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Food-Processing Industry with Emphasis  
on Sugar-Cane Processing

Havana, Cuba, 26-30 September 1988

Issue Paper I

DIVERSIFICATION OF THE SUGAR-CANE INDUSTRY\*

Prepared by the  
UNIDO Secretariat

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## SUMMARY

The purpose of this document is to identify the major problems relating to the present situation of the sugar-cane processing industry with special emphasis on its diversification, to reveal and specify constraints which hamper the development of this industry in developing countries, and to examine and propose ways and means for international co-operation and actions needed to overcome them.

The world sugar economy is presently characterized by a combination of serious problems predominantly affecting developing countries. It is faced with recurring supply/demand imbalances reflected by fluctuating and unpredictable market forces. This has had unfavourable consequences for the GNP growth and commodity exports in many countries, especially those which strongly depend on sugar as the dominant export product and the principal source of foreign exchange earnings. The proliferation of alternative sweeteners in many industrialized countries also led to an accelerated decline of sugar consumption.

Broadly speaking, the crisis caused by low price levels over long periods accompanied by rising costs of production, has acted as a disincentive to the expansion of the sector. Consequently, investment or reinvestment for modernization and even maintenance of the industry has been made difficult, leading to the inefficiency of factories and low productivity in the sugar-cane agro-industry.

Because of the depressed state of the world sugar market and sugar producers, many export-oriented economies, especially in Latin America, have launched programmes of diversification, namely the introduction of the production of sugar by-products and derivatives. These could open new horizons for the sugar industry. The possibilities offered by diversification are well known, both in the agricultural and the industrial spheres; among the obvious advantages are its contribution to reduce cost of production, and to increase earnings and revenues from sale of these products on the market. Although the range of possibilities is promising, nevertheless it will be necessary to consider all the requirements for outlining a coherent programme and plan of action for its implementation in the short, medium and long term.

In spite of all obstacles and drawbacks in the way of achieving structural changes in the sector with the aim of improving its performance and profitability, diversification of the sugar-cane industry through the integrated utilization and sophisticated processing techniques is now one of the promising ways to save the sugar-producing potential of developing countries. The response to export decline in the wake of declining or at least stagnant international sugar prices and consumption is the development of an economic stimulus system to make the industry function in a new price environment to achieve competitiveness of by-products on the domestic and international markets and fully utilize the benefits of the diversification process.

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## I. SUGAR-CANE PROCESSING INDUSTRIES

### (a) Present performance and economic situation

1. The present critical situation in the sugar-cane processing industry in the majority of developing countries is characterized by depressed prices which are below the production costs of even the most efficient producers. It is also subject to recurring supply/demand imbalances thus influencing adversely the economic performance of the main exporters due to the dominant position of the sector in their economies. The sugar industry, being one of the principal sources of export revenues and a backbone in terms of employment, GNP and finance, has a definite "trigger effect" on other branches of the agro-industries and manufacturing sectors.

2. In the context of the analysis of the world sugar industry, it should be noted that as far as developing countries are concerned, the principal producers of cane sugar are located in Latin America, Asia and the Pacific. The former's current production amounts to 29 million tons, being the leading producer of the world's sugar production accounting for over 50% of the total sugar cane output. The Asia and the Pacific region, being in second position, account for a share of approximately 24% of the world output (24 million tons), but its exports amount only to 11% of world exports in comparison with almost 40% for Latin America.

3. Sugar cane cultivation in Latin America is characterized by high costs of cultivation, harvesting and transportation. The field work represents 60.8% of total production costs. Techniques and equipment dating back from the turn of the century co-exist with isolated advances introduced through technology transfers. The industry has also been facing such problems as obsolescence of machinery, waste of energy, pollution, lack of organized maintenance based on preventive and modern techniques. Consumption of sugar in Latin America grew at a yearly rate of 3.4% between 1970 and 1984 (from 10 million to over 16 million tons) with a per capita level nearly 40% higher than that of the average world rate. As a result, one of the principal points in the evolution of the sugar industry in Latin America is the recent shift from a traditionally export-oriented industry to one geared towards domestic consumption because of the increasing internal demand and drastic decline of exports. Consequently, exchange earnings dropped sharply from US\$ 5.5 billion in 1974 to US\$ 1.1 in 1985.

4. The situation in Asia is much more diverse than in Latin America. This makes a global analysis rather complex. The region has both the world's largest producer, India, and some of the major importers such as the People's Republic of China and Japan. Production technology ranges from the very traditional methods, still used in Nepal, to the most advanced in Japan and Taiwan. Most sugar produced in Asia is consumed by the domestic market or exported within the region. Consequently, in comparison to Latin America, Asia is not a major exporter of sugar. Furthermore, Asia as a whole is the world's largest importer with 10.0 million tons of sugar imported in 1988. In general it may be said that apart from Thailand, the Philippines and some export-oriented countries of the Pacific, facing similar problems within the sector as in Latin America, the preoccupation of the Asian countries is to have more self-sufficiency and improvement in productivity. There is a common view that to guarantee the efficient performance of the sector, it is necessary to seek ways and means for the diversification process and efficient utilization of by-products.

5. In addition to the pure technico-economic aspects, the cane sugar industry is characterized by large accumulated surpluses of commodity stocks and low prices of the raw sugar on the open market as well as stagnation in the growth of world consumption, especially in developed countries. The other features of the sector are the reduced import requirements of the open market owing to the increasing self-sufficiency of some importing countries, increasing protectionism on the part of the developed market economy countries, which has led to a reduction of their imports and increase in their exports, and consequently a shortening of the market available to the other exporters as well as downward pressure on world market prices. The failure of attempts to regulate the international sugar trade by means of a Sugar Agreement with proper economic clauses has also affected negatively the prospects for any improvements. Some new trends such as the growing importance of the white sugar and the rapid growth in many countries of consumption of caloric and non-caloric sugar substitute sweeteners, such as high fructose corn syrup (HFCS) and aspartame has further aggravated the complexity of the situation.

6. The principal effects of the above situation in the sugar-producing developing countries are a significant reduction in the value of their sugar exports and a decrease in the volume of sugar exports and sugar production itself. Taking into account the importance of the sugar-cane processing industry to these countries, the comprehensive analysis of the situation leads to the conclusion of the necessity of structural changes in the industry, its rapid and decisive adjustment to the new economic environment and market circumstances to preserve it as a key element in the economies concerned.

(b) Perspectives and development

7. As a logical result of the permanently worsening situation in the sugar industry and changes in the world market, the recognition of the need to intensify the search for alternative ways for the development of the sector and to seek viable solutions have started to transform sectoral and national economic policies and approaches. The comprehensive analysis of the sugar-cane processing industry with all its intersectoral linkages has strengthened its perception as an organic part of the economies of developing countries and the need to deal with it as an agro-industrial complex.

8. In the course of discussions which took place during the Regional Expert Group meetings in preparation of this Consultation, it was agreed that in view of the current economic situation of the industry, the search for higher productivity as well as for alternative and supplementary activities was a necessity which called for a redoubling of efforts to effectively face the economic problems caused by the present commodity crisis. In this connection the development of the industry, based on by-products production and the diversification of the industry in countries with an oversupply of sugar, would make it possible to offer them new opportunities, while in countries with a short-supply situation, special emphasis should be given to improving productivity, rational energy utilization and modernization of technology. Greater attention should be paid to analysis of markets and in this connection to the economies of by-products.

9. A comprehensive and integrated set of measures is called for to increase productivity and competitiveness in a new economic environment. It is necessary to extract the full benefits from the potentials offered in the system, i.e. the efficient direct or indirect use of all parts of the production chain, the industrial processing and utilization of the by-products of sugar manufacture, and manufacture of derivatives, that is to say, products other than sugar. With these considerations in mind, it is desirable to stimulate the process of diversification aiming at creating a new highly competitive industrial sector.

10. Theoretically, the possibilities offered by diversification are well known and have been thoroughly examined by many leading research centres and international organizations for example GEPLACEA. Nevertheless, though the range of these possibilities is rather wide, there are still certain circumstances that hamper its development. Regional or national characteristics should be taken into account in order to study the feasibility and applicability of diversification. It will be necessary to consider all requirements for outlining a sound programme and plan of action for its implementation in terms of its economic viability and justification.

## II. APPROACHES TO THE PROBLEMS FACING THE INDUSTRY

### (a) Diversification in all aspects

11. In view of the current economic situation of the sugar-cane industry the search for an alternative or supplementary activity within the industry is a reality which calls for minimizing the economic problems caused by the serious crisis of sugar oversupply on the world market. At present it has become evident that one of the ways to deal with this problem, with the exception of further efforts to reach a New International Sugar Agreement and to regulate prices, is the diversification of the sugar industry, which means among others the rational use of available resources and by-products.

12. The restructuring of the cane-sugar industry involves both the physical installations and the operating systems of the various production units as well as managerial methods. At present, the sector in its traditional form of operation does not fulfill the expectation of producers and consumers. It is necessary to raise the value of sugar-cane as a raw material and derive greater benefit from it than before by extracting more products.

13. Generally speaking, diversification and agro-industrialization of the sugar-cane sector present vast opportunities for the sugar-oriented economies but should not focus solely on the elimination of existing extra stocks and supporting of the world prices by restricting exports. The development of by-products would, in particular, make it possible to diversify the economies of the sugar-exporting countries and to eliminate their dependence on a single product. The efficient use of by-products might contribute to solving the problems of renewable raw materials, sources of energy and food supply. In this case thorough strategic planning, i.e. what group of by-products each country can start up with and build upon overtime is of great importance.

14. In practice the process of diversification of the cane sugar industry presumes the development of a co-ordinated plan of action for changing the traditional production activity within the sector. The strategy consists of deciding to produce the fullest possible range of consumer goods apart from sugar that would have an assured market and an acceptable price in the light of resources availability. It is also important to analyse the ways in which diversification is to be carried out, that is to say, what to produce, how to produce and with what resources, for what markets the new products would be intended when the process of diversification of production would commence, and in how many stages it would be carried out.

15. Apart from the "industrial" aspects of diversification, it is also necessary to regard the "agricultural" ones, i.e. to increase productivity of sugar-cane plantations to improve the efficiency of the entire activity. During the various expert group meetings the conclusion was reached that it was important to stress the need to cultivate the most productive varieties of sugar cane, to apply the most efficient cultivation methods and to introduce an intercrop rotation process to ensure maximum benefit from the soil. These practices are being adopted with excellent results in some of the sugar producing countries and many of these countries have devoted substantial resources to related research and development.

16. There are also new challenges to the process of diversification in a broader sense. In recent years, the phenomena of a rapid restructuring of the international sugar market pointed to the importance of the growing demand for and supply of "white sugar". In this connection any increase in the processing activities and of value added in the sugar industry would undoubtedly lead to the strengthening of the position of the sugar-exporting countries. The proper use of the spin-off benefits of research and development and effective application of technology development at all stages of the production chain could play a positive role in the process of restructuring of the industry.

(b) Production and utilization of sugar industry by-products

17. The processing of sugar-cane in modern agro-industry involves two principal products: sugar and alcohol, which can be produced separately in independent sugar mills and alcohol distilleries or concurrently or alternatively in the same industrial complex, by attaching distilleries to the sugar mills. In either case, one by-product is always present, namely, bagasse whose use as a fuel and as a raw material for the manufacture of other products is of great economic value. Over the past few years, bagasse has become a very important raw material for a wide range of new activities such as manufacture of pressed wood, animal feed, a source of caloric energy and electricity, paper and cardboard, fuel in pellet form, furfural, etc. However, the use of bagasse as a raw material calls for a study of various technico-economic factors, ignorance of which could make it difficult to process this valuable by-product. These are: the need for surpluses and knowledge of the best methods for obtaining them; the establishment of factories with capacities commensurate with those of the sugar mills and situated close to them; a link between the sugar mill and the derivatives plant; the study of bagasse and the best ways of handling and treating it in order to improve efficiency of operation.



18. The world production of molasses - another principal by-product of the sugar industry - fluctuates around the level of 36 mln. tons annually of which nearly 13 mln. tons originate in Central and Latin America with such leading producers in the region as Brazil (ca. 6 mln. tons), Cuba (2 mln. tons), Mexico (1,5 mln. tons), etc. It is mainly used as animal feed and to a lesser extent, transformed into alcohol by fermentation and distillation. Other alternatives include the production of yeast, citric acid, pharmaceuticals, monosodium glutamate, dextran, filter cake, etc.

19. One of the most impressive example of successful utilization of the sugar-cane by-products is fuel alcohol which proved most successful among the priority areas of the economies of Latin America. In spite of their controversial character from a purely economic point of view they are closely linked to a country's particular needs and are considered to play a multifunctional role in its economic stability. Advantage can be derived from reduction of the equitable sugar surpluses by, inter alia, expanding the internal market for alcohol, switching sugar exports for alcohol exports, and distribution of sugar production costs by producing derivatives which will help to overcome the effect of low prices. In Brazil, the alcohol produced in the framework of the Brazilian National Alcohol Programme (PROALCOOL) is basically used as an anhydrous alcohol, which is mixed with gasoline, hydrated alcohol (alcohol as a pure fuel), alcohol for exports, alcohol used for purpose other than energy such as in the pharmaceutical, beverage and alcochemical industries.

20. The alcochemical industry may be considered as a solution for the use of the extra stocks of sugar cane as a substitute for non-renewable raw materials in the petrochemical industry. Diversification always depends on the characteristics of each region and of the constituent countries. The example of Brazil shows the possibilities of the development of the alcochemical industry to the greatest extent. It now has eleven industrial sites in which the following products are obtained: ethers, acetaldehyde, acetic acid, acetates, glycolic ethylic esters, ethylic ether, ethylamines and ethyl chlorate. The ethanol by-products are the base of a wide range of products used daily: disposable cups, brake fluid, detergents, synthetic fibres, solvents, etc.

21. Sucrochemistry is another way to promote the process of diversification. It has a long history of development and there are more than 10,000 products derived from sucrose whose processing is technically feasible and economically viable. In general terms, there are three technically proven and economically profitable methods for producing derivatives from sucrose, namely, fermentation synthesis and conversion. These methods yield a number of commercially interesting chemical products, including enzymes, medicaments, sucrose esters, polyurethane, sorbitol, mannitose, glycerine, fructose, carbonic acid, etc. There is a consolidated captive market for each of these products in which sucrose derivatives can compete with derivatives of other raw materials.

22. The perspectives for a more intensive and efficient utilization of molasses are rather broad and impressive. Until now the principal molasses consuming countries are the US, Japan, and the European Economic Community. These markets consume around 80% of the total world molasses supply. That is why the national policies adopted in each country of Latin America and Asia

could play a vital role to the extent of the utilization of sugar-cane by-products within the national boundaries or by exporting semi-raw materials abroad. Given acceptable prices, sugar and alcohol can compete as raw material for the chemical industry, which has so far been based mainly on petroleum. However, as the latter is a non-renewable resource, it is necessary to intensify the use of other raw materials; there are technically and economically feasible production processes based on sucrose and ethanol, and these two raw materials come from a renewable resource, namely sugar-cane. Sugar-cane is also an excellent base for the manufacture of many liquid or low-calorie sweeteners and these products also have potential to compete with sugar substitutes that have caused the decline in demand.

(c) Market situation

23. The complexity of the market situation as was expressed in the document prepared by the International Trade Centre (ITC) for the Consultation meeting, and the necessity of its analysis were confirmed in the course of the regional expert group meetings for Latin America and Asia. Owing to the tight international market, the competition among exporters contributed to the destabilization of the production schemes. Creation of tariff and protectionist barriers has caused a difficult situation to a group of export oriented countries. The lack of efficient tools and mechanisms to regulate the situation hindered any effort to reach a mutually acceptable compromise in trade issues. In this connection the phenomena of the market forecast for by-products and derivatives is of great importance to assess the pace of the diversification process in the sugar industry.

24. To be economically profitable, industrial installations for the production of derivatives must have the capacity exceeding the domestic demand of most the sugar-exporting countries, since their markets are of small or medium size. It is also important to be aware of possible markets for the new products as well as their requirements and conditions with regard to quality and other characteristics, which are indispensable for successful competition with similar "original" products.

25. It has been found that a strong demand exists for alcohol, citric acid, monosodium glutamate and sorbitol in many developed and developing countries. If the product could be produced to meet quality standards and marketed at a competitive price, many sugar-exporting countries would be in a good position to transfer a tangible portion of the existing extra-stocks of sugar products. Any success toward expansion of international trade in by-products depends largely on production costs, and therefore, on the general performance and productivity of the sector. In this respect economies of scale, regional co-operation, introduction of new technology and know-how play a vital role towards meaningful changes in the sugar-cane industry.

26. For all the above reasons, the sugar-producing countries should reorient their traditional industry by diversifying their production so as to make it profitable and at the same time increase their exports when they have comparative advantage. Beforehand, it is essential to carry out realistic technico-economic feasibility studies and market assessments that take into

account information on all the peculiarities in the sector and subsectors in regard to regional differences. Because of the relatively high costs of such studies and the lack of adequate financial resources in developing countries to finance them, technical and financial assistance from developed countries, international organizations such as the Group of Latin American and Caribbean Sugar Exporting Countries (GEPLACEA), the International Trade Centre and other members of the UN system could be sought.

### III. PROBLEMS, PROSPECTS AND OBSTACLES OF DIVERSIFICATION OF THE SUGAR-CANE INDUSTRY

27. The prevalence of pessimistic outlooks of sugar exporters at present weigh heavily on the prospects of the industry. Even temporary improvements in price trends or accidental depletion of existing stocks cannot override the general tendency towards the stagnation of sugar consumption in its traditional form. Hopes to reach a new comprehensive International Sugar Agreement may be also justified only with a theoretical presumption that major producers, exporters and importers are definitely determined to create a balanced commodity system and are ready to sacrifice to some extent their national interests. Moreover, the present "unfavourable" trend in the sector for the export-oriented producers has given rise to a process of restructuring of economies. In this connection, it should be pointed out that any effort to preserve the old-fashioned approaches of dealing with the commodity crisis or to continue to build up export stocks in the form of sugar will undoubtedly be counterproductive and unsuccessful. In this respect, it should again be emphasized that the diversification of the sugar-cane industry would serve the best interests of sugar-producing and exporting countries by diminishing their dependence on the international sugar market.

28. Although the general orientation towards the diversification of the cane-sugar industry has become more or less obvious in the majority of sugar exporting and producing countries, the necessity of internal restructuring of the sector with serious consequences for the production chain and producers made it clear that a number of obstacles exist on the way of the implementation of this process. To reach the new horizons of the modern or even "futuristic" sugar industry requires certain efforts or even temporary sacrifices as a trade-off for the long-run benefits of restructuring.

29. Firstly, the availability of financial resources is one of the most pressing problems of the developing countries. The problem is that in addition to the general slow-down of the world economy and consequent financial restraints, the capacity of the developing countries for generating capital to any new economic programmes has been progressively diminishing as a result of the decline in international prices for their traditional export products and is further weakened by the rise in prices of imports of manufactured goods. Various socio-economic and political aspects of development have also brought additional financial pressure on the developing economies.

30. The availability of financial resources for the restructuring of the sugar industry becomes a key factor for its future development. One of the alternatives to acquire at least a portion of the necessary investment capital is the traditional instrument of getting financial assistance from international financing agencies (such as IMF, IDS, IBRD, etc.) on attractive

terms. Bilateral help or any kind of barter agreements might also play their role in providing the sugar industry with needed resources for its further development. Another alternative for the cane-sugar industry could be the implementation of diversification projects on the basis of mixed government - private financing, when both sectors have the needed resources for this purpose. Other variants would be an association between national and foreign capital through joint ventures or to attract foreign investments to the cane sugar industry by introducing a special tax exemption policy and economic incentives with a guarantee of their investments, profitability and safety.

31. A wide range of other problems should also be analysed and evaluated. Any restructuring process inevitably leads to the redeployment of various categories of manpower and temporary structural unemployment. This creates, in turn, a demand for special training for persons who would have difficulty in finding work in the same sector. When changing the orientation of the industry and existing production patterns, the need to close plants that are no longer profitable owing to their obsolescence and inefficiency also arises. In this connection, it is extremely important to plan the development of the sugar industry according to a comprehensive, carefully managed plan and guidance taking into account the macro-economic consequences of the process.

32. There are marked differences in degree of development of sugar-cane industry in different countries. Even at the South-South level, regional disparities sometimes reach a scale sufficient to characterize one of the sugar-producing countries as a possessor of high-technology and the other one with out-dated processing systems. In this connection the transfer of knowledge and experience among developing countries is of great importance in achieving growth objectives for their industries via diversification. It is therefore necessary to intensify South-South co-operation by concluding bilateral and multilateral agreements that enable these countries to strengthen national and regional markets, taking into account the need to reduce their dependence on the international market for sugar. These efforts, however, would be more effective if the support from developed countries in terms of technology and financing were forthcoming.

#### IV. FINAL CONSIDERATIONS

33. In view of the current situation in the sugar-cane industry the search for alternative and supplementary activities within the industry is necessary, in order to overcome present difficulties. In this regard, one of the ways to deal with the problems would be diversification, which should be given priority in the development of a new agro-industry based on sugar-cane as a raw material thus reducing dependence on a single product.

34. Diversification should be carried out by taking into consideration all aspects aimed at improving the operation of the cane-sugar industry and which require the necessary redefining of national policies and strategies. This process includes such measures as increasing the value added content of export products, capturing a greater share of the white sugar market and increasing the production and sale of derivatives. Special emphasis should be given to the economic aspects of diversification and especially to the mobilization of financial resources. Efforts are needed to provide necessary institutional and infrastructural arrangements to reach improvements of existing production especially in low productivity areas.

35. In principal the process of diversification is closely connected with the aim to improve efficiency and productivity of the sugar industry in general. Technological improvements available to the sugar industry as well as industries based on sugar by-products might play a vital role being progressively introduced. Mechanizing agricultural production as far as possible, modernizing sugar factories, especially with regard to energy utilization, establishing efficient preventive maintenance programmes for factory installations and co-ordinating technological development and research activities as well as training and transfer of technology would inevitably lead to the improvement of the performance of the industry in general.

36. Technological, managerial and economic innovations in the industry rely heavily on the requisite information and data base. This is why the exchange of information among industry, research centers and other institutions on a regional and global basis should be improved and promoted with better utilization of existing facilities and potentials. During the expert group meetings, it was considered that the establishment of regional advisory and consultancy services should be promoted to prepare, appraise and implement investment projects. The main objective of regional industrial research and development centers would be to conduct studies on subjects related to processing, production improvements and crop diversification in the sugar industry as well as to contribute to a better exchange of information through a network system. It would also be desirable to co-ordinate technological development and research activities as well as training and transfer of technology among sugar producing countries.

37. In a broader sense, international co-operation should be promoted on a wider scale as well as within the regions as on South-South and North-South basis, for short- as well as for long-term activities such as market development, transfer of technology, exchange of information, etc. It would be desirable for sugar-exporting countries to concentrate their external activities on intensifying the study of international markets for sugar, alcohol, molasses and other by-products and derivatives as well as negotiating fair prices for these products in traditional and non-traditional international markets. Broad activities are envisaged in the field of continuous efforts to use an International Sugar Agreement and the GATT forum to eliminate existing protectionist barriers in the trade of sugar.

38. Summing up, there is a definite need for co-ordinated activities of sugar-producing countries to solve the acute problems of the sugar-processing industry and to find reasonable and justified solutions for its future development. Joint actions, involving the active participation of both the developed and developing countries could give positive results for the benefit of all sides. Success could hardly be envisaged through unilateral actions.

39. The task of the Consultation is to:

(a) Discuss the present situation of the sugar-cane processing industry with special emphasis on diversification of the industry and the potential for expansion of by-products development that can be used for various purposes;

(b) Discuss the potentials for, and perspectives of applying new cost- and energy-saving technologies aiming at reducing production costs;

(c) Identify common and specific constraints which hamper the development of this industry in the developing countries of the region;

(d) Examine and propose ways and means for international co-operation and actions needed to overcome identified constraints;

(e) Develop and define project ideas for increased technical assistance and investment promotion activities to be implemented by relevant international organizations, North-South and South-South co-operation.