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Joint UNEP/UNIDO Seminar on the Implication
of Technology Choice in the African Sugar
Industry

Nairobi, Kenya, 18-22 April 1977

FINAL REPORT

Id. 77-3674

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INTRODUCTION

The Joint UNEP/UNIDO Seminar on the Implication of Technology Choice in the African Sugar Industry, was held at Nairobi, Kenya, from 18-22 April 1977, as part of the project "Development and Application of Appropriate Technology for the Sugar Industry in Africa", for which UNIDO acts as executing agency. The subcontracting component of the project is being carried out by the David Livingstone Institute, University of Strathclyde, United Kingdom of Great Britain and Northern Ireland.

The main objective of the Seminar was to indicate some basic guidelines for selecting environmentally sound technologies. A further objective was to promote the exchange of ideas and experience relating to research and development in the sugar industry. To facilitate this exchange, several formal presentations were made on work currently in progress by groups concerned with technological issues and by those addressing broader social, economic and physical environmental questions.

Few African countries are self-sufficient in the production of sugar and many are actively contemplating major expansion plans. The choice of technology and scale of production, therefore, are questions of considerable interest at the present time. While the current trend of the development of the sugar industry in Africa emphasizes medium- to large-scale projects, mostly designed and managed by a few large companies, the results of these projects may not always closely correspond to the development goals in certain areas.

Small-scale open-pan sugar production is of marginal interest for a number of African countries, particularly those that have already established or are planning to establish large-scale vacuum-pan sugar mills. Labour-intensive, small-scale operations with lower investment, if not subsidized, can hardly match the better yields, higher heat economy and benefits of by-products offered by large-scale operations. There may be scope, however, for developing simplified vacuum-pan mills with a smaller capacity (e.g. up to 1,000 tons of cane per day) in areas unsuitable for large-scale operations. The environmental impact of the sugar industry should be adequately studied in each particular case and corresponding steps should be taken to prevent deterioration of the environment as much as possible.

I. ORGANIZATION OF THE SEMINAR

The Seminar was opened by Jeremiah Nyagah, Minister of Agriculture of the Government of Kenya. In his opening address he outlined the history of the project and presented background information on Kenya's sugar industry. The chairman of the opening session was J. E. Opembe, Chief Executive Officer of the Kenya Sugar Authority.

The Seminar was attended by 12 participants from 8 African countries, 33 consultants and observers from both developing and developed countries, including representatives of the International Labour Organisation, the Food and Agriculture Organization of the United Nations and several commercial firms. Annex I gives the list of participants, consultants and observers.

Papers presented to the Seminar, listed in annex II, were discussed in working sessions. Each session had a chairman selected by consensus, who conducted the presentation of papers and discussions, as shown below:

<u>Session</u>	<u>Chairman</u>
1	Ato Hailu Shawel
2	M. H. Tantawi
3	Leo Pyle
4	J. Pickott
5	A. Mak
6	O. Popyrin
7	M. S. Wena

Miss F. Duguid was chosen as Rapporteur. Her report was adopted with a few minor modifications at the closing session.

II. REPORT

Session 1

The following paper was presented for discussion: "Recent developments in the world sugar industry" (ID/WG.247/8), by R. Robson.

The discussion revolved mainly around the question of the importance of high fructose corn syrup. In the United States of America, where corn is plentiful and demand for sweeteners considerable, high fructose syrup competes with sucrose. This phenomenon may be related to a high demand for sweeteners for industrial purposes rather than for domestic consumption. In Africa, where sugar consumption per capita is low but increasing, the proportion of total consumption by industry is relatively small; and there are more pressing needs for food grains. Competition between high fructose corn syrup and sugar should not be a serious problem for some time to come. It was pointed out, however, that for countries planning expansion of the sugar industry mainly for export, the possible loss of important markets in North America or Europe should be carefully considered.

Session 2

The following papers were presented for discussion: "Recent developments in large-scale sugar technology with particular reference to developing countries" (ID/WG.247/17), by A. W. MacGillivray and G. Wood; "Economic viability in African conditions of the large-scale vacuum pan technology" (ID/WG.247/10), by R. Alpine and F. Duguid; "Economy of scale in the sugar industry with special reference to sugar manufacture and transport" (ID/WG.247/20), by J. M. Paturau.

Much of the discussion on the first paper presented concerned the colour of sugar from large-scale vacuum-pan factories in developing countries. Technically, it is possible to produce any colour, from very white to dark brown, depending on the level of investment. Colour specifications are normally determined by the government, but since colour is not harmful, the question why should the whitest sugar be demanded was raised. In many developing countries, it may be preferable to supply slightly off-white sugar at a lower price than very white sugar at a higher price. The acceptability of any sugar is often cultural or strongly influenced by marketing.

The quality of sugar from open-pan sulphitation units was questioned. It was thought doubtful if this process could contribute to any export programme, both in terms of quality and the ability of the units to meet export requirements, particularly at times of low world sugar prices.

The final section of the paper, which offered a comparison between the merits of large- and small-scale sugar production, attracted criticism on the grounds that the economic underpinnings were based on casual impressions, and that insufficient attention had been paid to employment.

A large part of the discussion on the second paper involved the explanation or justification of basic assumptions used in the models and the reactions of experts in sugar-cane agriculture and sugar technology to these. A number of additional costs were suggested for inclusion in the models, such as housing, greater social welfare benefits, and the displacement of population, particularly in the plantation system.

Several participants showed considerable interest in mechanical harvesting. Despite the generalizations about surplus labour and scarce capital in developing countries, severe local or regional shortages of manual labour are forcing the possibly premature introduction of mechanized harvesting.

The main value of the third paper lay in the annex tables and figures reflecting Mauritian data. Some questions were raised about the validity of using power factors in calculating costs at increasing scales of production. It was pointed out that UNIDO had compared actual figures with such factors, and reasonable accuracy was found.

It was felt that a major message to be drawn from the paper was that concern with profitability would lead to the choice of the largest feasible scale of operation. This result, however, was based on a comparison of unit costs associated with different scales of operation relating to a particular specification of vacuum-pan technology. Results from a previous study were quoted to illustrate how changes at certain work stations within the vacuum-pan technology could lead to variations in other important economic and social parameters, such as employment, without significant sacrifice of profitability.

Session 3

The following papers were presented for discussion: "Environmental implications of different sugar technologies with special reference to India" (ID/WG.247/4), by B. Behari; "Economic viability in African conditions of the small-scale open-pan technology" (ID/WG.247/11), by R. Alpine and F. Duguid; "Engineering issues in the manufacture of open-pan sugar processing machinery in developing countries" (ID/WG.247/3), by S. W. Ohingo; "Australian cane-growing and sugar milling - some implications of the technology employed" (ID/WG.247/5), by G. A. Ferguson.

The first paper generated a great deal of interest in the Indian situation particularly as regards the fiscal variations between the vacuum-pan factories and the open-pan sulphitation (OPS) units. In India and elsewhere the viability of the small-scale units, if faced with the same tax burdens as large-scale factories, has been questioned.

The second paper complimented the earlier one on large-scale technology by the same authors, and, as before, some time was spent discussing the assumptions used. Parameters were largely based on Indian observations and literature. The need for consideration of land utilization and the opportunity cost of alternative uses was stressed, as was the possibility of considering alternative scenarios from those used in the large-scale model. A particular case mentioned was that of an area with insufficient suitable land to support a large-scale factory rather than making the assumption that the area of land needed for a given scale was automatically available.

The third paper dealt with the specifications of required equipment and the degree of engineering capability needed for a country to be in a position to fabricate each of the major items, and the concomitant requirements for skilled manpower. Possible alternative or modified techniques should be considered both before this type of industry is established and during its development. Two questions remaining concern the level of skill required at each stage in the process and the likely number of OPS units that would be able to sustain local manufacture at below the costs of imports.

The fourth paper, although departing from the theme of small-scale in the factory sense, dealt with the Australian experience on the agricultural side, in particular with the transition from plantations to small farms and increased mechanization. Participants were interested in learning more about the cane farms and the degree of control over the cane supply and of subdivision holdings. Several of the delegates pointed out that in their countries farmers were being forced to mechanize owing to labour shortages. It was explained, however, that in Australia mechanization was introduced gradually, beginning with smaller and simpler machinery. It took about 25 years, to reach the present stage of mechanization. The transition, if too rapid and not fully planned, would be very costly indeed.

Session 4

In this session the discussion, hitherto concerned with the necessary but narrow technical-economic view of the sugar industry, moved on to broader environmental questions.

The following papers were presented for discussion: "The long-term agricultural implication of cane-growing" (ID/WG.247/7), by Z. A. Manshawi; "Pollution control in sugar industry" (ID/WG.247/21), by P. Kiravanich and Y. Unkulvasapaul; "Possibilities for the further processing of sugar industry by-products" (ID/WG.247/16), by F. Duguid and R. Alpine.

A major point discussed in the first paper was cane burning. For the benefit of the soil, a trash-saving or return-to-field system was suggested, but the main disadvantage was in the lower productivity of cane cutters. Research elsewhere has found no advantage in trash-saving except from the point of view of cane deterioration as a result of burning. Development of mechanical harvesters for green cane is underway for this reason. Although the question of the impact of irrigation was not specifically covered in the paper, the Meeting felt that it was an important environmental issue. Depending on the scale of a new irrigation system, the effects on the existing habitat, flora and fauna can be severe as a direct result of river diversion and regulation.

It was felt that the report on Thailand's experience with pollution from the sugar industry could be taken as a warning to countries where the industry concentrated in a certain area, as is not uncommon. It was agreed that Thai conditions were somewhat unusual - with 18 mills on a short stretch of river and where a large proportion of the population depended on that river for domestic water or indeed their livelihood. However, it was noted that this situation was by no means unique. It was recognized that, in the large-scale technology at least, the original design of a new project should include such things as a water-treatment plant, reduced entrainment, adequate facilities for storing molasses, and separation of waste streams requiring different levels of purification. It was accepted that waste water from OPS units would cause greater pollution than that from the vacuum-pan factories; but since small units would tend to be more widely scattered, local effects would be less. For this reason, it may not be necessary to require small plants to invest heavily in treatment plants to achieve the same stringent standards applied at present to the large factories.

The third paper emphasized a few of the simpler and more likely possibilities for further processing the by-products of the sugar industry such as producing cattle feed and fibreboard. Part of the discussion related to the value given to molasses in the analysis. Contradictory views among the participants illustrated the problems of dealing satisfactorily with commodities having a widely variable world market price. A great deal of interest was expressed in the production of power alcohol for use as a petroleum substitute in a proportion of 15-30 per cent. Although some participants felt that molasses processing was unnecessary if export markets were secured, others advocated diversification. A useful environmental issue was raised - namely, the feasibility of producing charcoal briquettes from bagasse with the possible advantage that deforestation resulting from the production of charcoal would be reduced.

Session 5

The following papers were presented for discussion: "Potentials and impact of by-products of the sugar-cane industry" (ID/WG.24/6), by O. Almazán del Olmo; "Energy consumption in the sugar industry" (ID/WG.24/13), by F. Duguid and R. Alpine; "Environmental and economic impact of alternative agricultural sugar technologies" (ID/WG.24/12), by J. Pickett and F. Duguid.

Despite its general title, the first paper proved to be fairly specific to Cuba. The paper warned against producing sophisticated chemicals with restricted markets; if export was the main objective, severe competition would have to be faced with large producer-cum-buyer companies.

The second paper, pointed out that small-scale technology did not prove to be much different from the large-scale with the same distribution pattern, but it consumed considerably more energy in the less densely populated rural area than in urban centres. Although the large-scale technology appeared to lose some of its fuel economy when the problem of distribution was added, this loss could be somewhat offset by distributing inputs such as chemicals to one rather than to several units. A point of interest was the possible generation of surplus electricity during the crushing season. It would be technically feasible, particularly if the idea could be incorporated into the early stage of factory design. It would thus be desirable if government authorities responsible for the sugar industry and power generation individually could come together at an early stage.

Although the third paper concluded in favour of a continuation of manual as opposed to mechanical harvesting in the situations examined, several participants reiterated that their countries faced a severe labour shortage. However, after a discussion of the manual harvesting system of Australia before the introduction of mechanized harvesting, it was generally agreed that there was tremendous scope for improvement in productivity and in the working conditions of the cane cutter. Three of the items for consideration are the nutrition of the cane cutters, the improvement of cutting tools, and an effective wage-incentive scheme.

An important consideration not covered in this paper is the acceptability of mechanically cut and chopped cane to the factory. Sucrose losses can be serious, so on the one hand manually cut cane would be preferable. On the other hand, field staff are faced with the problem of having to supply a given quantity of cane per day; in certain circumstances, meeting the target may be possible only with mechanization.

Session 6

The following papers were presented for discussion: "Sociological issues in the design of cane-growing systems" (ID/WG.247/1), by A. H. Barclay; "The impact of sugar technologies on social change and development" (ID/WG.247/2), by A. H. Barclay; "Present and potential sugar production and consumption in Africa" (ID/WG.247/19), by T. Gedamu.

The first paper discussed the success or failure of the outgrower system in several countries. The influence of the prevailing land-tenure system was the next topic; it was recognized that this system could be significantly altered for the benefit of all. Some participants felt that certain arguments presented against the plantation system were not entirely valid. It pointed out that a sugar company required a given quantity of cane every day; although control over small holders could be taken to an extreme, some degree of control was needed to run the factory smoothly. With regard to the acquisition of land for new plantations, the difficulties associated with displacing those living on the land were discussed. It was pointed out that the new settlements resulting from movement of population required careful planning if environmental hazards were to be avoided.

The second paper analysed the vacuum-pan and OPS technologies from the point of view of social change. A number of participants remained sceptical as to the suitability of the OPS unit to African conditions and held the view that the introduction of OPS would be a backward step. It was suggested that there might be a compromise, whereby more labour-intensive methods could be used in small vacuum-pan factories. Much of the less sophisticated equipment could probably be manufactured locally, which would give a country the feeling that it did possess the know-how and ability to create the goods and thus could develop further on that basis.

Questions were asked about the Australian experience. It has shown that the sugar industry has thrived, and brought about development of regions, despite the fact that in most years it would have been cheaper to import sugar. The development has also been assisted by the transition from wage labour on plantations to the ownership of small farms.

The third paper gave a projection of per capita sugar consumption in 1985 that was judged by some to be an overestimation on the grounds that alternative sweeteners would cut into the export markets; others believed it to be an underestimation in view of the expected increase in the income of the poorest sector of the population and therefore increased consumption. Increased income, however, depends on the generation of greater employment opportunities and hence employment was one of the major elements of discussion in the proceedings.

Session 7

The following papers were presented for discussion: "Impact of different technologies on the economic environment" (ID/WG.247/9) and "The sensitivity of sugar technology performance to changes in technical and economic parameters" (ID/WG.247/15), both by R. Alpine; "Measuring the environmental and economic impact of alternative technologies" (ID/WG.247/14), by J. Pickett.

The first two papers of this session were presented together. The basic methodology was generally acceptable to the participants and several valuable suggestions were made for additional costs and benefits and alternative parameter values, particularly shadow exchange rates. (It was agreed by both participants and authors that the models used throughout the series of papers from the David Livingstone Institute were not expected to be used intact. It is hoped, however, that enough detail and explanation was presented to enable more specific country or project data to be substituted.)

The discussion of the third paper touched on the relationship between economic growth and the maximisation and utilization of the surplus. There was some further discussion of the respective merits of the OPS and modern vacuum-pan processes.

The conclusions of the Seminar were outlined in the closing session. There was general agreement that the Seminar had produced useful discussions and that the background papers had been exceptionally informative. Appreciation was expressed of the work done by the David Livingstone Institute. It was suggested that UNIDO and UNEP should consider organizing seminars similar to the present one. It was noted that the combination of consultants and practitioners facilitated the discussions, and that the focus of the seminar on specific industry gave meaning to the general questions of environmental impact and choice of technology.

Much of the discussion was concerned with the OPS technique. There was general agreement that this technique and the problems of using it in certain African conditions should be further investigated.

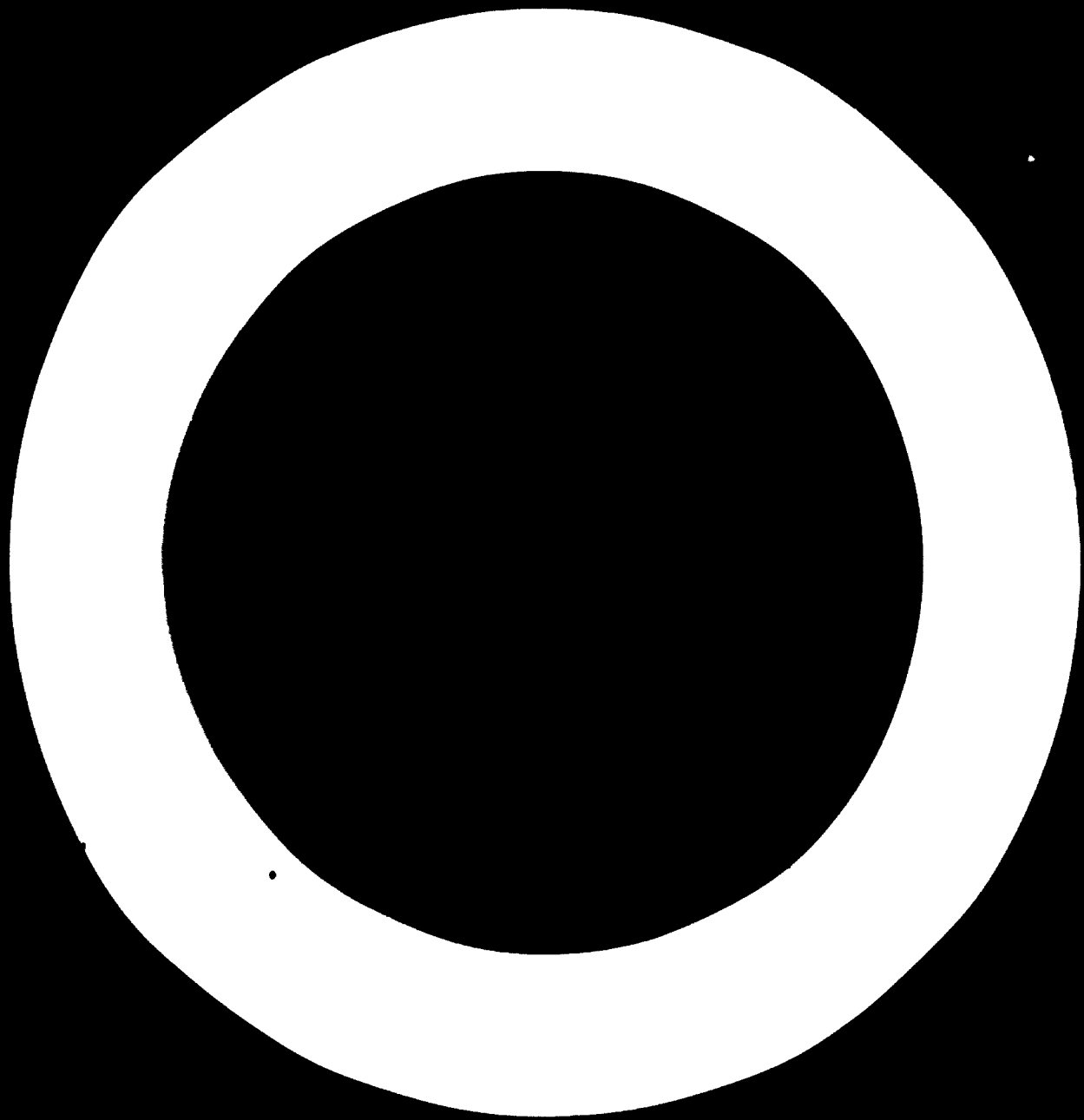
In this connection, one suggestion that seemed to command general support was a programme phased as follows:

- (a) A further study of the OPS technique in Indian conditions with a view to establishing its suitability for Africa;
- (b) The establishment - after suitable research and development - of a number of pilot OPS plants in "representative" African countries;
- (c) A systematic evaluation of the operation of these plants.

It was made clear that not all of the subsequent attention paid to technology should be given to the OPS technique. In particular, it was pointed out that there was scope for work on modification of the modern vacuum-pan process, and also scope for a careful investigation of the circumstances under which the large- and small-scale technologies would be viable. It was also noted that it might be relatively easy to establish a number of small OPS factories, but the problem of obtaining substantial amounts of sugar in this way might present difficulties. The suggestion was made that contact with the National Sugar Institute of India might be helpful.

It was recognized that the models that underlay the technical papers were not directly applicable to specific African countries. It was, however, felt that the models were useful and suggested guidelines that could help individual countries.

It was also felt that large-scale technology should not be neglected; combinations of large- and small-scale could be feasible. Even more consideration should be given to the environmental impact of technology choice; and the importance of conducting market research before using one system or the other was stressed.



Annex I

LIST OF PARTICIPANTS

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Annex II

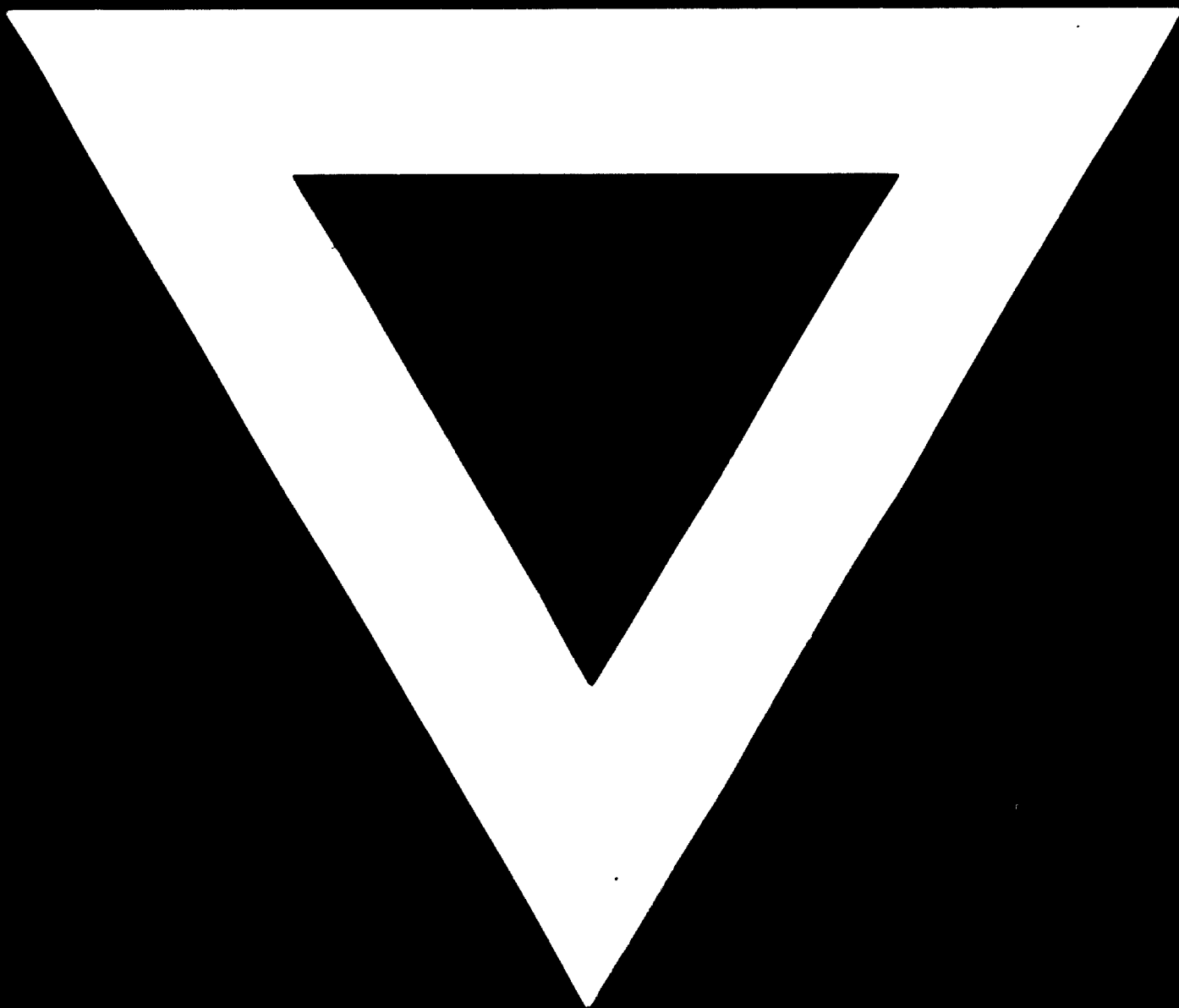
List of documents

<u>Symbol</u>	<u>Title and author</u>
ID/WG.247/1	Sociological issues in the design of cane-growing systems By A.H. Barclay
ID/WG.247/2	The impact of sugar technologies on social change and development By A.H. Barclay
ID/WG.247/3	Engineering issues in the manufacture of open-pan sugar processing machinery in developing countries By S.W. Ohingo
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ID/WG.247/6	Potentials and impact of by-products of the sugar-cane industry By O. Almazán del Olmo
ID/WG.247/7	The long-term agricultural implication of cane-growing By M.A. Meshawi
ID/WG.247/8	Recent developments in the world sugar industry By R. Robson
ID/WG.247/9	Impact of different sugar technologies on the economic environment By R. Alpine
ID/WG.247/10	Economic viability in African conditions of the large-scale vacuum-pan sugar technology By R. Alpine and F. Duguid
ID/WG.247/11	Economic viability in African conditions of the small-scale open-pan sugar technology By R. Alpine and F. Duguid
ID/WG.247/12	Environmental and economic impact of alternative agricultural sugar technologies By J. Pickett and F. Duguid
ID/WG.247/13	Energy consumption in the sugar industry By F. Duguid and R. Alpine

- ID/WG.247/14 Measuring the environmental and economic impact of
alternative technologies
By J. Pickett
- ID/WG/247/15 The sensitivity of sugar technology performance to
changes in technical and economic parameters
By R. Alpine
- ID/WG.247/16 Possibilities for the further processing of sugar
industry by-products
By F. Duguid and R. Alpine
- ID/WG.247/17 Recent developments in large-scale vacuum-pan sugar
technology with particular reference to developing
countries
By A.W. MacGillivray and G. Wood
- ID/WG.247/18 Provisional list of participants
- ID/WG.247/19 Present and potential sugar production and consumption
in Africa
By T. Gedamu
- ID/WG.247/20 Economy of scale in the sugar industry with special
reference to sugar manufacture and transport
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