0865

UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED
E/ECWA/NR/SEM.1/29
September 1977
Original: ENGLISH

ECONOMIC COMMISSION FOR WESTERN ASIA

Seminar on "Technology Transfer and Change in the Arab Middle East".

Beirut, 10 - 14 October 1977.

APPROPRIATE TECHNOLOGY, EMPLOYMENT AND BASIC NEEDS IN ARAB COUNTRIES WITH SPECIAL REFERENCE TO THE FOOD INDUSTRIES

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77-1203

UNECWA Conference on Technological
Transfer and Change : the Arab Middle East
Beirut, October 1977

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S Y N O P S I S

In the context of the World Employment Programme the ILO has carried out an extensive examination of choices of technology and of product. As a result of this work, and other investigations by institutions concerned with economic development, the concept of 'appropriate technology' has become more clearly defined. This concept is discussed in relation to employment generation, and in the light of the basic-needs- oriented development strategy endorsed by the ILO's World Employment Conference of June 1976.

Caution is required however, in interpreting the concept of appropriate technology in terms of the very diverse economic development experience of the Arab countries. Nevertheless, even if these countries enjoy rather different endowments of natural and human resources than the poorest countries of Africa and Asia, there is still a need for rational technological choices and the development of national technological capacity to make such choices and adapt and transfer technology from abroad.

The notions of technological and product choice are illustrated in a concrete manner by case studies in the food processing sector, namely bread, and fish processing.

The paper concludes with a summary of the policy implications of implementing appropriate technology at the national level.

APPROPRIATE TECHNOLOGY, EMPLOYMENT AND BASIC NEEDS IN ARAB COUNTRIES WITH SPECIAL REFERENCE TO THE FOOD INDUSTRIES

The term 'appropriate technology' has become especially fashionable in recent years, and at the same time its meaning is increasingly a matter of confusion. In this paper we therefore begin with a brief discussion of the origins and definition of the concept, subsequently relating it to the context of the economic conditions of the Arab countries of the Middle East.

In defining appropriate technology the emphasis will be placed on its relationship with two foremost concerns of member states of the ILO, employment generation and the objective of eliminating poverty by ensuring the satisfaction of basic human needs.[1] It is easier, however, to begin our definition of 'appropriate' by looking more closely at 'inappropriate' technology.

In the industrialised countries of Europe and North America the continuing rise in levels of income since the Industrial Revolution has gradually led to the almost complete elimination of poverty in the sense of distressing material deprivation and poor conditions of health. The same period has also witnessed a very rapid rate of technological change in industrial production, and in the characteristics of the products consumed by the populations of these countries. Given this apparent association between

[1] The Organisation confirmed its concern with these objectives of economic development strategy in the Declaration of the World Employment Conference, June 1976. Paragraphs 47-62 of the Programme of Action attached to the Declaration specifically deal with 'Technologies for Productive Employment'. More recently, H.R.H. Crown Prince Hassan of Jordan, addressing the 1977 International Labour Conference, indicated his country's support for ILO work in the field of technical choice and innovation in developing countries.

modern technology and high standards of living, when an awareness began to dawn of the problem of economic development for the poorer two-thirds of the world at the end of the Second World War in 1945, the solution seemed obvious: the rapid establishment of the modern industrial sector, by the transfer of up-to-date technology from the industrialised countries.

In some respects this strategy has succeeded. Certainly, industrialisation appears to have brought about higher rates of economic growth in many countries than occurred in nineteenth century Europe. Nevertheless towards the end of the First UN Development Decade (1961-1970) it came to be appreciated in one developing country after another that this solution was not working the miracles that were expected, as can often be observed by even a casual observer in a brief visit to a poor country today. The modern sector may or may not be prosperous but is nevertheless very often juxtaposed with the continued poverty of most of the people, high migration rates from rural areas to urban areas with all the over-crowding and squalor to which this may give rise; and increasing unemployment. This unemployment in the towns and cities is a significant cause of discontent in developing countries; it frequently has serious political implications, which may well increase in gravity especially since such unemployment is likely to increase at a high rate in the next quarter of a century.[1] It is due in part to migration from rural areas, on the one hand, stemming from pressure on the land and the dearth of job opportunities in rural industries; and on the other hand, from the attraction of big cities with the apparent promise of jobs and high incomes, a hope which is rarely fulfilled because of the capital-

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[1]The Director-General's Report to the World Employment Conference in June 1976 (entitled 'Employment, Growth and Basic Needs') gave a rough estimate of 300 millions for the number of persons totally or partially unemployed in developing countries today.

intensity of most large enterprises. This capital-intensity is of course a consequence of the transfer of technologies designed specifically to save labour in the industrialised countries where wage rates are relatively very much higher than in countries of the Third World. It is n w quite clear that this sort of technology prevents the modern sector in poor countries from playing a significant role in the generation of income-earning opportunities.

This experience so far in economic development has given rise to the concept of 'appropriate' technologies. Stated in the simplest terms a technology is more appropriate for the production of a given product, which employs more labour, preferably at lower capital investment, per unit of output, and is at least reasonably competitive with more capital-intensive techniques, in terms of unit costs of production, in the country in which it is to be used. Since this concept began to receive attention in the early 1970's a great deal of evidence[1] has been published indicating that there is indeed a considerable choice of technologies when the product is broadly defined, although this range of choice is often narrower when product characteristics are tightly specified.

'Appropriate' technological choice is linked to the concept of the satisfaction of basic human needs in two major ways. Firstly, if technology A requires less investment per unit of output than technology B then more can be produced with a given outlay of investment funds: this is relevant to basic needs if the product in question can be

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[1]See for example the ILO publication, 'Technology and Employment in Industry', 1975; another ILO publication, 'Manual of labour-intensive Road Construction', 1977, concerns capital-saving methods of road-building.

regarded as an essential consumer good (e.g. a food product perhaps, or textiles, clothing or footwear). Secondly, if a technology A uses more labour per unit of output than technology B, then with technology A, more people can be offered the employment that gives them the income to properly feed, clothe and accommodate themselves and their families.

In practice the choices available are a good deal more complex than our account has so far suggested. For example there are often a number of technologies A, B, C ... producing in each case, a product of somewhat different characteristics. The case studies of certain products presented below are intended to give some firmer substance to this paper than this general discussion can itself provide.

* * * * *

Is the 'appropriate technology' concept useful in the context of Arab countries of the Middle East? After a first and superficial glance the answer might be No : one widespread image of the region is that of small oil-rich countries with super-abundant capital resources and relatively small populations (e.g. the Emirates, Kuwait, Bahrein, Qatar, the Libyan Arab Republic and Saudi Arabia). These countries are experiencing severe skill shortages and have begun to import expatriate technicians of various types on a quite significant scale. Open unemployment is not a problem, in part because of government policies to absorb new entrants to the labour force into the public service - which may in fact tend to obscure the fact that there is a measure of disguised unemployment. Such economies do not therefore manifest any obvious need for capital-saving, simpler technologies. But still, there would seem to be a case for selecting industrial technologies for transfer from abroad with some care. The most sophisticated modern technologies cannot absorb as much labour as some more appropriate variants of the same technologies which may enable a larger number of people to be trained in the pattern of industrial work, and the use and repair of machines. For the future industrial growth of these countries skill accumulation in the local population is probably of vital importance and it is not at all certain that the most labour-saving technologies can assist the achievement of this objective.

A second group of Middle East countries, including Egypt, Morocco, Yemen, Tunisia, Jordan and in some measure, Algeria, face problems which are more similar to those of developing countries generally. These countries have low land/man ratios, which encourage high rates of migration from the agricultural sector into the towns, and correspondingly, significant open unemployment in the latter. Techniques of production which absorb labour have an important role to play in these economies. The emigration policies followed by some of these countries may however be in some contradiction to the objective of developing domestic technological capacity, since it is the technically-qualified worker who is most likely to secure employment abroad.

A third group of Arab countries, notably Iraq, Syria and Sudan, lies somewhere between the first two groups. The land/man ratio is high, so that the key problem is that of generating economic growth from a rural base, rather than unemployment. However, disguised unemployment is likely to be common in rural areas and simpler technologies for application in small-scale rural industries - especially those using the products and by-products of the agricultural sector - may be significant in employment generation and the raising of low rural incomes. The encouragement of traditional agriculture is also important in such economies, and this involves tools and implements for manual application in cultivation and irrigation rather than immediate tractorisation and other forms of mechanisation.[1]

To summarise, Middle East economies vary considerably. Certain categories of skilled manpower are in short supply everywhere; but most countries suffer from an excess supply of labour to a greater or lesser extent in the rural and urban areas.

* * * * *

The general concept of appropriate technology may be demonstrated in a more concrete manner by referring to a specific industry, one which is of the largest sub-sectors of manufacturing in terms of output and employment : food processing.

As in many other industries the transfer of modern technology from the advanced industrialised countries has strongly influenced the development of food processing in most Third World countries. The root causes of this transfer of technologies directly from the relatively labour-scarce, capital-rich countries to poor ones are :

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[1] See 'Growth, Employment and Equity : A Comprehensive Strategy for the Sudan', ILO, 1976.

1) Policies of industrialisation favouring large-scale modern plants and private foreign investment using unadapted technology, rather than small enterprises.

2) The weakness of domestic research and development efforts and capital goods industries in most developing countries, so that alternative, simpler technologies and machines are not generally available.

The principal effects of modern technology transfer are the following (although with considerable variations among developing countries):

1) The food industries are increasingly dualistic in structure. On the one hand there are a few capital-intensive large-scale plants; on the other hand, a greater number of small enterprises using rather simpler technologies but generating more employment per unit of output.

2) The processed foods marketed for consumption in developing countries include an increasing number that are inappropriate in price and/or characteristics, to the real needs of their peoples.

The epitome of such perverse influences is the sort of brewery found in some poor countries. Producing lager, a beer of European origin based on European crops, to standards of clarity only recently achieved in Europe, such a brewery is reliant on raw materials and machinery imported from that continent. Several million dollars worth of investment is required, although much of the machinery (such as high-speed bottling lines and conveyor belts) has been expressly designed to save labour, so that the employment actually generated is very small. To take another example, the supply of sifted maize in Kenya is growing rapidly despite the fact that the more traditional 'wholemeal' maize can be produced by small-scale, capital-saving and labour-using plants and is in fact more nutritious.[1] In this case the larger scale technology was imported into Kenya from

[1] See F. Stewart, 'Technology and Underemployment', London, 1977.

South Africa and the sales of the refined product have been encouraged by higher incomes among the urban middle classes, and strong advertising.

Similarly inappropriate features are not however peculiar to breweries, or to maize-milling in Kenya: they are to be found in many food processing projects and indeed throughout the manufacturing sector, in the developing world.

Two case studies of food products manufactured in most Middle East countries, bread and processed fish, illustrate the choices which in fact exist and are presented below.

Case study : the baking of bread[1]

From the point of view of employment, bread baking is of particular interest: bakeries of all sizes appear to be able to operate in essentially the same market, in both developed and developing countries.

To make a typical 'raised'[2] bread, wheat flour is mixed with water, salt, sugar and yeast in specified proportions. The mixture is worked to form an elastic dough, which is allowed to rise, worked again, and cut and shaped into loaves. The loaves rise once more, and are baked in an oven. After

[1] This case study, and the one following, on fish processing are edited versions of more detailed work by Dr. W. Cleghorn and Dr. J. Keddie of the David Livingstone Institute, University of Strathclyde, consultants to the ILO in respect of a Technical Report for the Second Tripartite Technical Meeting for the Food Industries. The Technical Report, entitled 'Appropriate technologies for employment generation in the food processing and drink industries in developing countries' will be published early in 1978 and will contain more detailed analyses of the choice of technology in relation to ten food products (including the two mentioned here).

[2] 'Raised' - leavened with yeast. Wheat is the only flour that naturally forms a dough capable of retaining the evolved gases that 'raise' the loaf prior to baking.

cooling, they are wrapped for sale. The mixing process is always a 'batch' operation and the nature of the fermentation process which causes the dough to rise limits the size of batch that is practicable.[1] These factors, and the high transport cost of bread, a light but bulky product, limit the competitive advantage of large bakeries over small ones.

Table 1 below sets out in summary form the inputs and outputs of two small-scale bakeries, one of them partly mechanised, and a larger, fully mechanised bakery. Table 2 shows the comparative annual costs and revenues for these projects.

The large project is profitable under both the high and the low wage regimes. The labour-intensity of the small projects, however, makes their profitability very sensitive to wage rates, and they are unprofitable under the high wage regime. Partial mechanisation at the small scale is not attractive, showing lower profits than the labour-intensive alternative under both wage regimes. The profitability of the large project is partly due to the slightly higher average price it generally obtains for its product: this is a marketing advantage stemming from the direct retail distribution of half its total output.

In the circumstances assumed in this analysis, the large bakery project is no less profitable than the other smaller sized bakeries considered. However, the assumptions made about its costs represent a very efficiently managed large bakery, and such efficiency is sometimes obtained in developing countries.

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[1]Kilby, P. (1965), "African Enterprises: the Bread Industry in Nigeria", Stanford University.

Table 1

Schedules of inputs and outputs for three bakery projects

Process Type	Labour-intensive	Partly mechanised	Mechanised
Land: Buildings, M^2	160	320	1320
Equipment type:	Manual process. wood-fed oven	Mechanised mixing and slicing; other manual; wood-fed oven	Entire proces mechanised; oil-fired ove
Total Labour:[1]			
- Management	1	1	1(expatriate)
- Skilled/Administr.	2-4	2-4	12
- Low-skill	24	19.2	48
Raw material inputs:[2]			
Wheat flour, tonnes/year	360	360	4500
Output: Loaves/Year (each containing 0.36 Kg. flour)	1,000,000	1,000,000	12,500,000

[1]Labour input is computed on the basis of an 8-hour day, 300 days per year. Bakeries actually work 360 days per year. All the projects work 2 x 10 hour shifts per day.

[2]Other inputs include sugar, water, yeast and packing materials (wrappers).

Table 2

Comparative annual costs and revenues, US$ x 1000, 1976

Scale: Loaves/Year	1,000,000	1,000,000	12,500,000
Process Type	Labour-intensive	Partly mechanised	Mechanised
Assumed price per loaf $:	0.152 (all wholesale)	0.152 (all wholesale)	0.158 (50% whole-sale; 50% retail)
Revenues:	152	152	1,970
Total costs: - low wage	133	140	1,720
- high wage	160	163	1,770
Annual profitability after deduction of interest costs:			
- low wage	19	12	250
- high wage	- 8	- 11	200
Investment costs in fixed assets, $ 000's	24	74.6	686

The employment implications of a choice of technology can be seen more clearly if we look at employment generation for a given level of output, say 100 million loaves:

Table 3

Level of output: 100 m. loaves

Scale of bakery	1m.	1m.	12.5m
Process type	Labour-intensive	Partly mechanised	Mechanised
No. of plants	100	100	8
Employment creation	2600	2300	488
Investment requirement ($m)	2.4	7.46	5.5

Again, the advantages of the smaller labour-intensive bakery over the large-scale automated 'factory' sort of bakery are revealed clearly, and the partly mechanised small-scale technology is shown to be inefficient with respect to the automated plant insofar as it uses more capital per quantum output and also more labour.

Omitted from this straightforward economic analysis[1] are other less easily quantifiable considerations. If for example it is thought particularly desirable to encourage employment creation in villages and small towns the small-scale bakery technology is obviously preferable. On the other hand, if it is regarded as important to exert social control over the quality of bread, working conditions and the supply of a basic foodstuff, by centralising production in a single large plant, then the automated bakery might be thought more desirable; although, as the analysis above suggests, there may be significant economic and social costs attached to such a decision.

Case study: Fish processing

Fish, in one form or another, is another form of foodstuff, like bread, common to many countries of the Middle East. Fish may be eaten fresh or processed by a variety of technologies for future consumption: presently, of the world catch of 55 m tons, about one half is prepared as animal feed, 8 m tons are smoked, dried or salted, and 7 m tons are canned.[1]

Of the available technologies of processing and preservation canning is the most modern and is increasingly popular even in developing countries. Here we compare the economic and employment implications of canning with two possible alternatives. Both canning and curing are technically capable of preserving in many developing countries a valuable additional source of animal protein for the needs of inland areas, where protein is presently scarce. Under proper control, tropical fish can be uniformly smoke-dried in simple wood-fired 'ovens' - cabinets constructed of brick and wood, protected from the weather by sheds - with minimal losses, over a period of about 15 hours.[2] This technique is an improvement of the traditional method using improvised drying cabinets in which burning or under-treatment are difficult to control, rendering the finished product less long-lasting and saleable.

It is possible to can fish on a very small scale, but the typical cannery is a large-scale, mechanised enterprise with high investment costs and a high daily rate of utilisation, often working only for a limited season of the year, according to the availability of the fish in nearby

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[1] FAO Yearbook of Fishery Statistics (1975).

[2] FAO (1971), Fisheries Technical Paper No. 104, "Equipment and Methods for Improved Smoke Drying of Fish in the Tropics"; FAO, Rome.

or distant waters. The catch may be pumped directly from the hold of the fishing vessel into the cannery, where mechanised and automated handling and preparation (e.g. washing, removal of head and guts, etc.) precedes packing in cans, salting, oiling, vacuum sealing, cooking, can washing, cooling, labelling and storage.

Smoke drying and canning are thus quite dissimilar activities in scale, technology and organisation. However it seems reasonable to attempt at least an 'order-of-magnitude' cost comparison of canning and smoke-drying and this follows.

Table 4 gives a summary of the schedules of inputs and outputs assumed in this analysis.[1] The price of canned fish assumed is that prevailing in Swaziland for canned pilchards, while the price of dried fish is that in Indonesia.[2] The schedules are largely self-explanatory; but it may be useful to note that in fish-canning, every kilogram of (small) fresh fish is converted into a net can content of 0.85 kilos of fish together with 0.15 kilos of edible oil and salt; and that in smoke-drying, every kilogram of (small to medium-sized) fish is assumed to be converted into 0.33 kilos of dried product, which includes the entire edible portion (80%) of the original freshly caught fish.

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[1]Based on the FAO paper mentioned, and on a technical note by FAO on fish canning.

[2]FAO, op. cit.; Szal, R. and van der Hoeven, R. (1976), 'Inequality and Basic Needs in Swaziland', WEP Working Paper ILO, Geneva, 1976; US AID (1967) 'Canned Sardines, Industry Profile No. 67376', Washington D.C.; Keddie, J. and Cleghorn, W., 'Brewing in Developing Countries' Strathclyde University, Glasgow; Biro Pusat Statistik, 'Indikator Ekonomi', Jakarta.

Table 5 below indicates the annual production costs and revenues for each of the projects. The larger of the two smoke-drying projects is almost identical in design to the smaller. It incurs lower costs per unit of fresh fish input and is evidently preferable on grounds of profitability where local fish supplies and investment resources permit. The choice of the larger smoke-drying project would however halve labour requirements per unit of input. All the projects are profitable at either wage régime, though the profitability of the smallest is very sensitive to the wage rate. The larger smoke-drying and the canning projects are not so sensitive, in terms of profit, to the prevailing wage rate. The canning project has the highest profitability of the three in terms of profit per ton of fresh fish input.

However, canning is an extremely expensive method of fish preservation; its profitability depends on the very high price of the canned product on the basis of equivalent weights of edible fresh fish.[1] The price for canned fish, however, also covers the edible oil and salt in the cans. These extra nutrients are not present with smoke-dried fish.

If cost prices covering interest charges of 10% per annum are computed, with the costs of edible oil and salt excluded from that of canned fish, we have

Table 3

Cost Prices, US$ per ton of Edible Fresh Fish

Wage Regime	Smoke-Dried Fish: Small Project	Smoke-Dried Fish: Medium Project	Canned Fish (Fresh weight of edible fish, excl. oil and salt)
Low	247	232	708
High	295	250	727

[1] $300 per ton = $750 per ton x 18/45, for dried fish; $941 per ton = 800 per ton x 8640/7345, for canned fish; (See the Output' section at the bottom of Table 4.

Table 4

Inputs and Outputs for 3 Fish Processing Projects

Process Type	Smoke-Drying		Canning
Scale : Tons of Fresh Fish per Year	54	216	8640
Utilisation:			
Hours/Day	8[1]	8[1]	16
Days/Year	200	200	300
Land:			
Buildings, M^2	30 (shed) 6 (store)	60 (shed) 12 (store)	1000 (factory) 500 (store)
Equipment Type:	Manual Process; Wood-fired 'Altona'-type Oven	Manual process; Wood-fired 'Altona'-type Oven	Manual preparation tables; mechanised canning line, oil-fired cooking
Total labour:			
- management	-	-	4 (1 expatriate)
- skilled	1	1	21
- low skill	1	3	53
Raw materials:			
- fresh fish (tonnes/year)	54	216	8640
Principal packing materials (units/year)			
- storage boxes	15	60	-
- cans 400g	-	-	14,400,000
- cans 200g	-	-	14,400,000
- cardboard cartons	-	-	900,000
Output: (tons/year)			
- dried fish	18	72	-
- canned fish (net content of can)	-	-	8640
- equivalent edible weight of fresh fish	45	180	7345

[1]This work is spread in practice over a longer period (12-15 hours) according to the oven cycle.

Table 5

Table of comparative annual costs and revenues of 3 fish-processing projects

Process type	US$ x 1000, 1976 Smoke-drying		Canning
Scale: Tonnes of fresh fish per year	54	216	8,640
Revenues[a]	13.0	52.2	6,912
Total costs : Low wage	10.6	40.1	5,917
High wage	12.7	43.4	6,015
Annual profitability after deduction of interest costs			
Low wage	2.4	11.9	995
High wage	0.3	8.9	897
Investment costs in fixed assets $	2100	5100	505,000

[a]Assuming fish prices......

	US$ per ton
Fresh fish	150
Smoke dried fish	750
Canned fish	800

Thus, while the smoke-drying of fish requires a very modest price premium over that of fresh fish - $150 per ton., or $176 - 188 per tonne of fresh edible fish[1] - the price premium required to support canning as a method of preservation is enormous. It is increased further by the inclusion of higher transport costs for canned fish; with its greater weight per ton of edible fresh fish. Assuming a 200 km. journey inland for each product, at $0.035 per tonne-km., the costs of transport per ton of edible fresh fish are $8.2 for canned fish, and $2.8 for dried fish.

The smoke-dried product is clearly a cheaper method of providing additional protein in developing countries. Smoke-drying is also more labour-intensive. At the scale of output of the cannery, the cannery itself requires 74 non-management employees; medium-scale smoke-drying requires 160; small-scale smoke-drying requires 320. At the level of (say) 100 canneries smoke-drying projects would thus directly provide many thousands of extra jobs if they were promoted in place of canneries in the developing world; and might also generate substantial indirect employment, since the 4,000 medium-scale drying projects that would be equivalent to 100 canneries would require an investment of only $20.4 m. as opposed to $50.5 m for the canneries themselves. This saving of over $30 million in investment funds might be used to create jobs in other industries.

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[1]That is, $150 per tonne x $\frac{100\%}{85 \text{ or } 80\% \text{ edible content}}$.

The policy implications of implementing appropriate technological choices

Each developing country is unique in its decision-making institutions, but the discussion here of policies can be simplified by thinking in terms of the typical "mixed economy" composed of some publicly-owned, and some privately-owned enterprises. Policy instruments may include physical controls having the effect of making certain practices impossible; or persuasive measures encouraging (or discouraging) certain decisions by subsidies and incentives (or taxes and duties). Policy measures may be applied at different levels : at that of the particular product, its markets and its sources of technology and machinery; at that of the industrial sector or sub-sector; or at the national level through instruments affecting the economy in its entirety.

Institutional and economic fields of application of policies to generate more employment through appropriate technological choice include (1) removal of the preference given to modern large-scale projects and the encouragement of small-scale enterprise in a variety of ways; (2) measures to shift the pattern of consumer demand towards more appropriate products; (3) institutional steps to encourage the more efficient appraisal of development project proposals; (4) expansion of the functions of the domestic science and technology system in creating and adapting technology. We could name a number of other possible policy areas, but these are the most important and each deserve the brief elaboration that follows.

(1) Policies to encourage small enterprise development and the application of technologies of a capital-saving nature, at any level of scale, cannot be viewed in isolation from the

policy environment of large-scale enterprise. In many countries it is the large-scale sector which is most encouraged by the customary framework of import-substituting industrialisation; it tends to have easy access to bank loans, sometimes at preferential rates of interest; machinery is often free of customs duty, naturally favouring capital-intensity; and large-scale production plants are frequently assisted by the monopoly position they enjoy in domestic markets. Given the objectives of basic needs satisfaction and employment creation this preference for large-scale plants using high-cost modern technology, should probably be reduced, in favour of smaller plants producing cheaper, more essential-intensive products. Such enterprises need however, to be encouraged by government services in respect of training, technology, marketing and credit.

(2) The pattern of consumer demand is primarily a function of income distribution and cannot easily be altered. In some countries there may however be a case for restricting the advertising of products which are quite clearly inappropriate. (It is a particular characteristic of the food processing industry for example, that the advertising of products with foreign brand names is rarely reflected in the nutritional quality of the product. Indeed it can be argued that the more refined a foodstaff, the less nutritious it is.) Restrictions on advertising may discourage private foreign investors and multinational corporations from establishing plants designed to serve high- or middle-income markets rather than the mass of the people.

(3) The choice of more appropriate products and technologies may in the first instance be encouraged by institutional measures such as the establishment of a 'Technology Search and Appraisal Unit' within a ministry of industrial development. Such a unit may (a) examine each proposal for a modern sector

project, evaluating the appropriateness of the product to be manufactured, and the total employment implications, direct and indirect, of the technology embodied in the proposal; (b) provide information on technological alternatives to all potential investors, small- and large-scale, domestic and foreign.

(4) The stimulation of the growth and functions of the domestic science and technology system (STS) is the most important policy area in the long term. By STS we mean (a) technical and scientific manpower training, (b) research and development activities, and (c) machinery manufacture. Typically, scientists and technologists in developing countries are caught between aspirations to achieve the standards set in the advanced industrialised countries, and the needs of their own countries. The result is an equivocation in purpose once graphically summarised by an Indian scientist as follows :

> "Science in most developing countries and likewise in India has two faces. One face is turned expectantly towards the achievements of the advanced nations in regard to the fantastic progress that science has made in landing a man on the moon, sending missiles to objects in the solar and extra-terrestial systems, the harnessing of atomic energy and powerful generation; advances in civil aviation; electronics, communication, synthetic fibres ... . The cost of these achievements and of an R and D system to maintain this progress is fantastic and beyond the means of the developing countries ... . The other face of science in developing countries is towards the utilisation of science and technology for improving the welfare of the common man. This effort includes the introduction of new technologies for agriculture and small/medium scale industry, the dissemination of scientific knowledge to overcome superstitions and prejudice, the creation of job opportunities and the achievements of greater economic and social justice."[1]

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[1] Mr. Bav Dev Singh, in a paper entitled 'The dynamics of technology diffusion and institutional design in India', Seminar at the East-West Centre, Honolulu, October 1972.

It may then be desirable to consider what institutional measures have to be taken to re-orient local scientific research units to address the problems of adapting the technology embodied in imported equipment to make it more appropriate for local use, and for 'upgrading' techniques already employed in traditional activities and in small enterprise, to make these techniques more efficient.

With respect to training, it has been the experience in many developing countries that their formal educational systems have structures emphasising paper qualifications reflecting manpower needs in the very industrialised countries. There may be a need to reduce this emphasis and make instead, increased provision for the training of middle-level mechanics and technicians to strengthen national capability in that area so crucial to long-term economic growth in circumstances of self-reliance, machinery design, fabrication and repair.

Annex

ILO Research and Technical Co-operation on Technology and Employment

This programme of work was launched in 1972. The economic sectors so far investigated (to a greater or lesser extent), are : manufacturing industry (small- and large-scale), agriculture and construction (roads, irrigation works and low-cost housing). Technical co-operation projects are being carried out in relation to national science policy, labour-intensive rural roads, and employment generation in handicrafts projects.

Major publications of the programme have been :

'Technology and Employment in Industry', (edited by A.S. Bhalla, ILO, 1973.

'Manual of Labour-intensive Road Construction', by G.A. Edmonds and M. Allal, ILO, 1977.

'Technologies for Basic Needs' by Hans Singer, ILO, 1977.

More detailed information on alternative technologies is contained in a list of documents, working papers and articles available from the author of the paper to which this Annex is attached.

In the future the ILO will embark on a programme of information dissemination on alternative technologies in manufacturing industry and construction. This programme will be specifically designed to improve the information flow on technological choices to decision-makers in small-scale industry organisations and in public works in developing countries