OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

08186

Distr.
LIMITED

ID/WG.279/5
20 June 1978

ENGLISH

United Nations Industrial Development Organization

Second Consultative Group on
Appropriate Industrial Technology

Vienna, Austria, 26 - 30 June 1978

APPROPRIATE TECHNOLOGY AND THE ACTIVITIES TO BE STIMULATED*

by

J. Tinbergen**

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Professor, Honorary President, Foundation Reshaping the International Order (RIO), The Hague

id.78-3797

Introduction

Relationships with other development problems

In this paper, an attempt is made to identify those activities that should, and have to, be stimulated - at both an individual and institutional level - in order to obtain a technology that is optimally suited to a given least developed country (LDC). The requisite stimulation may emanate from an institution which can influence those who have to act such as Government (possibly the most important), as well as from such institutions as a country's educational system or an international agency.

In approaching the subject, proper cognizance must be taken of the interrelationship between the establishment of an optimal technology and the execution of other tasks essential to attaining an optimal development process. The development process has many aspects, all of them relevant to the attainment of an optimal growth in social welfare (which is synonymous with optimal development). These aspects range from educational activities, financial and trade policies, to policies and restrictions pertaining to property rights, and so on.

Moreover, technology, which is one of the characteristics of the production processes carried out in a community, is directly linked with other characteristics of those processes, such as the organisation of production, its management and marketing. As a consequence, our main subject cannot be treated without touching upon other developmental tasks or aspects of the production process directly related to technology.

Constraints upon world development and national development

The process of development - international and national - comprises a set of human activities against the global backdrop of world history. The physical and spiritual worlds in which mankind lives impose a number of restrictions, and account has to be taken of what natural scientists term laws of nature, as well as of a number of psychological laws which supposedly determine, or at least limit, what human being are able to do or undergo.

For a long time, it has been known that the production processes are subject to the laws of nature. This is quite clear in respect of chemical production, and it also holds true for the production of cotton yarn (where the quantity of yarn obtained from one pound of raw cotton is practically constant with an input-output ratio slightly below one) as well as for the operation of an electric motor. In respect of more complicated processes, such as agriculture, biological elements enter into the relationship between input and output, while in the construction of a house or the manufacture of machines, not only are physical laws relevant, but also psychological or mental processes. A man building his own house may be more motivated than a member of a large labour force in a major building company. Mental processes are involved, especially if inventiveness plays a role in the design of a new production method.

In recent decades, we have been confronted with constraints of a relatively new nature, such as pollution of the production environment. This phenomenon has now assumed such dimensions that governments have had to ban certain processes altogether, such as the use of DDT in agriculture, or formulate strict regulations governing the emission of toxic fumes. The attitudes adopted and policies introduced in this area aim at the reduction of pollution and the conservation of an ecological equilibrium, thereby ensuring an adequately clean environment for subsequent generations or preserving animal or plant life considered valuable for a variety of reasons.

In fact, the problem of maintaining a balanced ecosystem is intimately connected with the problem of producing enough food, for example. Possibly, the most important aspect of the latter problematic issue is the extent of our ignorance. This may be illustrated by the work done on the model of international relations in agriculture (MOIRA) by a group of economists, agronomists and others at the Free University of Amsterdam and the Agricultural University of Wageningen (Linnemann et al., 1976 [11]) in the Netherlands. As work progressed on MOIRA, two reports were published, Buringh, Van Heemst and Staring in 1975 [4], and Buringh and Van Heemst in 1977 [5], which serve to illustrate the degree of uncertainty surrounding the question as to how much food can be produced on our planet. Assuming the use of tractors and of chemical fertilizer

wherever enough water is available, the first report estimates "absolute maximum" production at about thirty times the output of 1970. In the second study food production estimates are "based on labour-oriented agriculture" in which neither tractors nor chemical fertilizers are used, and it is concluded that the ouput would not be enough to feed the present population of the world and would, moreover, result in insufficient of forested area. The possible ecological damage caused by the maximum production estimated in the first study has not been studied.

Other examples of our present ignorance are the well-known debates on the feasibility of using nuclear energy and on the impact increased energy production would have on the climate of this planet.

The "inevitability" of nuclear energy production

The margin of uncertainty surrounding this issue may be illustrated by another Dutch study, undertaken in 1977 by Th. Potma [13], who, assuming the elimination of nuclear energy production, estimated possible rates of energy consumption until such time as solar energy could assume the role now played by energy produced from fossil and nuclear fuels. His assumption as to the total production of all goods and services was that no increase would take place until 2000 nor presumably thereafter. His main emphasis was placed on the necessary energy savings, using such well-known devices as proper insulation of buildings and improved energy recycling (for instance, using surplus hot water from power plants for district heating purposes). Under such circumstances, energy consumption in the year 2000 would be 75 per cent of 1975 consumption, of which fossil fuels would account for 83 per cent, a level equivalent to 62 per cent of total consumption in 1975. Whereas the availability of some luxuries, such as the use of automobiles, would have to be less than now, greater housing volume and more central heating would be available and employment could be maintained. This brief summary of the conditions and results may be enough to give an impression of the doubts surrounding such a blueprint, whereas other authors writing about nuclear energy consider its use indispensable.

General principles of fair international competition

The technologies to be recommended to developing countries cannot be discussed without due consideration being given to the extent and policies of international competition and trade. During the last decade, industrial exports of a number of labour-intensive products from the developing

countries have increased considerably, and the developed countries have been confronted with a loss of employment in the corresponding branches of industry. This has alarmed the workers, especially if these industries are concentrated in a limited area: garment manufacture and the textile industry are two well-known examples. The situation is aggravated by the prevailing recession which also has reduced employment in a number of metal-working industries, such as shipbuilding. Tendencies to protect such industries have become stronger and, in fact, some forms of protection have already been introduced by the European Economic Community, Japan and the USA. Clearly this policy has affected employment in a number of developing countries, and it is severely opposed by the third world.

The major interests involved on both sides call for a very precise formulation of what constitutes fair competition between the developed and developing countries. The point of departure should be that international trade is in the interests of both the importing and exporting countries, provided the production processes applied and the prices charged satisfy the conditions of an ideal international exchange model. The most relevant elements of such a model would seem to be the following:

(i) Each country applies production processes which, taken together for all activities, use all the productive resources available. These resources or production factors are the natural resources, labour and capital available to each country.

(ii) Prices of both production factors and products are prices which clear the market by a process of free competition. Product prices are equal to marginal costs of production to the national community.

(iii) Proper cost calculations must include the cost of damage done to the natural and human environment.

On the basis of these elements, it may be concluded which trade is acceptable and which deviations should be avoided. The following conclusions seem worthy of mention:

(i) Trade restrictions of a quantitative character must be rejected except when used to compensate for incorrect policies on the part of the partner.

(ii) Dumping prices (prices below the marginal costs of producers) must be rejected.

(iii) Factor prices used in the calculation of product prices must reflect the real scarcity of the factor concerned. In economists' jargon,

they are termed "shadow prices". As a rule, this implies that wages are permitted to be lower than actual rates, while interest rates have to be higher than those on official markets. Subsidies granted by governments of developing countries in order to compensate for actual costs being higher than shadow costs are acceptable.

(iv) The quantities of factors used in the production process should be optimal: this means that they should reflect the real scarcity of factors in the exporting country. Low costs resulting from the adoption of production processes which are more capital-intensive than are optimal for the country concerned constitute an element of unfair competition. Such processes may be those applied by transnational enterprises which tend to introduce processes developed in their home country which have not been sufficiently adapted to conditions prevailing in the host country.

(v) Optimal quantities of natural resources used in production processes cannot be easily estimated. They depend on the total reserves present, which are often unknown, and they depend on the time period over which their exploitation should be optimally extended. As a rule, it will be the capital available rather than the resource availability which determines the quantity of natural resources to be used per annum.

(vi) The principles enumerated may be a starting point for negotiations between developed and developing countries, but they need not be the final ones to be agreed upon. Considerable weight should be given to the additional principle of preferences to be given to products from developing countries as a (partial) compensation for their disadvantaged position in the present international order. The above principles should therefore be considered a limit: the lower limit for imports into developed countries.

(vii) Finally, a principle <u>sui generis</u> may be added to the extent the developing countries are able to live up to it: namely, the principle that certain forms of exploitation of labour are prohibited, on which agreements within the International Labour Organization have been concluded. One of the most convincing examples is the banning of child labour.

<u>The need for concrete policies and projects and the learning process</u>

It is not intended to elaborate further on general principles governing the choice of appropriate technology, as they have already been discussed too often <u>in vacuo</u>. What is really needed is a number of more concrete activities, based on the experiences of the last decade or so, and on the

far too infrequent quantitative assessment of a technological nature. Given the increased awareness of self-reliance as another element on which to build, the final general introductory remark to be made is that self-reliance cannot contribute much, if it is not supported by a number of learning processes. In a way there is some truth in the statement that hitherto the population groups most in need of our concern - the lowest income groups - have evidently not achieved very much, and that self-reliance might not bring us very far. There is a parallel here with the labour movement in industrialized countries. The full fruits of self-reliance can be reaped only if the innate abilities of the working population are developed through appropriate learning processes. As a consequence, in an attempt to design a technology policy for developing countries, benefit may be derived from the considerable research recently conducted in the broad field of educational policies in developed countries.

Aims of technology activities and policies

Maximum employment

In the present search for better development policies it is the agreed starting point that the lowest income groups everywhere must be the target groups. The most direct way of raising the lowest incomes is to raise the zero incomes of the unemployed. This is reflected in the primary emphasis the International Labour Organisation has placed on the need for a World Employment Programme.

Employment is intimately connected with technology, in both quantitative and qualitative terms. For the third world, the quantitative aspect constitutes the most urgent component. Qualitative aspects, such as efficiency and, even more, work satisfaction, are luxuries for nations rich enough to have already established almost full employment. In the present situation, employment of any kind whatsoever is an advance over joblessness, since it provides an income, however modest. The creation of employment is, therefore, the most urgent contribution to reducing inequity.

This notwithstanding and wherever possible, employment is better if it contains an element of participation. This may even help to create employment and, as a matter of course, raise both its efficiency and quality. Since rural employment enjoys the highest priority - by far the larger part of the population being rural -, participation is often attainable through forms of co-operation, as indicated below.

Satisfaction of basic needs

In the World Employment Programme emphasis is also placed on the satisfaction of basic needs, an objective that may be seen to overlap partly with that of achieving the fullest possible employment mentioned above. Employment at a wage adequate to buy goods and services in the quantities needed to serve as a basis for a "life of dignity" (cf. RIO report, Tinbergen et al., 1976 [16]) makes the present aim superfluous. But at least some steps might be taken to satisfy certain basic needs before everybody entitled to employment is actually employed. This may be true for some public services provided at no cost, such as elementary education, including school meals, an area that is touched upon below (see pp.9 ff). As for calculating the satisfaction of basic needs in quantitative terms, estimates as to the goods and services considered necessary to do so differ from country to country for reasons of culture, climate and customs. One component, however, can be established rather accurately: that of food expressed in terms of calories, proteins and vitamins. One method of estimating the quantities of other goods and services may be to study family budget statistics and to establish the income levels at which people, under prevailing conditions, voluntarily buy the quantity of food considered adequate. These quantities will depend on the size and composition of families and on the relative prices of various consumer goods. The basic needs for other consumer goods (clothing, footwear, household goods and fuel) and services (rent, health services) may then be satisfied at the income level found.

Depending on the socio-economic system of the country under consideration, certain components will be supplied free of charge, such as elementary education, whereas other components will be produced by the family itself. This applies in part to food and, possibly, to the building of a dwelling as well. The extent of production as well as the quality may depend on various public policies, which are discussed below (see pp. 9–11 and 12–13).

Geographical decentralization

An important aspect of the aims of development policies is the degree of decentralization in the various components of socio-economic life. Such components include the places where people live (villages, towns and cities) and the size thereof. Another component is the production

units in which people work and the question as to their size distribution. The answer is linked to the industrial structure and to our main subject, the recommended technology discussed below. Apart from the efficiency aspect, the degree of decentralization is also important as a factor of the human satisfaction derived from labour, and hence as a factor indicating motiviation, creativity or inventiveness. The link between inventiveness and self-reliance pointed out above is also of significance to the general strategy of development.

On the other hand, the level of inventiveness should not be overestimated or idealized. Depending on the circumstances under which children grow up, whatever innate inventiveness is available may, or may not, have been stimulated. Consensus has been reached, it would seem, on the desirability of checking overcrowding in cities beyond their present levels and hence explicitly on the desirability of achieving the maximum decentralization of production compatible with industrial structure. A further component of this general objective is to strive towards a higher degree of self-sufficiency in food production, as recommended by the World Food Conference at Rome in 1974.

Choice of sectors

The choice of sectors exerts considerable impact on the creation of employment. Preference should be given to labour-intensive sectors as far as this is compatible with the general constraints under which development has to ensue. In some sectors this may not be feasible; some forms of inland transportation can only be operated in a capital-intensive manner. It is a fortunate coincidence, however, that many developing countries enjoy comparative advantages in labour-intensive branches and has thus been able to expand their exports of a number of labour-intensive products, such as garments, leather and leather products, and wooden furniture. The expansion could have been even greater, had import barriers imposed by developed countries been removed or reduced more rapidly.

Preference should also be shown to those sectors in which local natural resources are processed, whereby processing is taken to include both trading and marketing. This endeavour can again be severely affected by the restrictive import policies adopted by developed countries.

Of the natural resources some, such as iron ore, may give rise to the creation or expansion of heavy-industry centres which can contribute to the collective self-reliance of the third world in the decades to come.

The choice of a third category of sectors may be governed by the aim to utilize renewable rather than non-renewable resources. In the coming decades, it is to be hoped that further attempts to use solar energy instead of fossil energy will determine the technology employed in such fields as agriculture and horticulture (see pp. 9-10 and 16-18).

Research and development institutes

In view of its importance, the establishment on a much larger scale than hitherto of high-level research and development institutes in the developing countries may be regarded as an autonomous aim. Experience in the past decades in two different fields may be cited in support thereof. On the one hand, the transfer of technology from developed to developing countries calls for considerable research into adaption, so as to meet local or national requirements, ranging from climatic or topographical conditions to idiosyncrasies of the population both as producers and as consumers. On the other hand, the phenomenon of the brain drain from the developing countries calls for a countervailing force. Both objectives can be achieved simultaneously by setting up high-level research and development institutes in the third world in order to provide stimulating work to scientists and technicians from the third world, even though the salaries may be modest in comparison with those paid in the developed countries. Apart from reducing the brain drain, the institutes may also absorb some of the unemployed graduates in an increasing number of countries.

Means of stimulating activities

Food and agriculture: Decentralized decision-making

The desirability of increasing food production in the developing countries, as recommended at the World Food Conference in 1974, was mentioned above, and the technology to be used in agriculture calls for closer consideration In this connexion, the general economic constraints discussed above should

be recalled since some of the answers to the questions posed are such that, as S.N. Ghosh [3] puts it, we may learn more from living nature itself than from chemistry and physics. The latter sciences seek to attain command over nature rather than to behave as part of the natural environment. This thought deserves attention as a possible starting point to our thinking about technology in general. Those who might reject this idea as being unlikely to yield results should be reminded that there have been previous instances of man having been inspired by the way nature solves technological problems: some ships resemble fish in shape as do aircraft birds.

Ghosh and others take this idea still further by emphasizing such processes as recycling and such forms of co-operation as symbiosis and antibiosis. A case in point is the possible combined production of biogas, nitrogen and protein at village level as described by Reddy, Prasad and Prasad in 1974 [14], which would ensure agriculture a more natural fertilizer source than chemicals. As in China, insecticides can be replaced to 90 per cent by ducks, and nature offers scope for more: one need only think of the leaves that could be recycled. Stopping soil erosion by means of reforestation should be part of agricultural policy, and the search for fast-growing trees has been already organized in India, for instance, by the National Commission on Agriculture.

Some of the proposals restated here only bear promise of success if human attitudes are also subject to change. The need for more intensive co-operation among small agricultural producers constitutes a case in point, as evidenced by the well-known success of farmers' co-operatives in Denmark and the Netherlands. These co-operatives have not been imposed on the farmers by Government, but have grown out of the farmers' own initiatives. Successful government intervention was restricted to the organization of agricultural schools and of extension services.

Activities relating to rural infrastructure

Whereas in the preceding section activities were suggested which may, to a large extent, be carried out as a result of local initiative, other activities, although part of local work, may have to be organized on a

national scale or by other decision-makers at a much higher level. Well-known examples are road building and the establishment of railroad or airline networks. Africa offers an example of the need for such infrastructural activities, but in many parts of the other continents similar objects might be recommended. By their very nature, however, decisions, and hence initiatives, are called for at a considerably higher level than that of the village, and their execution can be stimulated by subsidies from, and control by, a central agency.

The same applies to the management of water resources. In 1977, Ghosh [8] quoting Dastur, stressed this point in respect of India, but it holds true for numerous countries, where successions of floods and droughts are a regular phenomenon and, of course, represent an incredible waste of a precious resource. As is well-known, the implementation of such programmes not only requires high-level technological advice relating to hydrology, but it also calls for improved intergovernmental co-operation, as has been pointed out by Baade [1] (1970).

As already mentioned, a third component in any country-wide improvement is reforestation. An urgent example is to be found in Java, Indonesia, where the threat of desertification is considered very real, an additional difficulty in this particular case being the need to transfer a substantial proportion of Java's population to some of the more sparsely populated outer islands such as Sumatra and Kalimantan.

Other sectors: labour-intensive

Even if it is recognized that a greater degree of self-sufficiency in food production is a necessity, industrialization remains part and parcel of development. Industrial activities will have to be added to the creation of rural employment. As already mentioned, biogas factories constitute feasible operations for individual villages. However, a more general approach is needed, and it is proper to make a distinction, as Van Ginneken has done [17], between non-flexible and flexible technologies and industries. The labour-intensity of the former type is almost constant under very different relative factor price conditions, especially in terms of labour and capital. Well-known examples are the production of clothing, furniture, footwear and simple tools as well as repair work. These are carried out in a relatively labour-intensive manner almost throughout the world. Figures as to the varying degrees of detail and sophistication may be found in studies by Boon [2] (1964), Herman [6] (1975),

Hilhorst [7] (1964), and Griliches and Ringstad [9] (1971). Herman employs Swedish data relating to 89 sectors producing tradeables (a number far larger than the other authors mentioned) and allocates industries to eleven country groups. Although his method is admittedly simple and rudimentary, his attempt is the first of its kind to take a world-wide view and provides a challenge to the profession. Hilhorst, as well as Griliches and Ringstad, estimate production functions: the former in respect of 27 industries in the Netherlands, the latter two in respect of an equal number of Norwegian industries. Both studies have been inspired by similar studies undertaken by Cobb and Douglas, Kmenta and four well-known pioneers (Arrow, Chenery, Minhas and Solow).

The authors of both studies were interested in the parameters characterizing the elasticity of substitution between labour and capital, the impact of scale-size and technological change. Their difficulty was, however, that they used data from a single country, which implies that the price ratio between labour and capital hardly varies among their observations. Consequently, their information about the impact of that ratio on the ratios in which the factors are combined is very limited. A further difficulty is that scale-effects can hardly be derived from industrial census data: if in some industry a high scale-effect prevails, it follows that there are few production units and the number of observations too small to yield reliable estimates of parameters. Consequently, in my own attempt to collect evidence on scale effects, I had to use direct technological information (Tinbergen, 1973 [15]). Boon has adopted the same approach and, as a consequence, he has introduced concepts which are hardly ever used by econometricians investigating production functions, such as lot size, setting and training costs. Boon has extended his research into another eminently practical direction: to the technology market, a subject of great importance to the relationships between transnational enterprises and developing countries.

Studies on scale-effects also imply the collection of data on the capital needed to employ one worker. This capital intensity is considerably lower for small-scale than for large-scale production units, and hence small-scale production is necessary in at least part of the economy, if employment has to be created for all employable people.

Other sectors: flexible technologies

Alongside sectors where technology is labour-intensive regardless of the relative prices of labour and capital, there are other sectors where low

prices of labour in comparison to capital make for the choice of labour-intensive operations, while high prices of labour relative to capital would indicate the optimality of capital-intensive operations. As observed above flexibility of this kind cannot be easily established on the basis of statistical data for single countries. Data from countries with very different factor price ratios are needed and have to be made comparable especially with regard to the nature of the products compared. More research of this kind than is currently available would seem useful. From technical studies some evidence has been derived, such as that collected by Boon [2] (1964 and after). At least in the past it has been argued that the number of machines supervised by one man can be varied within a wide range and will depend on the price ratio between manpower and machines. Sometimes it is also the nature of the machines used that is affected by the same price ratio. In metal-working the distinction between single-purpose and multiple-purpose machines is made, the former being used in high-wage countries, the latter in low-wage countries.

Another clear example of a flexible industry is construction. In developing countries, the construction of cheap dwellings can and must be done by the prospective inhabitant, preferably assisted by local authorities in obtaining materials, access to water, energy and credit, as described by Jørgensen [10] (1975).

A considerable volume of research has been devoted to the automation of labour-intensive processes with the purpose of making the industries in which they were used competitive with labour-abundant counterparts in developing countries. Such research was based on the desire to maintain these industries in the countries in which they had long been established. This desire may, however, be a doubtful basis for an optimal application of research activities. It seems desirable to establish whether such automation research was perhaps too expensive in comparison with alternative research programmes: a potential area of investigation, perhaps, for both UNIDO and the coming United Nations Conference on Science, Technology and Development. The basic endeavour is to widen the horizon of national research institutes so as to avoid a priori preferences for keeping some industry in inappropriate geographical areas.

Employment versus efficiency and trades union activities

In the section on maximum employment above (see p.6) high priority was given to the creation of employment, as this would seem to be the most direct means of combating mass poverty. It is also useful to be aware

that trades unions often face a dilemma whether to direct their activities towards attaining higher wages or more employment. Higher wages will tend to lower rather than expand employment. In marginal enterprises, higher wages can only be paid, if efficiency is raised: this requires a different type of investment than the investment needed to create more employment. The logical sequence in which to pursue these two competing objectives seems to be that priority should be given to employment. As soon as almost full employment has been attained, wages can be made the main objective of trades union activity. It would seem to be a simple question of solidarity between workers and the unemployed that one first assists the unemployed to get work and, once that goal has been attained, joint action is undertaken to obtain higher wages.

In developing countries this policy is not always easy to follow, since trades unions are often first established in industries, and only later in agriculture. They first emerge in highly-paid activities and only later in badly-paid activities. In the history of trades unionism the differences between a labour élite and other workers have led to well-known difficulties. The mistake made in developed countries should not be repeated by developing countries. It is a matter for satisfaction that the International Confederation of Free Trade Unions has shown understanding for the priority of solidarity and has assisted the Indian National Trade Union Congress in an attempt to start organizing the poorest. It is only a beginning, but it deserves the full attention of trades unions and Governments everywhere.

Educational preparation

The search for, and application of, appropriate technology will require a host of different efforts by many people, all of them essential components of what self-reliance requires. Viewing the population pyramid from the top down to its very base, the creative research needed will have to be conducted by men and women who have demonstrated excellence in their younger years and have been selected to occupy posts in the leading research institutes aimed at. The country's rulers, politicians and senior civil servants as well as managers in numerous fields will have to develop enough understanding of the problems at large in order to express preferences as to the directions in which research will have to be organized. In the production processes proper, however, thousands, and sometimes millions, of workers are those who use "appropriate technology".

All this requires a system of education and training geared towards the aims of optimal development: a situation that might well differ from both the present system in the country concerned and those prevailing in various developed countries. Most developed countries themselves are involved in large-scale overhauls of their systems. By way of illustration, many of those involved in education are seeking to find a healthy equilibrium between discipline and freedom at schools; a balance between team-work and personal competition as well as between physical and mental training. The manner in which the selection system works has been profoundly criticized by men such as Bowles and Gintis [3]. The optimal combination between cognitive and non-cognitive abilities has to be found in the education system with all its ramifications. Answers have to be found to such issues as: Up to what age should there be a uniform school for all in order to further mutual understanding between pupils from different backgrounds? At what stage should the separation of differently endowed students start? What cross-linkage should there be in the branches of the education "tree" so as to be able to rectify mistakes made during the selection process? How can an interest in learning be stimulated by curricula which are directed towards specific professions or jobs?

Of all the sectors in the social fabric, the educational sector has a tendency towards conservatism. This notwithstanding a wave of innovative educational experiments is gaining momentum, with sometimes exaggerated tendencies to eliminate useful elements of training. Factual knowledge or learning necessary basic information by heart and similar techniques now tend to be avoided on too large a scale. Creativity, which was previously suppressed, is now hailed, but it cannot work without a basis of factual knowledge, on which the capacity of association has to be tested if something new is to be created.

Certain well-known conservative attitudes should be done away with, such as the white collar complex and religious or political indoctrination. The Moral elements must be accorded prominence, and the example set by the teacher is sometimes much more important than his words alone; the two are inseparable.

Co-operation among developing countries

In the process of industrialization and technology transfer, an important role can be played by closer co-operation among the developing countries. Their position in negotiations with the suppliers of technology is often

weak, as is customary when one party is specialized and the other more broadly oriented. Developing countries will have to co-operate as closely as possible in order to co-ordinate and organize all accessible data and thus become better equipped to evaluate the possibilities offered them. In its document TD/107, UNCTAD provides an example of what Colombia was able to attain during negotiations with transnational enterprises after the Treaty of Cartagena to establish the Andean Common Market had been concluded. UNIDO has set up a technological information centre and will become increasingly able to provide the information needed to evaluate technologies, even though complete judgement of the pros and cons of specific offers will remain the advantage of those who have worked with the technology in question for some time.

The best source of unbiased information are probably independent consulting firms, especially those companies which adhere to an ethical code, including the rule that they do not recommend individual firms as possible suppliers.

An area of co-operation easier to handle is the question of tax advantage offered to prospective investors in given countries. In this context, inter-governmental competition in tax advantages should be eliminated, and the element of solidarity should be stressed because it is in the long-term interests of all concerned. Tax holidays only distort competition, further to which they are incompatible with the general principles set out above (pp. 3-5).

An agenda for research and development

This paper can be summarized in the form of an action agenda in the field of research and development. Such an agenda should fit into an optimal development policy, an important component of which is the production-mix, high priority being given to employment generation and the satisfaction of basic needs, including incomes policies permitting payment for the basic goods and services by those who want them.

The production pattern in optimal development shows, inter alia, the following features:

(i) A higher degree of self-sufficiency in food production, using ecologically favourable inputs, emphasis being placed on manure and other nutrients and the cautious use of chemicals and mechanical traction;

(ii) Joint production of biogas, protein and nitrogen in a large number of villages;

(iii) Flood and drought control with the aid of rural public works;

(iv) Reforestation and transportation infrastructure, planned at national or higher levels, and implemented locally;

(v) Industrialization on the basis of labour-intensive and raw-materials-processing industries;

(vi) Self-help in constructing dwellings, with municipal aid to obtain material and technical assistance, the provision of access to energy and water supply, as well as a credit system adjusted to the prospective earning power of the family.

The research and development activities needed should be directed towards

(i) Adapting available technologies to the needs, climate and other factors of the country or region concerned;

(ii) Finding out the optimal international industrial structure, while avoiding the maintenance of industries which show a flexible technology in their present traditional locations, and attempting to establish the production functions of flexible industries from international data;

(iii) Contributing to the co-ordination and integration of technological data banks available in different institutions;

(iv) Developing and disseminating information on proper cost-accounting and fair international trade policies as a means to enhance the optimality of the international division of labour;

(v) Contributing to the shift to the use of non-exhaustible resources in food and energy production.

A much larger part of this research should be undertaken in the new high-level research institutes to be established in the developing countries with a view to reducing the brain drain. The preparation and selection of the scientific labour force should be improved by overhauling the educational systems. This overhaul is desirable not only in order to provide a scientific labour force, but also and even more importantly, in order to prepare the whole labour force for its future task and to aim at a job structure ensuring work satisfaction at all levels of capability.

The educational system should be based on a balanced mix of:

(a) discipline and freedom; (c) team work and stimulating competition;

(c) physical and mental training; (d) cognitive and non-cognitive capa-

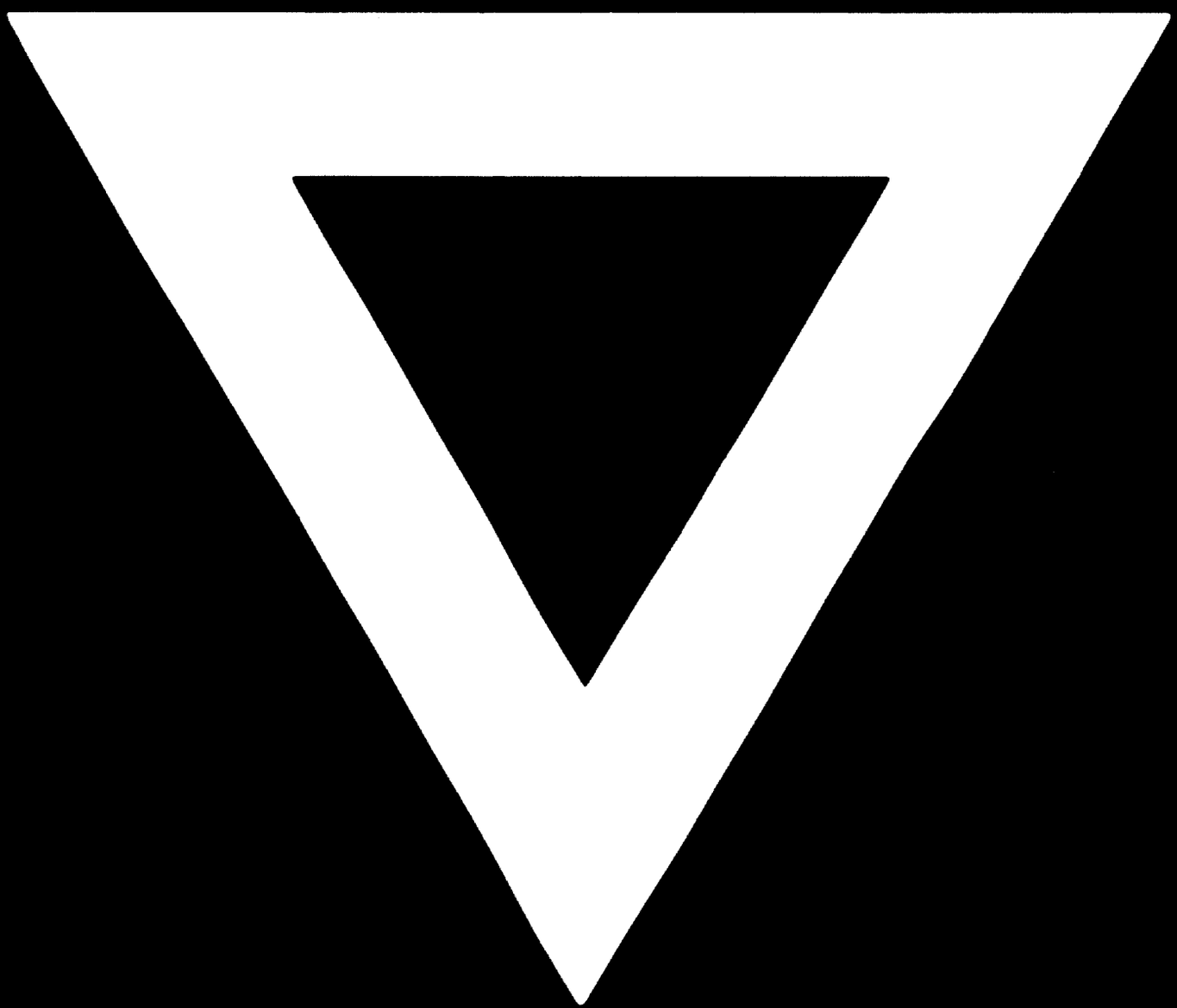
bilities; (e) a uniform school up to a certain age in order to avoid alienation and differentiation where motivations begin to differ; and (f) training for future jobs and options to correct initial choices. The educational system should have curricula designed to stimulate motivation and to counteract the irrational white-collar preference where necessary. It should not aim at one-sided indoctrination, and it should contain stimuli towards high standards of morality, in which the example of the teacher should demonstrate such standards.

In the process of negotiation on the purchase of technology, developing countries should be guided by international agencies, such as UNCTAD and UNIDO, and by independent counselling firms. They should co-operate, instead of compete, with regard to policies designed to attract investors with technological know-how.

References

1. Baade, F., Weltweiter Wohlstand, Oldenburg/Hamburg 1970 (World-wide prosperity), p. 195
2. Boon, G.K., Economical Choice of Human and Physical Factors in Production, Amsterdam 1964
3. Bowles, S. and H. Gintis, Schooling in Capitalist America, New York 1976
4. Buringh, P., H.D.J. van Heemst and G.J. Staring, Computation of the Absolute Maximum Food Production of the World, Wageningen 1975
5. Buringh P. and H.D.J. van Heemst, An Estimation of the World Food Production Based on Labour-Oriented Agriculture, Wageningen 1977
6. Herman, B., The Optimal International Division of Labour, ILO, Geneva 1975
7. Hilhorst, J.G.M., Monopolistic Competition, Technological Progress and Income Distribution, Rotterdam 1964
8. Ghosh, S.N., "Direction of new thrust", Seminar, November 1977
9. Griliches, Z. and V. Ringstad, Economics of Scale and the Form of the Production Function, Amsterdam 1971
10. Jørgensen, N.O., Housing Finance for Low Income Groups, Rotterdam 1975
11. Linnemann, H., J. Garbutt et al., Mensen tellen (People Count), Utrecht-Antwerpen 1976
12. Meuer, G., "Eco-Farming - Herausforderung des Agro-Business mit einem Überlebungsmodell" (Challenge of Agro-Business with a Model for Survival), Entwicklung und Zusammenarbeit, April 1978
13. Potma, Th., Energiebeleid met minder risico (Energy policy with fewer risks), Veren. v. Milieudefensie, 1977
14. Reddy, A.K.N., C.R. Prasad and K.K. Prasad, "Bio-gas plants; Prospects, Problems and Tasks", Econ. and Political Weekly, IX (1974), p. 1347-1364
15. Tinbergen, J., "Exhaustion and Technological Development: A Macro-Dynamic Policy Model", Zeitschrift für Nationalökonomie, 33 (1973), p. 213-234
16. Tinbergen, J. et al., Reshaping the International Order, New York 1976
17. Van Ginneken, W., Socio-economic Groups in Mexico, ILO, 1978

C-665



78.11.06