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DIVERSIFICATION AS A STRATEGY FOR THE SUGAR-CANE SECTOR

Background paper*

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* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

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CONTENTS

	<u>Page</u>
I. Introduction	3
II. Diversification as a strategy for the development of the sugar-cane agro-industry	5
III. A closer look to diversification	7
IV. The diversification programmes for Latin American and Caribbean Sugar Exporting Countries	9
V. The state of diversification in the Latin American and Caribbean Countries	10
VI. Final remarks	11

Annexes

Annex I: Potential of the sugar-cane industry derivatives	12
Annex II: Sugar	13
Annex III: Molasses derivatives	14
Annex IV: Bagasse derivatives	15
Annex V: Fermented juice	16
Annex VI: Wax	17
Annex VII: Latin American and the Caribbean: development of the diversification of the sugar-cane agro-industry, 1990 (plants & processes)	18
Annex VIII: Agriculture diversification through intercropping and crop rotation	19

I. INTRODUCTION

In order to discuss fully the implications of any strategy for the sugar industry, we consider very relevant to start summarizing some of the features of the sugar international activity:

- Sugar is produced from two different sources, cane and beet. The first comes from tropical and subtropical climates while the second comes from the mild ones.

As a result sugar is produced in almost any country with the exceptions of deserts and ice-capped areas.

- Cane sugar represents around 60% of the total and beet sugar 40%.
- Most of the sugar produced is consumed in the country of origin, with the international market representing only a rather small proportion of the total production, slightly over 20% of the total production, estimated for the current crop in around 110 million tons.
- The International Market is divided in two sectors:
 - a) The preferential markets
 - b) The residual or so called "Free Market"
- The preferential markets are:
 - The sales of the ACP countries (Africa, Caribbean and the Pacific countries), representing around 1.4 million tons.
 - The agreement between Cuba and the Socialist Block, representing until 1990 around 5 million tons.
 - The U.S. import quota representing for the current season over 2 million tons.
- The "Free Market" is the residual of deducting of the total production the self-sufficient consumption and the preferential markets, estimated slightly below 20 million tons, including reexporting.
- The per capita sugar consumption is 22 kg. per year, with a maximum over 50 kg. in some countries.
- There is a wide variation in productivity, with indexes ranging from less than a ton of sugar per hectare to 15 tons, with a world average of 5 tons, slightly higher in the case of cane as compared to beet.
- This is reflected in cost of production of sugar, ranging from 8 to 50 cents per pound of raw sugar, with an average of over 15 cents.

The range is wider in the case of cane showing both the lowest and the highest, with the average being lower for cane than for beet.

- There is an increasing use of substitutes, particularly the high fructose corn syrup, among the caloric sweeteners, and aspartame, among the non caloric ones, being very important in the case of the U.S.A.
- Sugar is the strongest case of use of almost any kind of economic policies in order to rule the internal markets. Being the most important cases the protectionist policies of the U.S.A., the E.E.C. and Japan.
- Sugar prices in the Free Market fluctuate widely showing two important features:
 - The widest variation among all the commodities, due mainly to the size of the international market as a proportion of total world production.
 - Most of the time they are below the cost of production of even the most efficient producers in the world, due to a chronic surplus in the market as a result of excess supply resulting of the protectionist policies, with no link between internal and international prices.
- Currently there is no international agreement to regulate the market with economic provisions.
- The increase of the level of self sufficiency in importing countries added to a decrease in the rate of growth of consumption has resulted in a shrinking of the Free Market with negative consequences on the prices.

Since the beginning of the 70's there has been important changes in the international sugar activity:

- The already mentioned shrinking of the international sugar market.
- The lowest international prices in real terms, registered in most of the 80's.
- The increasing share of white sugar in the international market, being in the present almost as important in volume as raw sugar, while in 1970 the former represented almost 90% of the market.
- In the case of the U.S.A. the share of sugar in the caloric sweeteners market has decreased from 85% in 1970 to 45% today, with the rest being taken by the corn sweeteners.
- Aspartame entered in the market at the beginning of the 80's reaching almost 10% of sweeteners consumption (sugar equivalent) in the U.S.A. today.
- There is an increasing awareness of the possibilities of using sugar cane as a raw material for a rather large number of products including alcohol, paper, animal feed, plastics, etc.

II. DIVERSIFICATION AS A STRATEGY FOR THE DEVELOPMENT OF THE SUGAR CANE AGRO-INDUSTRY

- Traditionally, sugar cane has been used only to produce sugar, being used only exceptionally for other purposes.

As it has shown before the sugar producers were facing hard times due to the depressed international prices.

On technological grounds, there is a rather long list of sugar cane derivatives and by-products, given an excellent alternative to the sugar producers to get rid of depending on only one product, and particularly one with the market problems described before.

- Diversification, being understood as the integral use of sugar cane to produce not only sugar but a number of derivatives and by-products, came to be an alternative strategy to develop the industry in the long run.
- Thus, the first attempt to diversify the industry came from the industry itself, being considered as an opportunity to avoid dependence from the international sugar market as well as to reduce costs sharing it among a larger number of products.

Even more, the potential increase of the production and use of derivatives and by-products could reach a volume which would allow a better control of the sugar supply in the international market.

- Since the beginning of the 60's some of the Latin American countries have started a diversification process reaching today a considerable degree of development and opening a whole new spectrum of possibilities.
- Today, the diversification of the sugar industry could be understood as a strategy of development of the industry through the optimum use of sugar areas and integral use of sugar cane for the production of several goods of higher value added.

Diversification is no longer an strategy of defense from the low sugar prices, but mainly a relevant contribution of the sugar sector to the development of the other economic sector in any country.

It could also be the starting point of a system of cooperation and integration among third world countries.

- Summarizing, we can state the following advantages of a diversification programme:
 - Better revenue-cost ratio while sharing costs among a larger number of products and getting additional income from them.
 - To create horizontal integration.
 - Restructuring of the present sugar cane agro-industry through integrated industrial multiproduct complexes.
 - Increase of productivity.

- Better allocation of resources.
 - Increase of the industry value added.
 - More stability for cane growers and sugar producers.
 - Modernization of the industry with a higher possibility of the use of biotechnology in the process.
 - Higher level of research, both basic and applied.
 - Better cooperation, exchange of technology and integration among third world countries.
- As an example to the real contribution to other sectors we can summarize a list of products, among others, to be produced from sugar cane and used by the rest of the economy:

<i>Sector</i>	<i>Product from Sugar Cane</i>
<i>Food Industry</i>	<i>Proteins, carbohydrates, vitamins, aminoacids, beverages,</i>
<i>Health</i>	<i>fats and oils enzymes, pharmaceutical products.</i>
<i>Agriculture</i>	<i>Fertilizers, pesticides, animal food.</i>
<i>Construction</i>	<i>Bagasse Boards.</i>
<i>Chemical Industry</i>	<i>Plastics, solvents, fuels, packing and intermediate chemical products.</i>
<i>Energy</i>	<i>Fuel Alcohol, Biogas, Bagasse</i>
<i>Transportation</i>	<i>Fuel Alcohol</i>
<i>Light Industry</i>	<i>Textiles, Bitumen, Polishes, Chemicals, Printing Paper, News Print Paper, etc.</i>
<i>Communication</i>	<i>Insulating Materials</i>
<i>Heavy Industry</i>	<i>Resins for Casting Molds</i>

SOURCE: ICIDCA-GEPLACEA-PNUD, "Handbook of Sugar Cane Derivatives".

- The most important achievement of the diversification programmes in the Latin American countries has been to show that this strategy is not only possible, but also profitable.

III. A CLOSER LOOK TO DIVERSIFICATION

- From a ton of sugar cane with an average sucrose content of around 10% we could obtain:

*275 kg. of bagasse (50% of humidity)
25 kg. of molasses (88 degrees Brix)
25 kg. of filter mud (77% of humidity)
77 kg. of green leaves
69 kg. of dry leaves
69 kg. of tops
100 kg. of sugar*

Using the juice to produce alcohol instead of sugar we can obtain 70 liters of fuel alcohol.

- As a first approach we could discuss different types of diversification schemes.
 - a) Diversification of sugar production, turning from raw sugar to white or other specialities sugar, with a higher value added, depending on the market differential among them.
 - b) Agricultural diversification, which includes complementary strategies:
 - Intercrop system, using the space between two rows of cane to produce other crops.
 - Rotation of crops in sugar cane areas.

This has the advantage of increasing agricultural production without affecting the cane production, and only marginal increases in costs, as well as reducing unemployment in rural areas and the optimization of the use of the land.
 - c) Industrial diversification, including:
 - Alternative use of cane, for example for fuel alcohol, or directly as animal food.
 - Industrialization of by-products.
- Analyzing the case of industrial diversification, undoubtedly the most important one, it is worthwhile to point out the different possibilities, already being undertaken in different countries:

1. Direct Use of Cane, including Animal Food and Alcohol:

- Fuel alcohol, which is the most important sugar cane derivative if we consider the volume of production, with programmes based on three alternatives:

- a) In order to replace gasoline as a part of the energy policy, for import substitution or generating oil surpluses for export, according to the country. The main example is Brazil, by far the most important producer of fuel alcohol, with around 13 billion liters.

It is important to keep in mind that Brazil, being the first sugar cane producer in the world, use around 60% of it in the production of fuel alcohol.

- b) For increasing foreign income through exports of fuel alcohol as the case of some Central American countries, supplying the U.S. market.
 - c) For ecological reasons, as octane enhacer replacing lead in the gasoline, as in the case of the U.S.A.
- Alcochemistry, through the transformation of ethyl alcohol into etylen and/or acetaldehyde, with a large number of derivatives.
 - Direct use of cane, or after a simple transformation, as animal food.

2. Uses of Bagasse:

- Animal Food, under different alternatives
- Production of Energy, allowing the mills to be self-sufficient in energy and to have a surplus to be sold to the national network or other uses.
- Furfural, to produce furfuryl alcohol, furanic polymers and furanic pesticides. Furfuryl alcohol could be used in foundry and oil drilling.
- Charcoal, for domestic uses in briquettes and activated charcoal, among other uses.
- Paper and Pulp, under different uses including newsprint paper.
- Board, under different alternatives (particle board, fibre boards, bagasse-cement boards) as a substitute for wood board for inside and outside uses.

3. Uses of Molasses:

- Alcohol for industrial use and human consumption
- Yeast, to be used for both human and animal food
- L-Lysine, to be used to enrich cereal for human consumption, in the pharmaceutic industry and for animal food.
- Monosodium Glutamate, used as flavour enhacer
- Butanol Acetone, to be used as solvent
- Citric Acid, to be used for the food industry as acidulant, emulsifier, fat stabilizer and flavour enhacer.

- Protein Molasses, as animal food
- Xantan Gum, for the food industry

4. Other Uses:

Such as technical dextran (for oil exploration and drilling, tooth paste, paints, glue and pharmaceutical products), wax from filter mud, biogas from wastes and residual waters for fertilized irrigation.

IV. THE DIVERSIFICATION PROGRAMMES FOR LATIN AMERICAN AND CARIBBEAN SUGAR EXPORTING COUNTRIES

- As a joint effort carried out by UNDP and GEPLACEA, the Programme has started in April 1987, with the fundamental purpose to create in the region the network for technical cooperation and exchange of technology in every item related to diversification.
- The main task in the first stage was to make known the experience of some countries, particularly Brazil and Cuba, among the rest of the countries with the goal of showing that diversification is an effective strategy for the development of the industry, being at the same time possible and profitable, but depending on each case on the particular situation of every country (including importance of sugar production, possibilities of increasing sugar cane production, internal, regional and international markets, competition with other raw materials, etc.).
- Among the different tasks we could summarize:
 - Creation of a network in order to exchange technological knowledge
 - Seminar on specific subjects such as animal feed, paper and pulp, alcochemistry, fuel alcohol, biotechnology, capital goods for the industry, rational use of energy in the mills, etc.
 - Publication of several books and video on specific items
 - A handbook on sugar cane derivatives, currently in its second edition, including technological and economic aspects of diversification.
 - Prefeasibility studies for different countries including furfural, alcochemistry, energy, fuel alcohol, animal food, etc.
- At present it is necessary to start the second stage of the programme with emphasis in two actions:
 - To replace general studies by specific ones
 - to go from prefeasibility studies to concrete investment
- At the moment we are discussing the possibility of creating a fund to finance diversification projects.

Among other things the programme has allowed to improve the quality of our technologist, to develop a capital good industry and to design new technologies to be applied in the case of underdeveloped countries.

V. THE STATE OF DIVERSIFICATION IN THE LATIN AMERICAN AND CARIBBEAN COUNTRIES

- Although the degree of development among the Latin American countries is very different in each one, according to their own situation, it is possible to point out a considerable progress in that direction for the region as a whole.
- There are already more than 1000 factories working on the production of sugar cane derivatives and by-products, producing almost 30 of them.
- The products already being produced at industrial scale are:
 - Pu'p and Paper
 - Boards
 - Furfural
 - Furfurylic Alcohol
 - Bagasse Briquettes
 - Alcohol
 - Rum and Sports
 - Acetaldehyde
 - Acetic Acid
 - Ethyl Acetate
 - Acetic Anhydride
 - Ethyl Ether
 - Tryacetone
 - Butyl Acetate
 - Isobutyl Acetate
 - Monochloroacetic Acid
 - Acid 2 4 D
 - Acetone Butanol
 - Ethylene
 - Diethyl Ether
 - Glycolic Ether
 - Ethyl Silicate
 - Amino Monoethyl
 - Ethyl Chloride
 - Anyl Acetate
 - MVC and PVC
 - L-Lysine
 - Monosodium Glutamate
 - Citric Acid
 - Dextran
 - Xantan Gum
 - Torula Yeast
 - Yeast for Human Consumption
 - Saccharomyces Yeast
 - Baker's Yeast
 - Protein Molasses

- Saccharine
- Molasses-Urea-Pith
- Predigested Bagasse
- Hydrolyzed Bagasse
- Biofermel
- Gecabu
- Melote
- Concentrated Vinasse
- Fusel Oil
- Sorbitol/Manitol
- Wax
- Crop Wastes
- Fertilizers
- Pajumel
- Molasses-Urea

VI. FINAL REMARKS

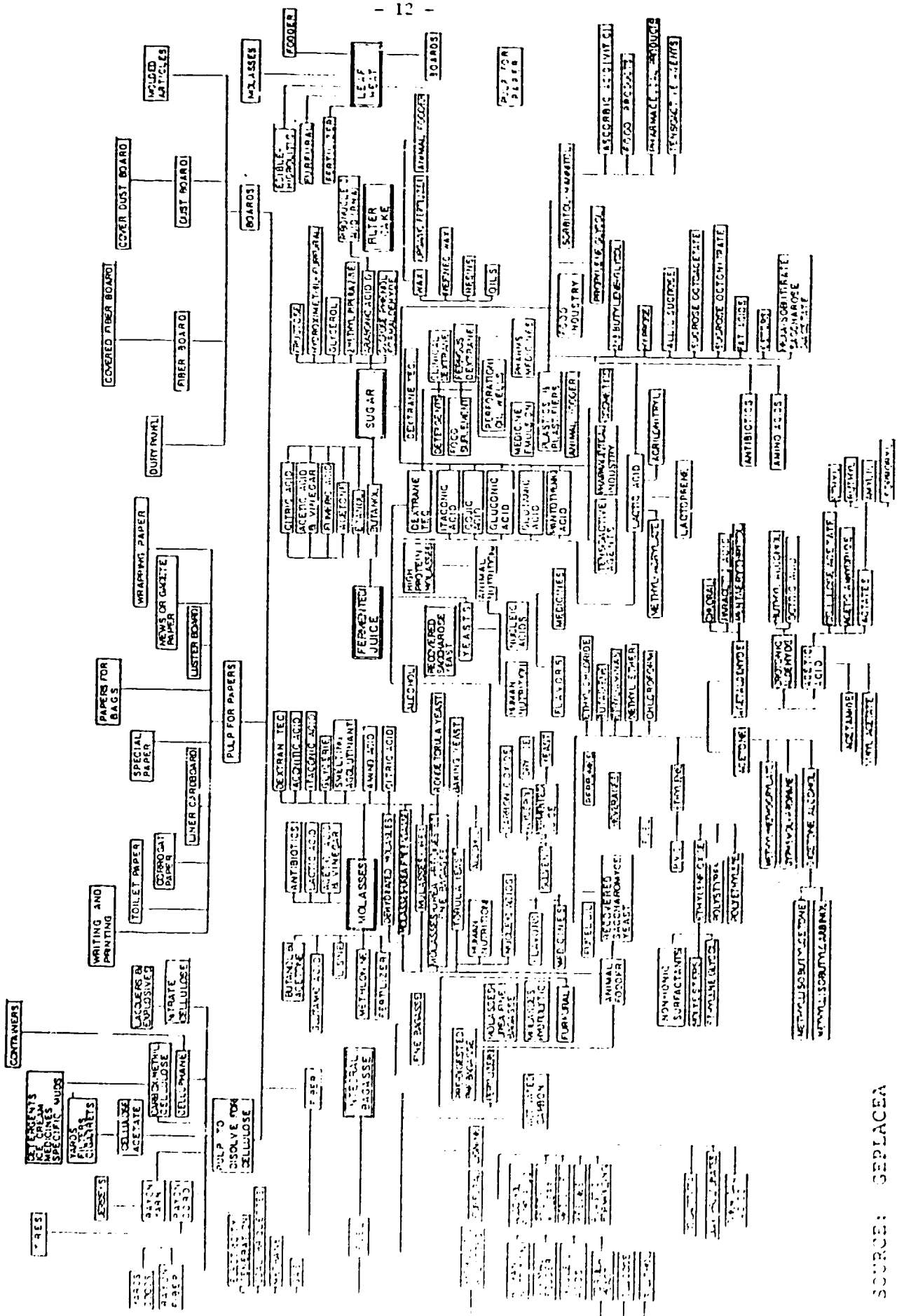
The main purpose of this paper is to show, through the experience of GEPLACEA, the possibilities of diversification programmes as a viable strategy for the sugar cane industry in the future.

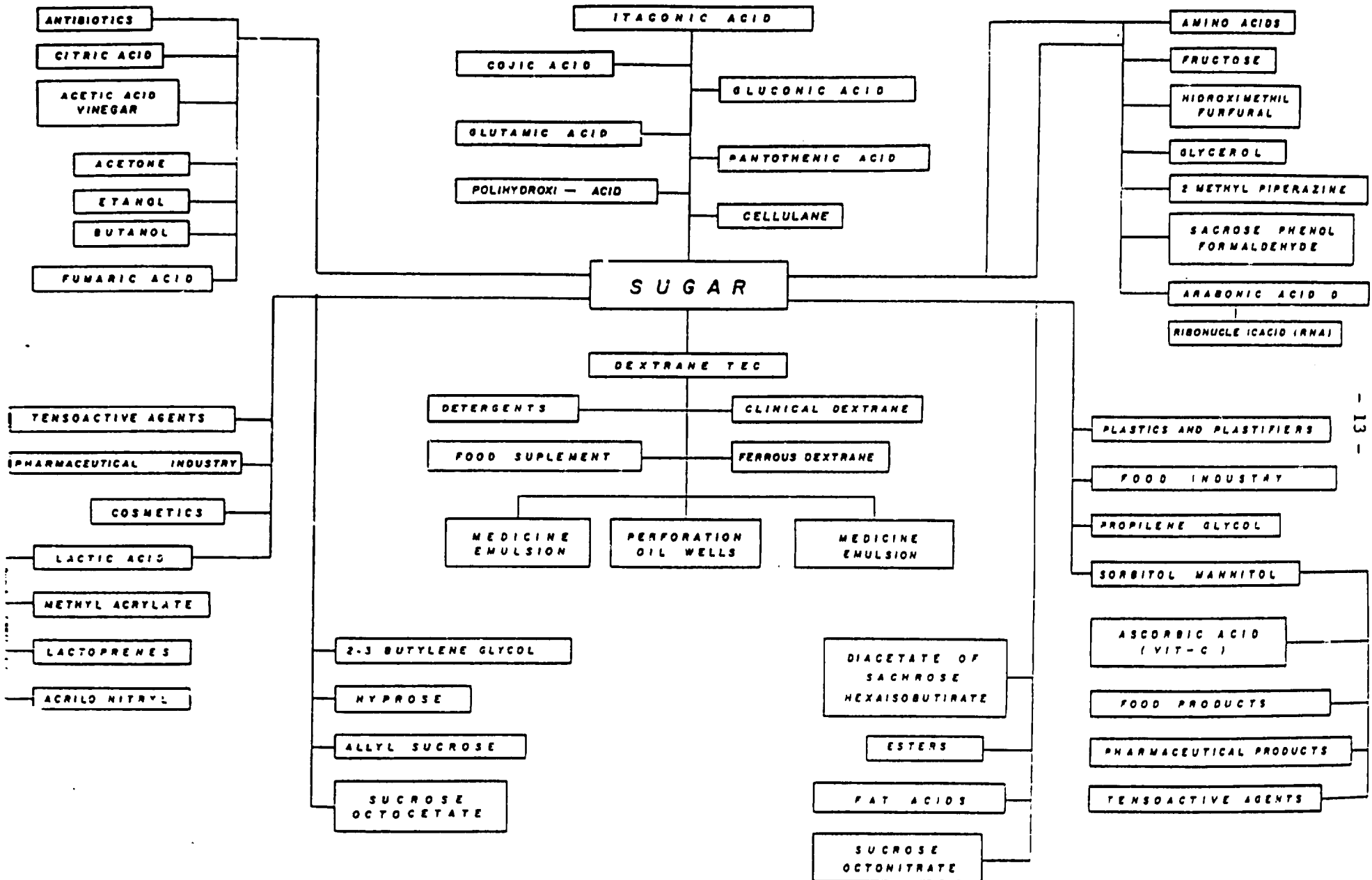
Starting from a list of different alternatives, from the technical point of view, it is possible to make an economic appraisal of the possibilities for every industry.

GEPLACEA has carried out a successful programme on diversification and is endowed with the capacity to disseminate the experience in the rest of third world countries.

As a closing remark we would like to express our willingness to share our experience with the Asian countries, in the same way we are already doing with the African countries, working together on practical steps, including every stage already followed by our diversification programme.

POTENTIAL OF THE SUGAR INDUSTRY DERIVATIVES





ANNEX III

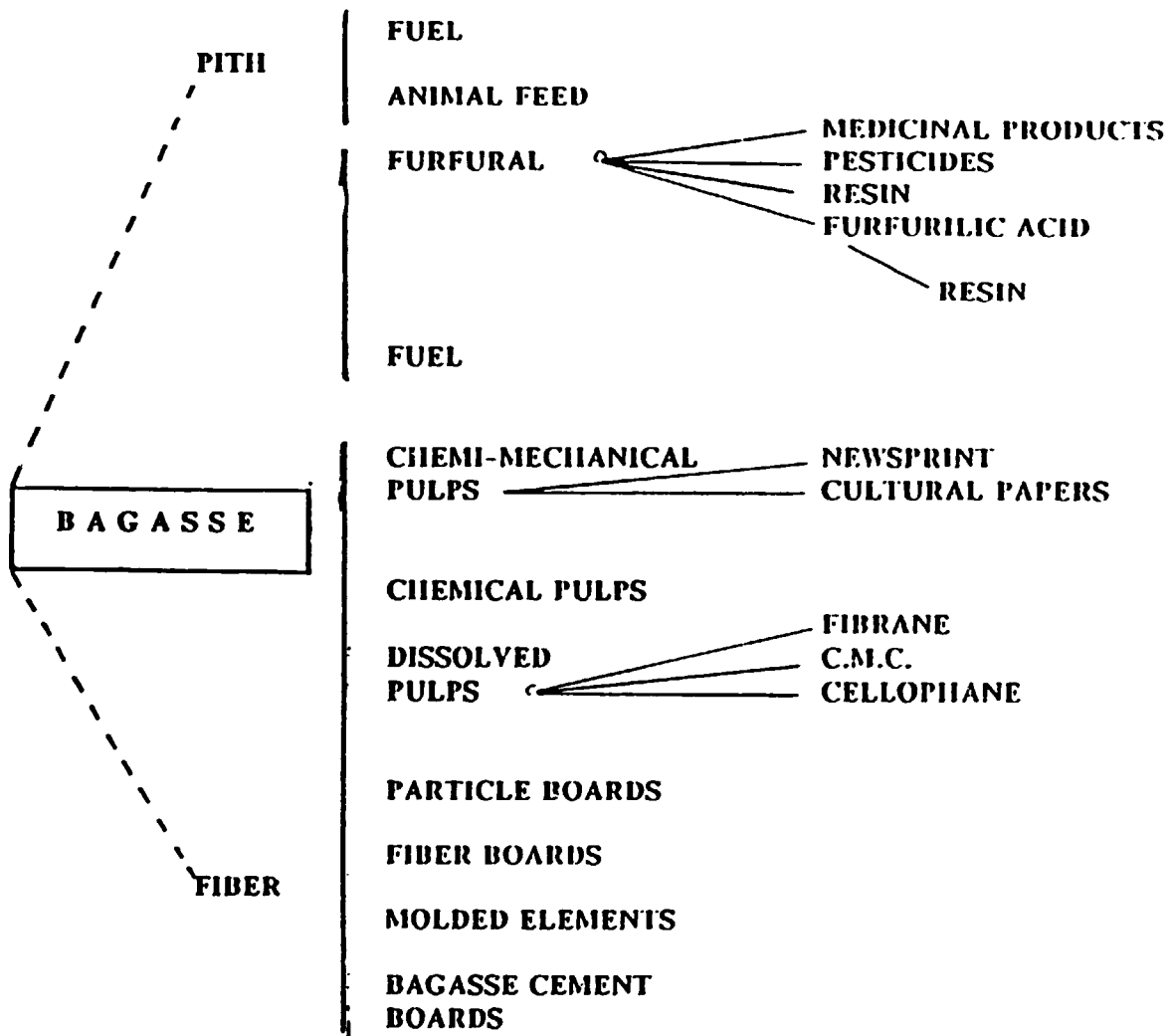
MOLASSES DERIVATIVES

	TORULA YEAST		
	YEAST FOR HUMAN CONSUMPTION	{	NUCLEIC ACIDS
	L-LYSINE		
	CITRIC ACID		
	MONOSODIUM GLUTAMATE		
	ETHYLIC ALCOHOL	{	ETHYLENE
			{ ALCO-CHEMICAL DERIVATIVES
			RUM
MOLASSES	CARBON DIOXIDE		
	FUSEL OIL		
	MUSTS	{	FERTILIZER
			ANIMAL FEED
			TORULA YEAST
	SACCHAROMYCES YEAST		
	RHODOTORULA YEAST		
	LACTIC ACID		
	PROTEIC MOLASSES		
	BUTANOL-ACETONE		
	ACETIC ACID		

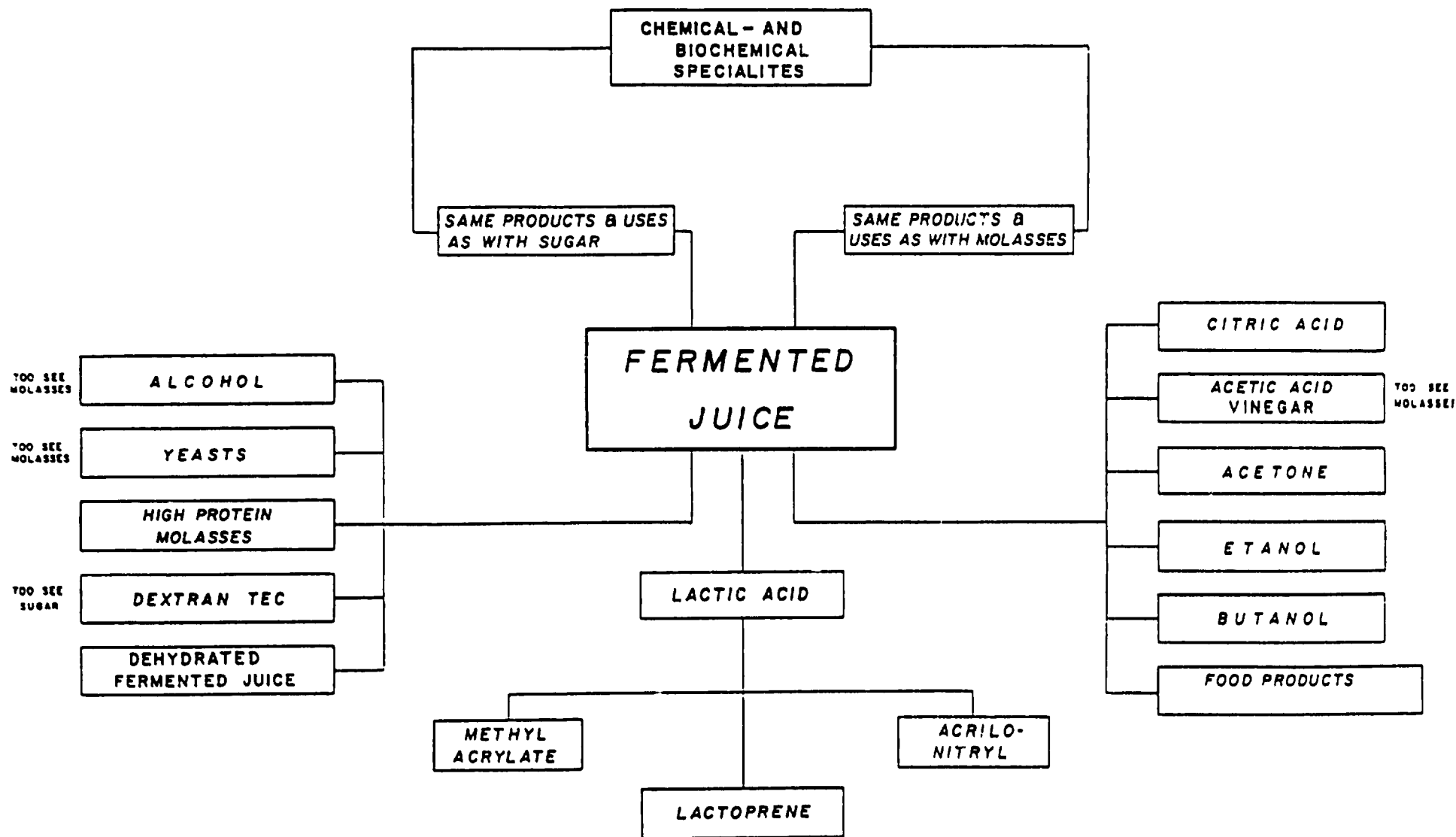
SOURCE: GEPLACEA

ANNEX IV

BAGASSE DERIVATIVES

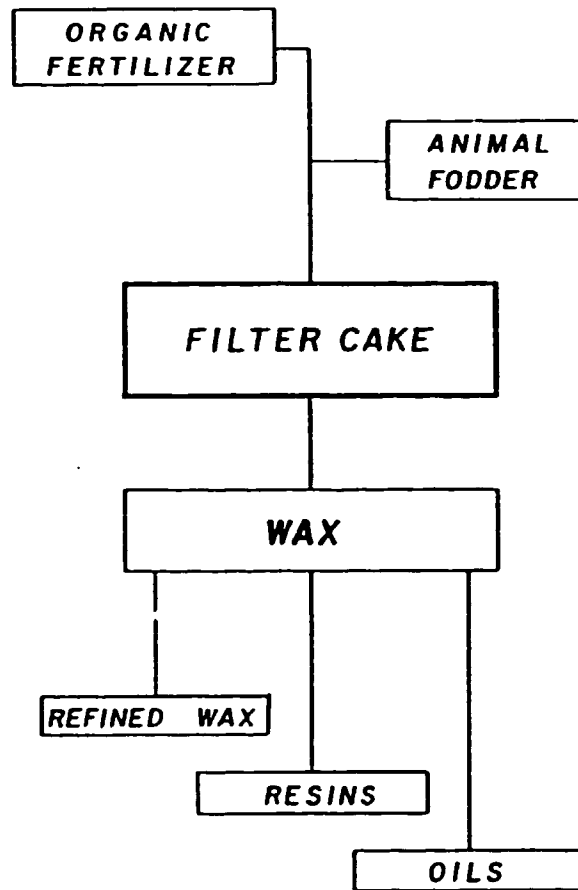


SOURCE: GEPLACEA



SOURCE: GEPLACEA

ANNEX VI



SOURCE: GEPLACEA

ANNEX VIII

AGRICULTURE DIVERSIFICATION THROUGH INTERCROPPING AND CROP ROTATION

The utilization of sugar cane areas to produce food as intercrop and crop rotation is an option to increase the diversification of the sugar cane sector.

There are many experiences on the subject, including Barbados, Indonesia, Fiji, Brazil, Costa Rica, Mauritius, Colombia and Australia.

The advantages of such a programme are:

- The sugar cane areas are usually soils of high productivity
- The cane growers have already a infrastructure to start new crops
- Maximize the use of capital goods and equipment, reducing the size of the idle season
- It gives additional revenue to the cane growers
- Increase employment reducing migration and fluctuations in the labor supply
- It could increase the productivity
- It reduce risk of erosion
- It has a multiplier effect in the agricultural sector

GEPLACEA is already working in a project on the subject with the objective of helping the countries to start an intercrop and crop rotation programme for sugar cane areas.

The expected results of such a project are:

- To set a network for exchange of experiences
- Projects for specific countries to be implemented
- Training on the subject
- Publication of methods and experiences
- A handbook on practical questions and recommendations