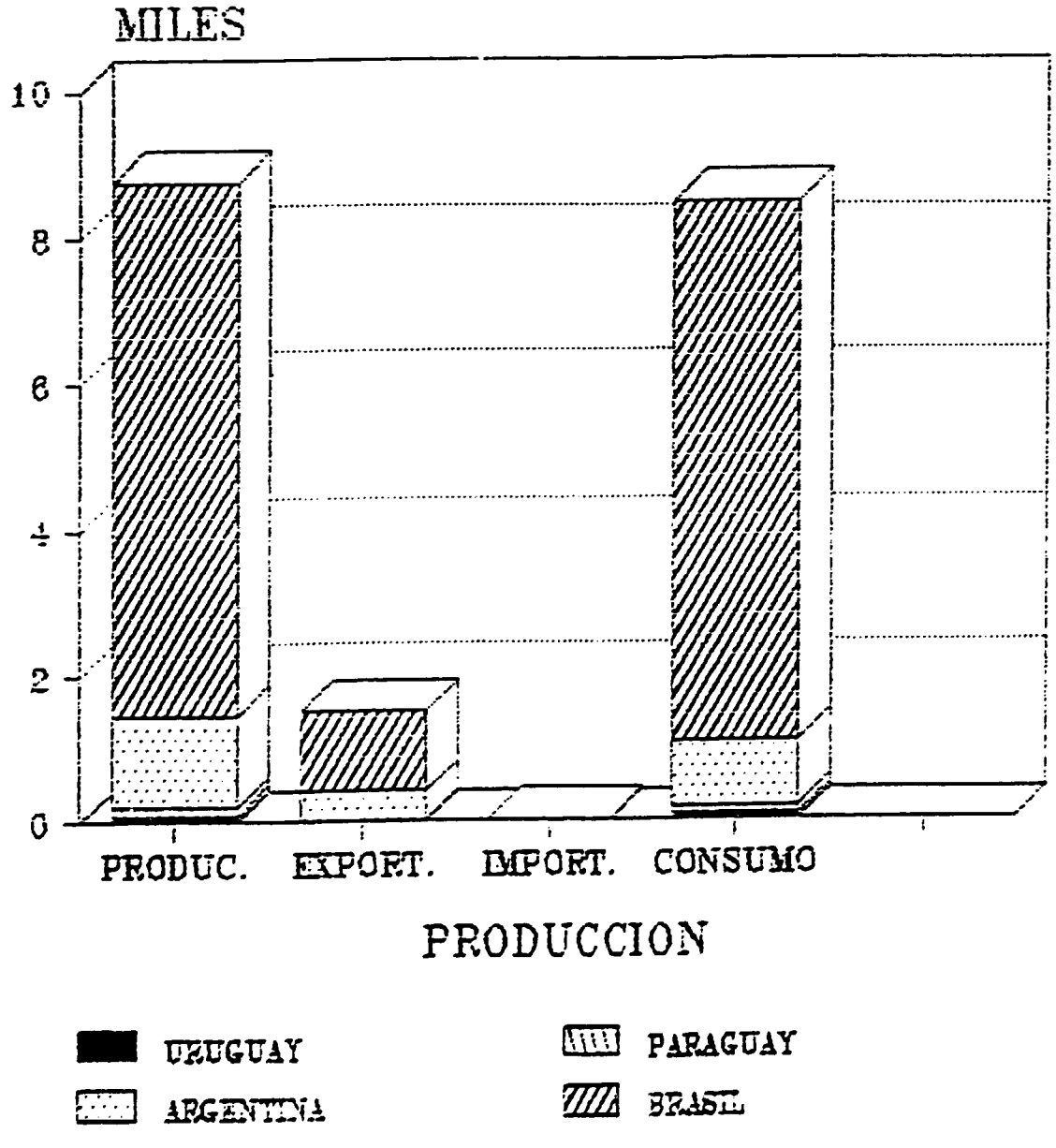
CUADRO NRO: 9

EXPORTACIONES ARGENTINAS DE AZUCAR, POR PROVINCIA
- En miles de U$S y Toneladas -

	AÑO 1988			AÑO 1989			AÑO 1990			AÑO 1991		
	VALOR	CANT.	%	VALOR	CANT.	%	VALOR	CANT.	%	VALOR	CANT.	%
I)AZUCAR EN BRUTO												
TUCUMAN	118.385	65.362	28,80	116.067	48.695	29,59	27.396	75.166	19,47	119.655	69.274	33,32
JUJUY	119.135	84.695	37,49	111.906	44.029	26,76	7.497	18.727	4,85	116.538	54.932	26,42
SALTA	7.794	32.368	14,55	9.033	31.486	19,13	10.579	30.933	8,01	2.828	8.190	3,94
RESTO	9.333	38.566	17,11	8.148	30.337	18,44	5.612	15.554	4,02	5.341	18.146	8,73
SUB-TOTAL	154.646	221.291	97,94	145.158	154.548	93,92	51.084	140.381	36,35	144.362	150.541	72,41
II)AZUCAR SEMI-REFINADA												
TUCUMAN	755	3.277	1,45	1.046	2.749	1,67	6.338	18.762	4,36	666	1.343	0,89
JUJUY	125	360	0,38	0	0	0,00	22.524	68.566	16,38	3.242	14.524	6,99
SALTA	0	0	0,00	0	0	0,00	1.265	3.400	0,88	0	0	0,00
RESTO	0	0	0,00	185	485	0,29	7.348	21.040	5,45	1.393	7.889	3,79
SUB-TOTAL	880	4.137	1,83	1.231	3.235	1,96	37.485	108.788	33,17	5.301	24.356	11,67
III)AZUCAR REFINADA												
TUCUMAN	99	510	0,23	464	1.749	1,06	4.785	18.213	4,72	1.392	4.629	2,22
JUJUY	0	0	0,00	0	0	0,00	27.414	76.550	19,82	1.779	9.300	4,71
SALTA	0	0	0,00	1.386	4.300	2,82	19.467	55.000	9,36	120	500	0,24
RESTO	0	0	0,00	100	240	0,15	2.558	7.250	1,88	3.742	13.766	6,62
SUB-TOTAL	99	510	0,23	1.950	6.780	4,12	45.204	137.013	35,48	7.033	28.586	13,80
IV)TOTAL												
TUCUMAN	119.237	68.348	30,47	117.560	53.173	32,31	38.499	112.143	29,04	121.713	75.737	36,43
JUJUY	119.320	85.555	37,87	111.906	44.029	26,76	57.445	160.843	41,65	121.560	79.256	38,12
SALTA	7.794	32.368	14,55	10.401	35.786	22,05	22.311	69.333	17,96	2.948	8.690	4,18
RESTO	9.334	38.566	17,11	8.433	31.364	18,38	15.518	43.823	11,35	10.975	44.231	21,27
TOTAL ARGENTINA	155.685	225.838	100,00	148.319	164.352	100,00	133.777	386.142	100,00	157.196	207.913	100,00

FUENTE: Elaboracion propia en base a datos del INDEC.

EL AZUCAR
EN EL MERCOSUR
- Campaña 1989/90 -



Fuente: FAO

CUADRO NRO: 19

PRODUCCION TOTAL DE CAÑA DE AZUCAR EN LOS PAISES DEL MERCOSUR
- En miles de toneladas métricas -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MERCOSUR	TOTAL MUNDIAL	PARTICIPACION MERCOSUR
1980/81	15.500	155.571	1.550	420	173.041	788.777	21,94
1981/82	15.046	186.647	1.500	480	203.673	887.706	22.94
1982/83	15.070	216.534	1.700	551	233.855	896.864	26.07
1983/84	15.468	222.313	1.700	552	240.033	913.698	26,13
1984/85	14.300	246.542	1.500	586	262.928	933.079	28.18
1985/86	15.465	239.178	2.758	637	258.038	930.637	27.73
1986/87	14,479	268.585	3.188	600	286.852	966.047	29,69
1987/88	14.772	258.412	2.668	496	276.349	999.524	27.65
1988/89	14.500	251.647	2.363	599	269.111	1.021.318	26.35
1989/90	16.000	262.313	2.374	667	282.103	1.035.094	27.25

FUENTE: Elaboracion propia en base a datos de la FAO.

CUADRO NRO: 11

RENDIMIENTO DE LA CAÑA DE AZUCAR EN LOS PAISES DEL MERCOSUR
- En Kilogramos por Hectarea -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MUNDIAL
1980/81	48.468	55.224	37.305	41.817	57.232
1981/82	48.771	60.515	37.500	47.241	58.823
1982/83	48.086	62.136	42.500	55.607	58.120
1983/84	48.565	55.644	42.500	53.181	58.327
1984/85	50.223	60.312	42.857	55.306	58.327
1985/86	52.203	60.323	46.667	61.790	58.554
1986/87	49.393	62.311	50.200	60.640	59.732
1987/88	49.736	62.762	50.148	50.271	61.541
1988/89	48.333	61.783	49.390	58.796	62.671
1989/90	49.000	61.468	50.320	66.374	61.329

FUENTE: Elaboración propia en base a datos de la FAO. SEAG.

SUPERFICIE COSECHADA DE CAÑA DE AZUCAR EN LOS PAISES DEL MERCOSUR
- En miles de ha -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MERCOSUR	TOTAL MUNDIAL	PARTICIPACION MERCOSUR
1980/81	329	3.317	41	10	3.176	13.781	23,06
1981/82	309	3.064	40	10	3.423	15.091	22,75
1982/83	313	3.485	40	10	3.338	15.451	24,87
1983/84	319	3.636	40	10	4.015	15.617	25,71
1984/85	235	3.900	35	11	4.220	15.997	26,38
1985/86	296	3.951	59	10	4.307	15.920	27,05
1986/87	290	4.310	64	10	4.364	16.173	28,34
1987/88	297	4.117	53	10	4.467	16.349	27,32
1988/89	306	4.076	58	10	4.454	16.466	26,93
1989/90	299	4.271	56	11	4.637	16.378	27,89

FUENTE: Elaboracion propia en base a datos de la FAO, SECA.

EXPORTACIONES DE AZUCAR EN LOS PAISES DEL MERCOSUR.
- En Miles de Toneladas -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MERCOSUR	TOTAL MUNDIAL	PARTICIPACION MERCOSUR
1980/81	775,15	2.731	0,10	0,00	3.516	29.711	11,83%
1981/82	284,90	2.677	15,00	0,00	2.947	31.011	9,50%
1982/83	891,94	2.305	14,50	14,00	3.725	29.761	12,52%
1983/84	415,30	2.372	11,00	13,31	3.810	28.748	10,48%
1984/85	148,25	3.165	10,00	9,65	3.333	29.287	11,78%
1985/86	196,36	2.652	10,40	5,32	2.775	27.656	10,03%
1986/87	82,37	1.535	6,90	27,85	1.652	28.516	5,80%
1987/88	225,94	2.259	7,26	16,24	2.509	29.232	8,59%
1988/89	164,80	1.833	15,20	9,16	2.026	30.046	6,74%
1989/90	136,14	1.397	9,10	17,46	1.510	29.362	5,14%
1990/91	202,45	1.665	S/D	S/D	S/D	S/D	S/D

FUENTE: Elaboracion propia en base a datos de la FAO. INDEC.

IMPORTACIONES DE AZUCAR EN LOS PAISES DEL MERCOSUR.
- En Miles de Toneladas -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MERCOSUR	TOTAL MUNDIAL	PARTICIPACION MERCOSUR
1980/81	0,00	0,00	0,00	18,74	18.74	28.690	0,07%
1981/82	0,00	0,00	0,00	0,13	0.13	29.546	0,00%
1982/83	0,00	0,00	0,00	0,11	0.11	28.357	0.00%
1983/84	0,00	0,00	0,00	4,16	4,16	28.118	0.01%
1984/85	0,00	0,00	0,00	1,00	1.00	27.353	0.00%
1985/86	0,00	0,00	19,70	0,02	19.72	26.595	0.07%
1986/87	0,00	0,00	9,40	0,00	9.40	25.179	0.03%
1987/88	0,00	0,00	0,00	8,21	8.21	25.199	0.03%
1988/89	0,00	0,00	0,00	10,42	10.42	28.305	0.04%
1989/90	0,00	0,00	0,00	3,30	3.30	27.367	0.01%

FUENTE: Elaboracion propia en base a datos de la FAO. INDEC.

CUADRO NRO: 13

CONSUMO DE AZUCAR EN LOS PAISES DEL MERCOSUR.
- En Miles de Toneladas -

AÑO	ARGENTINA	BRASIL	PARAGUAY	URUGUAY	TOTAL MERCOSUR	TOTAL MUNDIAL	PARTICIPACION MERCOSUR
1980/81	1.022	5.873	71	100	7.065	89.298	7,91%
1981/82	954	6.097	75	99	7.225	92.016	7,85%
1982/83	957	5.909	76	92	7.036	90.644	7,51%
1983/84	1.003	6.201	76	95	7.377	96.382	7,66%
1984/85	974	6.160	80	100	7.234	97.957	7,38%
1985/86	1.042	6.589	80	82	7.344	100.344	7,32%
1986/87	1.134	6.573	80	83	7.340	104.371	7,46%
1987/88	969	6.241	100	85	7.221	105.545	6,84%
1988/89	914	7.401	113	98	8.497	107.008	7,94%

FUENTE: UNCTAD.

ANNEX TO CHAPTER 5

Cost assumptions for the use of sugar cane alcohol for fuel

The following working assumptions are relevant:

- Argentina's experience shows that the country can produce 65 litres alcohol and even 70l/t per ton of cane;

- Proceeds could be shared in the ratio of 20 litres for industry and 45 litres for the growers. Under thepetrol-alcohol Alconafta programme. The growers areallocated the equivalent of 38 litres, allowance being made for a minimum level of returns for the respective sectors and for the fact that alcohol offers the mills a way of saving on energy and on sugar production costs;

- According to INTA calculations, the industrial cost of producing alcohol, disregarding the cost of the raw material, is approximately US$ 0.05/l, or US$ 3.25(65l x US$ 0.05) per ton of cane;

- The variable cost to industry thus comes to US$ 3.25 per 20 litres (allocated, as noted in (b), to industry), or US$ 0.1625 per litre;

- If the alcohol were sold at the international price of US$ 0.30l, industry could at least cover its variable production costs;

- Under these arrangements, growers would earn per ton of cane the equivalent of US$ 0.30 per 45 litres, or US$ 13.5/ton, as against US$ 17/t for their cane that goes to sugar making.

For both sectors the returns on alcohol production would therefore be lower than that for sugar. However, the alcohol scheme would make it possible, among other things, to lower sugar production costs and deal with cane over-production, which in turn would make for acceptable prices on the domestic sugar market. For the above assumption to be workable, further elements must be taken into account, thus:

- Costs of exporting (bank charges, customs forwarders,quality certificates, etc.) would attract a countervailing saving with the present refund of theduty (5% on FOB price) on sugar under the laws governing exports;

- Some control mechanism would need to be introduced toensure that cane bought in at a lower price for all products will not be diverted to sugar production.

- The provincial government could make its own contribution by waiving taxes on this novel activity, since even if it would were to additional revenue there on, the formula would help to attenuate social problems.