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THE IMPACT OF SUGAR TECHNOLOGIES ON SOCIAL CHANGE AND DEVELOPMENT 1/

by

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This paper is concerned with the linkages between sugar technologies and the patterns of development in the societies where they are introduced. Although the problem is of broad significance in many African countries where major expansion of the sugar industry is being considered, the full spectrum of relevant issues has not always received adequate analysis. Too often it has been conveniently assumed by those interested in promoting expansion that as far as the industry's impact is concerned, development and change are identical concepts. On this basis, virtually any major agro-industrial project could be justified as contributing to "development" in rural areas, so long as it generated substantial far-reaching changes. Indeed, the larger the investment and the greater the demand for land and labor to support the new project, the brighter the supposed developmental prospects.

Increasingly, however, within the developing countries and the United Nations system as a whole, a clearer conception has emerged of what development means and actually involves. The following are the key social dimensions of this conception:

1) reduction in inequalities;

2) decentralisation of economic power;

3) integrated planning to secure balanced growth;

4) mass participation leading to increased self-reliance; and

5) preservation and enhancement of endogenous cultural traditions.

In this context, the desire to promote the development process is closely bound up with certain preferences as to the form and direction of societal evolution. The framework does not amount to a detailed prescription for political and institutional measures, but it is self-evident that elitist and authoritarian structures are assumed to impede rather than assist

the development process.

With the benefit of this framework, we may proceed to examine the case of sugar technology operating under conditions where accelerated development is a matter of great urgency, namely, in the countries of Africa. Our perspective will necessarily be a critical one, since we wish to distinguish between consequences which contribute to the social-developmental goals outlined above, and those which do not. The following discussion contributes to the construction of technology profiles for the sugar industry. The focus on social dimensions anticipates the eventual integration of this argument into more comprehensive profiles that can be used in the decision-making process to identify environmentally sound and appropriate sugar technologies.

I. Background Notes on Sugar and Development

The sugar industry is relatively young in most African countries, but has experienced rapid growth during the past decade. As a tropical crop, sugar cane is well suited to the climatic conditions obtaining in many parts of the continent. Because of their concern with attaining self-sufficiency in sugar production - arising from the uncertainties of the world sugar market as a source of imports - many African states are now planning further expansion. For the most part, plans in this sector deal with the establishment of new vacuum-pan factories of comparatively large scale and high capital cost, and with the design of agricultural systems to supply them with sugar cane.

Such new projects give visible expression to the widely shared aim of industrialisation. They have the further appeal of promising to create employment in rural areas, as opposed to urban areas where most industrial activities have hitherto been concentrated. Given adequate specification of technical parameters and satisfactory calculation of financial returns, they are capable of attracting investment capital both from the

developed countries and from international agencies. In addition, the techniques of "social" cost-benefit analysis may be used to predict how various benefits, both direct and indire t, will be distri ted among the surrounding rural population.

It is hardly surprising, then, that in contemporary Africa - where opportunities for industrialisation are highly valued - further expansion of sugar production is thought to be an instrument for accelerating rural development. While standards of technical performance and levels of capacity utilisation vary from one project to another within and between countries, sugar as a product seems certain of a growing African market, and many new area exist where it is capable of being produced. Precisely because of these considerations, the relationship between the industry and the process of development - specifically with regard to social goals - invites closer study.

The need for such analysis is underscored by a reading of the literature on areas (outside the African continent) where the sugar industry has a much longer history. Several writers have dealt with the role of export crops in agricultural development and with the problems associated with monoculture. Douglass North, for example, concluded that "regions that remain tied to a single export commodity almost inevitably do not achieve sustained expansion".[1] R. E. Baldwin, another economic historian, maintained that areas dependent on plantation crops were unlikely to create sufficient internal demand to stimulate diversification; he identified greater potential in areas where mixed cropping was practiced on family-owned farms.[2]

Those general formulations have been applied to the particular case of sugar by a number of scholars. They have remarked on the fact that the historical evolution of sugar production has been characterised by increased specialisation, concentration of economic power, and the substitution of capital for labour. These very processes, they claim, have had the effect of diminishing the scope for local participation and control. Paradoxically, then, the industry develops

while the society around it stagnates. The basic premise of this model is that the social "product" of the sugar industry is not development, but underdevelopment.

Several examples from this literature may be briefly cited:

1) Fiji: Watters stated that "sugar is a crop that almost everywhere leads to a pattern of increased mechanisation, the growth of super-capitalism, foreign ownership, corporate control and economic imperialism".[3] He interpreted the growth of the Fijian sugar industry in the context of this general observation, and concluded that Fiji was typical of the pattern, especially with regard to the emergence of monoculture and the concurrent disappearance of other peasant crops.

2) Mauritius: Brookfield, in a study of the island's agricultural economy, noted that specialisation in sugar production had brought many people to a higher standard of living than would have been possible under subsistence cultivation. "But there is a reverse to the medal", Brookfield continued. "Monoculture has brought Mauritius into a position in which the demands of the dominant industry inhibit the development of others. These demands are leading to moves which are re-establishing the plantation in a more massive and capitalised form".[4] In a country with rapid population growth and a shortage of employment opportunities, Brookfield noted that the social costs of continued "success" within the sugar industry were likely to be severe.

3) West Indies: A school of thought has been emerging among West Indian political economists in which plantation agriculture and its associated social and economic institutions are seen as sustaining a cycle of "persistent poverty". The "spread effects" emanating from the system to the wider society are viewed as negligible. G. L. Beckford, a prominent member of this group, cited modern sugar estates as a case in point: "The enclave character of the sugar plantation creates a certain artificial specificity of resource use. Thus we find plantations serviced with roads, electricity and water supplies while

surrounding rural areas are without such facilities even where there is excess capacity for plantation use".[5]

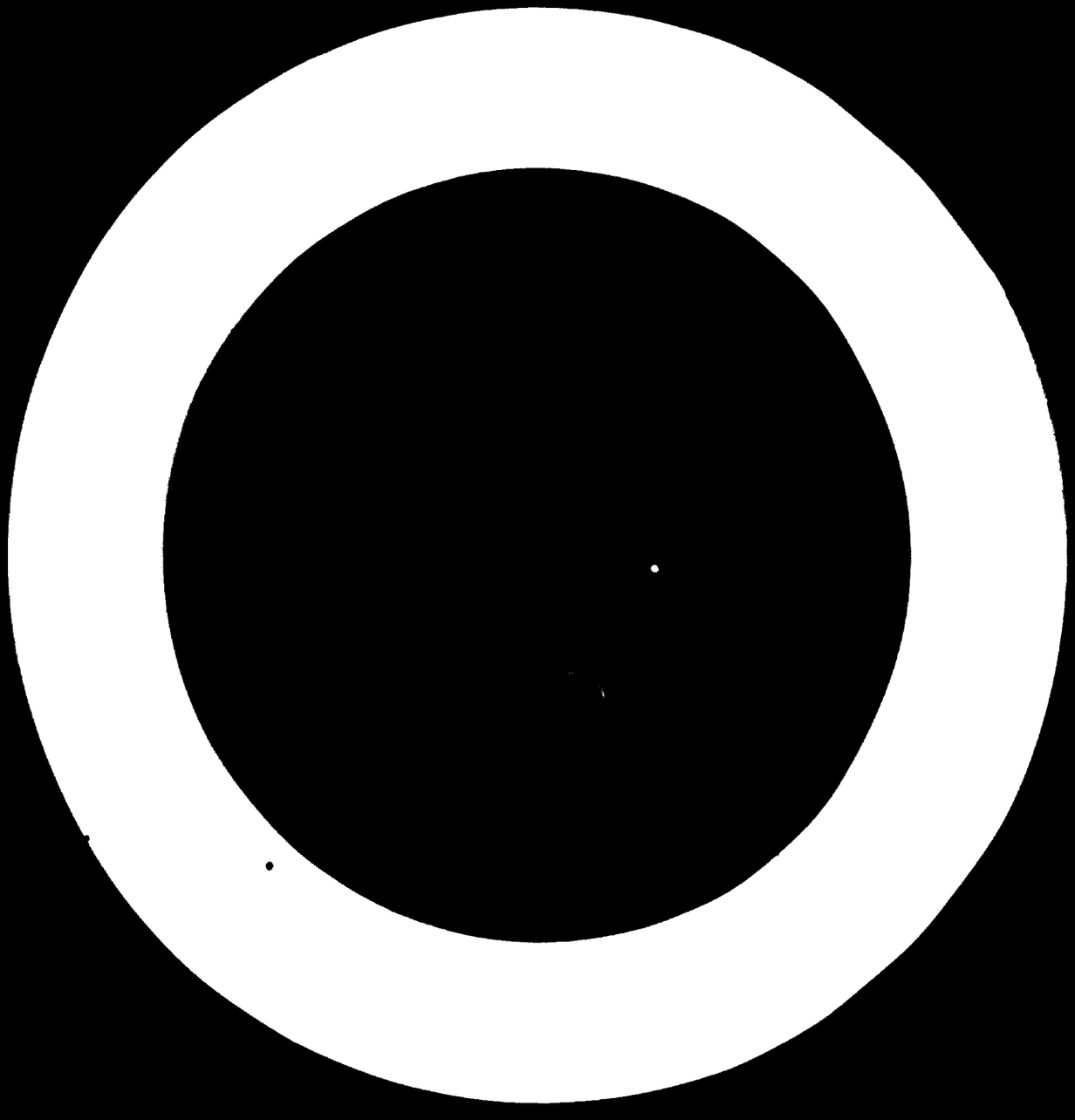
These critical views of the industry indicate that the developmental stimulus of sugar production cannot be assumed to exist *a priori*, but must be demonstrated empirically. Some of the problems identified in the literature manifest themselves in the agricultural sector, and have been dealt with in a separate paper prepared for this seminar.[6] There is a particularly strong concern with the effects on local development of placing vast areas of land under a single cash crop. Yet decisions in this sector are made in conjunction with decisions about the type and scale of sugar processing technology.

For purposes of clarity we will deal here - as in other presentations at this seminar - with a comparison between two processing technologies: the large-scale/vacuum-pan and small-scale/open-pan processes. To what extent and in what ways does the selection of one rather than the other influence the potential realisation of social-developmental goals? In other words, how do the technology profiles for vacuum-pan and open-pan sugar production compare in this crucial respect?

II. Social Dimensions of Sugar Technology Profiles

When a complete profile has been assembled for a particular technology, it will consist of a set of components, some qualitative and some quantitative. Obviously the direct comparison of technologies is simplest when only the quantitative criteria are taken into account. But the drive to improve the range and depth of technology assessment requires that qualitative judgments be given their due, even if they are inherently less rigorous.[7] As they are made more explicit, it is to be hoped that they will be further refined, thereby improving the precision of the selection process.

The social dimensions of development are relatively open-ended and are not mutually exclusive. The difficulties of quantification are immediately apparent if we examine concepts 4) and 5) in the framework presented in the introduction



feature of post hoc justifications for decisions already taken, and focus on the critical issue of equity. The questions need to be an integral part of the selection process, for they help the decision-maker to predict the form of the social system that takes shape once a particular technology has been chosen and introduced.

It is not easy to arrive at definitive answers to all these questions without reference to the endowment of skilled manpower and engineering capabilities in the particular area where a new sugar industry is to be created. We can make a broad comparison between the two sugar technologies, however, in relation to the general situation prevailing in the rural areas of Africa, where persons with technical or engineering backgrounds are in short supply.

Characteristically, vacuum-pan factories are established in African countries on a turnkey basis, having been designed and fabricated in an exogenous setting. Along with the importation of capital goods, foreign expertise is required in the initial stages: expatriate managers supervise the installation of the factory, test the equipment, and remain on site to direct actual processing operations when construction is complete. Over the course of time, these expatriates are replaced by local personnel as the latter acquire experience and training. The Africanization of senior posts generally does not involve modification of the social infrastructure established in the early phase of the project, wherein sharp divisions of class and status distinguish managers from labourers, and skilled workers from the unskilled. In this highly differentiated social system, workers recruited from the surrounding rural population enter at the bottom level and tend to remain there.

Dualism and inequality, therefore, are the hallmarks of this pattern. Are they the unavoidable consequences of adopting vacuum-pan technology? There is no basis for concluding that they are, but it is equally clear that the technology itself has limited flexibility: it is demanding in terms of skills, sophistication and experience, having benefited from continuous research and development activities in the developed countries. The successful operation

of a vacuum-pan unit requires specialisation and esoteric technical training on the part of its managers and supervisory staff, whereas the majority of ordinary labourers need not have any specific skills whatever to perform their jobs. The juxtaposition of those two categories of employees within a single industry poses enormous difficulties for the development of an egalitarian social system.

By contrast, the OPS unit is much less demanding in its skill requirements, and is therefore capable of absorbing untrained labourers into employment at most of its work stations. In a unit crushing 100 tonnes of cane per day, the total labour force would be in the range of 150-200 persons, of whom perhaps 15% would be skilled, semi-skilled or managerial staff. This scale of operations does not eliminate the need for direction and managerial control, but it permits face-to-face interaction between individuals, avoiding the impersonality of social relationships within a hierarchically organised unit of much larger size. In this respect it would appear that the small open-pan unit is inherently more flexible with regard to its internal social organisation, and therefore less prone to the development of dualism and class divisions.

2) Decentralisation of Economic Power: We may recall Watters' polemical remark about the association between the sugar industry and "super-capitalism", foreign ownership, and corporate control. These phenomena run counter to the conception of development that we have adopted, and are inimical to the expressed policy aims of virtually all the nations of Africa. Therefore we may ask whether they are universal within the industry, and whether the choice of technology affects the likelihood that they will recur in new projects.

Put more succinctly, the question is whether the sugar industry can serve the purpose of increasing domestic capital formation in African countries. Can the members of rural populations - generally the poorest and most deprived persons in society, and those most urgently in need of development - expect to acquire a

substantial stake in the ownership of sugar factory units? Which of the two processing technologies - vacuum-pan or OPS - has greater accessibility in terms of potential local ownership?

The answer appears to be directly related to the scale of operations, and to the magnitude of capital costs involved in the establishment of a new factory unit. The application of this criterion generates a clear-cut preference for the OPS technology, simply because the investment required is of an order that does not preclude the participation of low-income rural people in ownership and control of the plant and equipment. It should be noted that negative phrasing has been employed here, because the scale of the technology alone does not determine ownership: depending on socio-political conditions, units of this type might be owned either by cooperative societies composed of small-scale cane growers, or by individual members of rural elites, such as landlords or traders. What is significant is that sufficient resources can be mobilised in rural communities to finance new units at this scale of operations.

The same cannot usually be said for large vacuum-pan factories, which are almost always imported on a turnkey basis . Their costs - at present running to tens of millions of dollars - effectively do preclude mass participation in ownership and control. Investment capital must be attracted from overseas, often with the goal of eventually transferring ownership to the government of the country concerned. (The experience of cooperative sugar factories of the vacuum-pan type in countries such as India and Australia would seem to disprove the assertion about local-rural ownership. However, there are important mitigating circumstances that do not apply to the African situation: plant and equipment for the Indian mills are manufactured in India, at substantially lower cost than is possible with turnkey projects; in Australia, the cooperatives are composed of commercially oriented cane growers operating on much larger units of land, and with immensely greater capital resources, than African peasant farmers.)

We may fairly conclude, then, that with respect to this second criterion

the OPS unit has a marked advantage over the larger vacuum-pan factory. It must be emphasised, however, that the realisation of its potential depends ultimately on the nature of the institutional setting in which it operates, rather than on the selection of the technology itself.

3) Integrated Planning to Secure Balanced Growth: The concept of integrated rural development has gained wide currency in recent years among organisations and agencies involved with economic and social planning. Increasingly it has been recognised that the full spectrum of basic human needs, both material and non-material, must be considered in the design of new development projects. The quantitative indices of growth - particularly those reflecting monetary criteria - cannot be assumed to capture all the complex phenomena that characterise a sustained and broadly-based process of development.

The sugar industry, as suggested by the critiques reviewed in section I, has typically fostered an unbalanced type of social and economic change. Indeed, the industry has been portrayed as so thoroughly dominating the areas in which it operates that it restricts opportunities for diversification and perpetuates under-development within the framework of a single-crop system. In many project feasibility studies one can discern a preoccupation with ensuring the viability of a proposed new sugar factory; this is not surprising in view of the vast amounts of capital likely to be committed. This conventional approach to planning is, however, compartmentalised rather than comprehensive. Its fundamental (and unquestioned) assumption is that if the industry is able to operate profitably and at full capacity, the surrounding society is certain to reap major benefits. As we have noted, empirical studies in sugar-producing countries have seriously challenged this assumption.

If an integrated approach to planning is undertaken, it will have to consider, as a matter of course, issues such as the adequacy of food supplies, the nutritonal content of the diet, the quality of life in pre-existing and newly created human settlements, standards of community health, the improvement of

educational facilities, and the diversification of activities within agriculture and outside it. In sugar-producing areas, these issues appear at first glance to fall outside the purview of the industry itself, but they are nonetheless affected, directly or indirectly, by decisions taken as to the scale and type of processing technology to be adopted. It may prove possible to ignore the inter-relationships between them in the short run, but to do so only increases the probability that patterns of unbalanced change will be reproduced in future African sugar projects.

Which of the two alternative sugar technologies is better suited to the concept of integrated planning? Here the question of scale takes precedence over that of type: once a specific demand for raw materials (expressed in terms of daily crushing capacity) has been decided upon, it is possible to calculate the area of land required to produce sufficient cane. (Note that if the two types of technology, open-pan and vacuum-pan, were assumed to operate at the same scale, the latter would recover more sugar. Put differently, to produce the equivalent output of sugar a vacuum-pan unit of comparable size would require less sugar cane, and therefore a smaller area to supply it.) Technical and logistical considerations place limits on the distances over which cane can be transported; thus for a large-scale plant a fairly dense concentration of cane plots is desirable. In practice, this is most easily achieved when land is consolidated into a plantation or estate: the outcome, of course, is monoculture, the antithesis of integrated planning.

Opting for the smaller-scale technology does not ensure the success of integrated planning, but it does leave greater scope for the simultaneous support of other activities in the immediate area of the factory. Mixed farming, with attention being given to food crops as well as the industrial crop of sugar cane, is a key element in integratee development. In theory, at least, it can be better sustained where the demand for cane is localised and relatively modest, than in "sugar belt" regions where cane claims all the best land, and vast quantities are required to meet the needs of large-scale vacuum-pan units.

4) Mass Participation Leading to Increased Self-Reliance: As indicated above, the social-developmental criteria overlap to a certain extent, and we have already discussed the scope for mass participation in respect to ownership under criterion 2). Several other aspects of self-reliance may be briefly considered as well, and sociologically significant questions may be posed with reference to the two sugar technologies being compared:

Who manufactures and services the component parts of the technology? What linkages can be established with domestic engineering industries? With which technology is it possible to move most rapidly towards the attainiment of self-sufficiency in the supply of both the required skilled manpower and capital goods? In short, which technology can be brought under effective autonomous control in African countries in the short to medium term?

To a large extent, within the existing sugar industry in African countries, repair and maintenance activities are internalised, in factory and field workshops. Most spares then tend to be purchased from developed country sources, and local inputs are minimised. It may well be true that in the case of crystal sugar production, there is little traditional, indigenous technology to build on. The question then becomes: which implanted technology is more capable of acting as a catalyst for future development?

Here it seems plausible to argue in favor of small-scale sugar production, for two reasons: a) domestic engineering capabilities (at varying stages of development) already exist in a number of African countries, although their potential contribution to the sugar industry has not been thoroughly exploited; and b) the tolerances of OPS technology would appear to be less demanding, and the limited experience of vacuum-pan factories with local engineering to date suggests somewhat lower quality workmanship than that obtained overseas.

Over the longer term, it might be anticipated that broader involvement in the direct control of sugar technology - having begun at comparatively small-scale

production levels - might generate two important payoffs. First, the attainment of self-reliance in the supply and servicing of OPS technology could act as a stimulus to further research and development within that technology itself. (As noted in other papers at this seminar, there are several stages in the process where applied research might improve technical efficiency.) Second, the accumulation of experience with the sugar industry in small units ought to enhance domestic capabilities to participate more actively and directly in the control of the large-scale technology.

5) Preservation and Enhancement of Endogenous Cultural Traditions: The fact that the sugar industry in Africa has not been developed from an endogenous base would seem to indicate that this criterion allows no distinction between vacuum-pan and OPS technologies. Since both must be transferred from non-African settings, neither can claim to have evolved from pre-existing traditions of technology and culture. (An exception would be the upgrading of already existing jaggery factories - not endogenous, but implanted several decades ago - into OPS units, which is a possibility in some African countries.) But if we consider the impact of each transfe red technology on the recipient culture and social system, some significant differences do appear.

The following are several key areas of impact:

a) displacement of human populations in the course of land acquisition;

b) creation of new human settlements to house the industry's labor force;

c) increased monetarization of social and economic relationships, arising from

i) institutionalization of wage labour;

ii) production of a new cash crop.

Each of these phenomena, in varying degrees, entails disruption of pre-existing activities, and each is influenced by the choice of sugar technology. In other words, major social costs may be incurred when a massive transformation of the local economic system is undertaken. Satisfaction of the industry's technical and logistical needs, when carried to the extreme, seeks to restructure

man-land relationships, irrespective of the fact that these represent the outcome of long-term adaptation to the local environment. As a result, families and kinship groups may have to be dispersed in the course of resettlement; new "micro-urban" settlements spring up on the fringes of the industrial complex; and traditional norms of reciprocity and interdependence are progressively weakened, eventually being redefined in terms of monetary obligations. It is certainly open to question whether the quality of life in the transformed, "modernised" society is comparable to that enjoyed before the advent of the industry.

Identification of these social costs does not amount to an argument against change in any form, neither is our purpose to endorse the status quo in the rural areas of Africa, where the acute need for accelerated development has been well documented and is now equally well understood. What is required, though, is an adequate perception of the complexities of social change, and of the fact that such change is most constructive and beneficial when people participate in it as subjects rather than objects. Planners and other advocates of change should bear in mind that mechanisms of intervention must be adaptable, as well as the human populations that are designated to receive them. From the point of view of technology selection, the question may be posed this way: "does it [the technology] lead to creative mass involvement by being accessible, comprehensible and flexible?"[8].

A tentative answer has emerged from the cumulative review of the other social criteria, for we have acknowledged that the small-scale open-pan process is inherently more flexible, and therefore presumably more susceptible to modification, than the larger-scale alternative. Again we must emphasise, however, that the selection of a particular technology is not a short-cut to development, let alone a final solution. It merely defines the context within which other activities related to development may be executed. Sugar technologies themselves will not

preserve cultural traditions in the African countryside, but the two alternatives we have examined appear to have different effects on the rate and extent of socio-cultural change.

III. Summary and Conclusion

We have analysed the characteristics of two sugar processing technologies in relation to a set of social criteria. We have been concerned with their relative suitability, and this with a direct comparison between two options. If a larger number of options were being compared, a more complex evaluation would be required. Two possible methods suggest themselves, and since the technology profile approach which we have drawn on has wide potential applicability, we may briefly consider them.

The first technique has been suggested in the report of a UNEP Expert Group Meeting on the methodology of technology selection, and consists of using a bar-chart, divided into sections according to the number of criteria being analysed. In this instance the social dimensions would be represented by five such sections. Where quantification is not feasible, it was recommended that a simple colour code might be employed, with, for example, "green" for a satisfactory rating, "orange" for an ambiguous rating, and "red" for an unsatisfactory rating.[9] Thus for the set of social criteria we have used, the profile of a specific technology might produce a sequence of, say, green - red - orange - green - orange. Analysis of other technologies would then generate other colour sequences in the parallel sections of their bar-charts.

If we review the argument in section II of this paper, the colour-code technique does not seem very well suited to presentation of the analysis. The suggested technique implies that some absolute scale of measurement is available, and that since only three codes are to be used, technologies will be found to be equivalent with respect to certain (perhaps most) qualitative criteria.

A second possible method, which would be based on the same set of criteria,

would utilise a simple ranking of technologies under each section of the bar-chart. This method would have the advantage of representing their relative preferability, and would avoid the potentially misleading portrayal of equivalence, for example in cases where several technologies were found "satisfactory", but not to the same degree.

For the limited exercise in technology assessment undertaken in this paper, the second method of qualitative analysis seems preferable. Obviously further testing of the methodology is in order, and practical experience with study of a much wider range of technologies will undoubtedly serve to refine the techniques used in the selection process.

Returning to the particular issues involved in sugar technology, we may summarise by remarking that the small-scale open-pan technology performed better in relation to all five criteria than the large-scale vacuum-pan technology. What does this mean, in terms of policy implications? First, it was found that the critical element in the comparison, as far as these social criteria were concerned, was flexibility: the extent to which, having been introduced, they either widened or narrowed the range of options for ongoing social change and broadly-based development. In this regard the scale of operations appeared to have greater impact than differences in the type of processing technology.

Second, the judgments arrived at in this paper amount to only a partial assessment of the two technologies, for they must be integrated into more comprehensive profiles encompassing economic and environmental phenomena as well. At that stage, when the full range of impacts is scrutinised, the inter-relationships between criteria will have to be sorted out., and this is the province of the decision-maker. In common parlance, his task is to evaluate the trade-offs between the criteria, which involves assigning weights to each of them. Real-life choices are invariably complex, and it is not uncommon that a socially defensible choice of technology performs less well in relation to economic and/or environmental standards.

Small-scale sugar production provides an apt illustration of the latter point: having determined that it satisfies the major social-developmental criteria in our framework, we are led to ask why it has not been widely implemented in African countries. There appear to be several causes. First, it is probable that the social criteria have not always been made explicit, in which case this discussion may serve some practical purpose. Second, the momentum of technological change in the worldwide sugar industry has been consistently in the opposite direction, towards larger units using increasingly sophisticated techniques within the vacuum-pan process. As recipients of transferred technology, African countries are usually not in a position to alter this trend. Third, there may be objective preferences in the economic domain, the environmental domain, or both, for the large-scale technology. Other papers at this seminar will consider these issues in detail. Here we may note that policy trade-offs do manifest themselves quite clearly in the case of the African sugar industry. Depending on the weight attached to the social criteria, a case might be made for modifying policies affecting the other parameters in the technology profile, especially those that can be quantified.

In conclusion, we may reiterate a point made several times in the text of this paper: technologies are not the sole determinants of the development process, and therefore perfection of the methodology for selection does not constitute an end in itself. Adequate understanding of the differences between options is important, for it clarifies other issues in the process of development planning. One lesson from the historical record of the sugar industry is that these other issues cannot be disregarded if the full potential of development is to be realised; for this reason, African countries considering the choice of technology within the industry must retain a comprehensive framework of priorities for economic and social development.

NOTES

1. Douglass North: "Agriculture and Regional Economic Growth", Journal of Farm Economics, December 1959; the argument is developed more fully in North's book, The Economic Growth of the United States, 1790-1860, New York, 1961.

2. R. E. Baldwin: "Patterns of Development in Newly Settled Regions", The Manchester School of Economic and Social Studies, vol. 24, 1956.

3. R. F. Watters: "Sugar Production and Culture Change in Fiji: A Comparison Between Peasant and Plantation Agriculture", Pacific Viewpoint, March 1963, p. 38.

4. H. C. Brookfield: "Problems of Monoculture and Diversification in a Sugar Island: Mauritius", Economic Geography, Jan. 1959, p. 40.

5. C. L. Beckford: "Toward an Appropriate Theoretical Framework for Agricultural Development Planning and Policy", Social and Economic Studies, vol. 17, no. 3, 1968, p. 237. See also Beckford's book entitled Persistent Poverty: Underdevelopment in Plantation Economies of the Third World, London, Oxford University Press, 1972.

6. A. H. Barclay: "Sociological Issues in the Design of Cane-Growing Systems", paper prepared for Joint UNEP/UNIDO Seminar on Implications of Technology Choice in the African Sugar Industry, Nairobi, April 1977.

7. See the discussion on technology profiles in "Report on Methodology for Selection of Environmentally Sound and Appropriate Technologies", based on Expert Group Meeting at UNEP Headquarters, Nairobi, 30th August to 3rd September 1976, especially pp. 34ff.

8. "Report on Methodology...", p. 19.

9. "Report on Methodology....", pp. 34-35.

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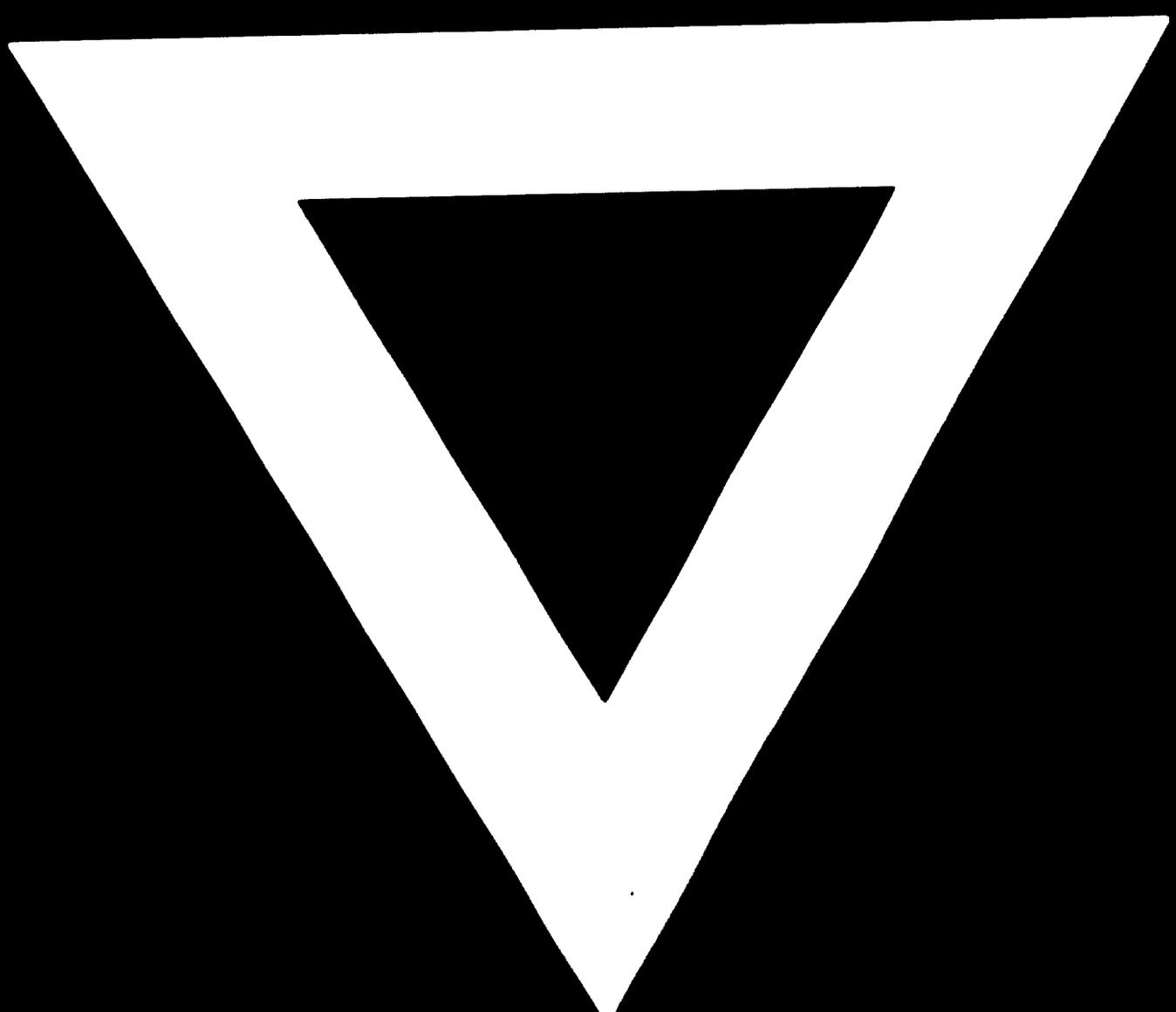

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