Towards Global Action for Appropriate Technology

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A. S. BHALLA

Foreword by

JAN DE KQNING

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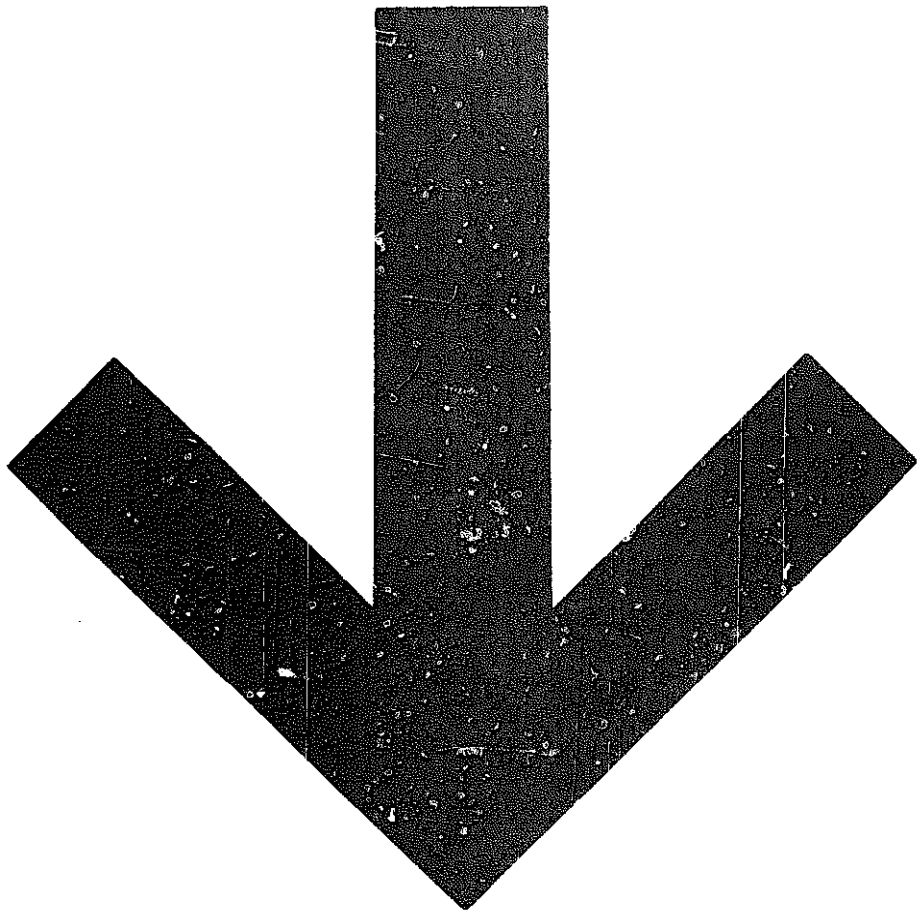

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FOREWORD

In the past few years many discussions have been held on the basic needs approach in both rich and poor countries. A growing number of countries and international organisations have decided to give more emphasis in their aid programmes to assisting the poorest countries and the poorest groups within countries. Several developing countries have likewise changed their priorities in order to put more emphasis on improving the living conditions of their poorest inhabitants.

This change in priorities has important consequences for the choice of technologies. The necessity to make use of the available means of production in such a way that the elementary needs of the population can be satisfied adequately, presents a considerable challenge to developing countries and donor agencies. Application of technologies developed elsewhere will not necessarily lead to the best results and it may even be counter-productive.

While the need for new and appropriate technologies is evident, the majority of current research is oriented towards the type of capital-intensive production found in industrialised countries. An extra effort is necessary to promote and implement technologies more appropriate to the needs of the developing countries.

For this reason, the Netherlands Government, in collaboration with the 150, convened a meeting in December 1977 at which individual experts and representatives of developing and developed countries as well as representatives of international organisations were invited to advise on the possibilities of organising a better coordinated international effort in the field of appropriate technology. The group formulated terms of reference for a team to study the feasibility of establishing a new international mechanism for the promotion of appropriate technology. The proposals of the feasibility team were based on extensive consultations in the first half of 1978 with authorities and experts in developed and de-

veloping countries as well as with the relevant staff of a selected number nf agencies within the UN system.

The revised discussion papers for the meeting and the proposals of the feasibility team presented in this book are edited by Ajit Bhalla of the ILO. I hope this book will serve as a basis for thought, and hopefully, for concerted action.

The Netherlands Government trusts that these proposals will find widespread support. It is my hope that at the founding conference recommended by the feasibility team, of which the Netherlands 'Government will be one of the sponsors, a new international mechanism for the promotion of appropriate technology will be established.

Jan de Koning
Minister for Development Cooperation
The Netherlands

The Hague,
September 1978

INTRODUCTION

by

A. S. Bhalla[1]

In recent years the concept of appropriate technology has gained currency in both developing and developed countries. This concept has emerged in response to a recognition that, in spite of rapid rates of economic growth in the past decades, the objectives of employment creation and elimination of poverty have not been achieved. One of the reasons for this situation has been an over-emphasis in the past on the part of a large number of developing countries on capital-intensive "heavy" industrialisation and the use of techniques that do not necessarily reflect factor endowments and socio-economic conditions prevailing in these countries.

While the concept of appropriate technology has now come of age, the national and international action required for its implementation is not yet commensurate with the magnitude of the task and the challenge it poses. As will be clear from Part II of this volume, while a lot of concern has been expressed to do something about appropriate technology development and dissemination, most of the proposals, particularly for international action, have so far remained on paper. One of the reasons for this is perhaps the controversy concerning the establishment of international institutions and research institutes of the type established under the auspices of the Consultative Group on International Agricultural Research. Is it better to carry out research and development and information dissemination in existing national institutions or in new international institutions? This remains a moot question. There are arguments for and

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[1] Chief, Technology and Employment Branch, International Labour Office, Geneva.

against both types of institutions. In favour of the international institutes, it can be said that in many cases the same basic design of hardware is applicable with no more than simple refinements to a number of developing countries. At times it is also argued that an international institution can attract talent without fear of losing it to local universities and institutes. Thirdly, the record of many national institutions in developing countries over the past several years has been rather poor in terns of results. In theory, a national "centre of excellence" could be transformed into a suitable international institution rather than creating one de novo. Yet, there may be difficulties in this transformation process.

There ace those, like the authors in this volume, who believe that research should be carried out within national institutions in developing countries in order to ensure that effective links are maintained between laboratories and users. A strategy of reorienting R and D towards the rural and small-scale urban sectors adopted in this volume makes it even more necessary that research is undertaken on the spot so as to adapt the hardware and software to local conditions and to capture learning effects of research locally.

If the major objective of action on appropriate technology is to ultimately build national technological capacity in the developing countries, then clearly the role of international action can be no more than sensitisation, financing of R and D, and other catalytic action in support of existing or potential national efforts. The following key questions need answering before a pronouncement car. be made on the form and content of an institutional framework for international action:

(a) what are the criteria and an operational definition of technologies appropriate for a basic needs or any other type of development strategy?

(b) what role do existing national and sub-regional institutions, particularly in developing countries, play in the development of appropriate technologies? How can existing institutional capacity in developing countries be strengthened?

(c) what mechanisms, if any, exist within the UN system to

ensure coordination of activities of different agencies within the framework of a unified policy for the UN system as a whole?

(d) what mechanisms exist for networking, information dissemination and promotion of research and development, and how effective are they?

(e) in the light of the above, is there a case for a new international mechanism for the promotion of appropriate technology?

The six chapters contained in this book provide at least some answers to these questions.*

Part I of the book deals with concepts, definitions and strategies. In Chapter 1, Nicolas Jéquier spells out some relatively unfamiliar criteria which should be taken into account in guiding the selection of appropriate technologies. Jéquier adopts a rather narrow definition of appropriate technology to mean small-scale technology that often has its origins in the traditional methods of production. He presents a number of criteria of appropriateness, e.g. cost, risk involved, modernity, individual or collective nature, and single or multipurpose character of technology. According to Jéquier, problems of non-economic nature, that is, sociological and institutional constraints, to the widespread adoption of appropriate technologies are more important than the purely economic considerations.

My paper (Chapter 2) assumes that the developing countries are (or should be) concerned with a rapid fulfilment of the basic needs of the poorer target populations through increasing national and collective self-reliance within the framework of a new International Economic Order. The links between the concepts of appropriate technology on the one hand, and basic needs approach to development on the other, are established by outlining a technological content of a basic needs approach, by examining the demands that this

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[2]Earlier versions of two chapters, namely, by Amulya Reddy and by the author, appeared as IL0 World Employment Programme Working Papers,

approach might make on decentralisation of production structures, and by considering the political and administrative requirements of technological self-reliance of developing countries,

Whatever the types of development strategy, no objectives, targets or instruments of action are likeiy to be implemented without the existence of adequate institutional mechanisms. Part II of the book therefore examines the existing institutional capacity at the national and international levels.

Amulya Reddy, in Chapter 3, argues that national capabilities in developing countries do exist in the form of science and technology institutions. However, at present these institutions are not harnessed for the development and dissemination of appropriate technology on any appreciable scale. Very few of these establishments have any direct contact with the users through field stations or extension centres. This situation has contributed to the neglect of the needs of the small-scale enterprises whose own resources are too limited to finance research for upgrading of technologies.

Two chapters are devoted to the international dimension of the problem.

The activities of the UN system on appropriate technology are examined in Chapter 4. Willem Floor reviews the ongoing activities of the UN agencies and comes to the conclusions that (a) appropriate technology with special reference to anti-poverty and basic needs approaches, forms only a small part of the UN activities on science and technology, (b) considerable overlapping of activities of different organisations occurs owing to lack of any systematic joint planning of programmes and (c) coordination is needed mostly at the country project level..

Frances Stewart, in Chapttr 5, reviews existing international mechanisms (both within and outside the UN system) and the proposals for new mechanisms dealing directly or indirectly with appropriate technology. She concludes that the existing mechanisms do very little on appropriate technology. Significant international action to improve information collection and dissemination and to promote appropriate R and D on appropriate technology, is therefore needed to supplement national efforts.

In the light of the preceding review of existing national and international mechanisms, Chapter 6 presents a blue-print for global action for the promotion of appropriate technology, through the establishment of a new mechanism. Extensive consultations in a cross-section of countries and at the headquarters of various UN and other inter-governmental organisations were held by Paul Marc Henry, Amulya Reddy and Frances Stewart regarding the feasibility of a new mechanism. The action programme proposed in this chapter reflects the majority opinion of the individuals and institutions in the developed as well as developing countries. It is also quite timely in view of the forth-coming UN Conference on Science and Technology for Development (UNCSTD) to be held in August 1979.

A programme of action for UNCSTD is currently being prepared by the UNCSTD Secretariat on the basis of proposals from countries, regions, UN organisations and the scientific community. According to the Secretary-General of UNCSTD, this programme of action is likely to reflect three "end products" of UNCSTD, namely: (a) appropriate mechanisms for a harmonised UN science and technology policy; (b) a horizontal mechanism for the exchange of experience among developing countries concerning technology development and transfer; and (c) a few specific pilot projects on topics of high priority. The blue-print for action proposed in Chapter 6 is particularly relevant to the horizontal co-opera-tion among developing countries.

The new international mechanism is intended to overcome the imbalance of work on technology between developed and developing countries, and to promote sound national technological capability for generating indigenous technologies best suited to the prevailing conditions of developing countries. This mechanism is proposed as a flexible entity like the currently operating consultative groups. It is not, however, intended as a new institution. Although it will resemble some consultative groups, it has a number of its own distinctive features. Firstly, unlike the consultative groups, it will not be dominated by the donors from the developed countries or from the developing countries for that matter. Greater participation of developing countries is anticipated. Secondly, it is proposed to be formally outside the United Nations System. Nevertheless, it will need to be closely associated with the different UN organisations currently engaged in work on science and technology.

Thirdly, it would not be responsible for coordinating UN activities in the field of appropriate technology. This is a task to 'be undertaken by appropriate bodies within the UN system.

PART I
Concepts, Criteria, Strategies

Chapter 1
APPROPRIATE TECHNOLOGY: SOME CRITERIA

N. Jéquier

INTRODUCTION

Theories about economic development are subject to the same whims of fashion as women's clothes: what appeared beautiful one season seems a little out of tune the next and distinctiy inappropriate three years later. There are good reasons to believe that our concepts, ideas and policies in the field of appropriate technology are in need of a little re-tailoring, if not of major m-designing. To put things in a more technical perspective, we must now make the jump from the "first generation" to the "second generation" in appropriate technology.

The first generation can be characterised by the paramount importance of moral and ideolbgicai considerations in the debate about development styles, by the seminal role of a small number of marginal groups in bringing these issues to the forefront of development thinking, and at the technological level, by the experimental nature of innovations in hardware. This first phase we have known in the last few years has been extremely important, but it has probably reached its natural limits.

The second generation which is now opening up raises a number of new and largely unexplored issues. One is that of institutionalisation or "de-marginalisation" of appropriate

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[1] Principal Administrator, OECD Development Centre, Paris.

technology. Another is that of effective linkages between the innovation system in appropriate technology and the financial and investment system. A third is that of developing national and international technology policies focusing specifically on appropriate technology. And the fourth is the role of appropriate technology in meeting the basic needs of the hundreds of millions of poor people in the less developed countries.

The purpose of the present paper is not to outline in any detail the scope and contents of this second generation strategy in appropriate technology, but rather to explore one of the critical issues in this debate, namely that of the appropriateness of technology. One assumption here is that the shape of this strategy will be determined to a certain extent by the criteria and yardsticks according to which a technology is defined as appropriate or inappropriate. Another assumption is that until now most of the yardsticks and criteria of a technology's appropriateness have been economic, and one aspect that has been particularly emphasized is that of a technology's effects upon employment. These criteria are important and the methods of economic analysis have become extremely sophisticated. However, without wanting to belittle the role of economic yardsticks and notably of their employment-generating component, it is well to note that economics is not everything, and that success in the innovation process depends not only on the economic attractiveness or appropriateness of a particular technology, but also on a number of social, cultural and technical factors which are perhaps more difficult to pinpoint and quantify, but which are at least as important.

The present paper will try to identify some of the less widely used criteria. Our hypothesis is that by considering such other criteria, it may be possible to design technologies which are in effect more appropriate than those whose main justifications are economic. What follows here is not a systematic methodology, but rather a presentation of potentially relevant criteria illustrated wherever possible by specific examples. For obvious reasons, it would be somewhat unrealistic to attempt to rank them according to importance: some may be particularly relevant in certain specific areas, and irrelevant in others, and the discussion which follows is intended merely to present some elements that night be taken into account both in the design of new

appropriate technologies, and in the definition and implementation of technology policies focusing specifically on appropriate technology.

At this stage, it may be useful to clarify a certain number of points. The first is that the search which is currently going on both in the industrialised and the developing countries for more appropriate forms of technology is probably not an ephemeral fashion, as many critics of the appropriate technology movement would claim, but rather the manifestation of deep-rooted social and political changes which are only just beginning to be translated into new types of technology and novel approaches to innovation. Appropriate technology is here to stay, but it should also be realised that the scope and number of successful innovations in appropriate technology is for the moment still too limited to serve as a convincing and viable alternative to the types of technology we have today. The situation is somewhat similar to that of the automobile in 1890: this new technology looked very promising, particularly to those who had developed it, 'but it was not yet a competitive substitute to the railway and the horse-drawn carriage,.

The second point is that appropriate technology should not be viewed as a second-rate technology. Designing a good appropriate technology, be it an inexpensive and reliable water pump, a long-lasting roof for slum dwellings or a truly efficient oxcart, is in many ways just as complex and challenging from the conceptual point of view as any modern industrial innovation. What is more, the diffusion of such appropriate technologies is in some respects much more complex than the diffusion of modern consumer goods or new industrial production processes: social and cultural resistances are much stronger, the income level of those who stand to benefit from such innovations is usually very low, and the market forces which could stimulate innovation tend to be rather inarticulate. Appropriate technology is not, and should not be viewed as a second-best solution. Conversely, neither should its role be over-estimated: appropriate technology is not a universal substitute for the conventional modern technology. Appropriate and modern technologies are complementary rather than contradictory, and the emphasis given to the former does not and should not rule out the use of the latter in those cases where they are particularly well adapted to local situations.

A third point which deserves some clarification here is the relationship between appropriate technology and the satisfaction of basic human needs. In the industriaiised countries, a sizeable proportion of appropriate technology groups are working on the development of innovations which focus on the better utilisation of scarce natural resources, the transition to renewable sources of energy and the minimization of technology's negative impact on the environment. By contrast, most of the groups working in the developing countries, as well as those groups in the industrialised countries which have given particular emphasis to the problems of developing countries, tend to view appropriate technology as the main tool in meeting the basic needs of hundreds of millions of poor people who have largely been left out of the development process. The picture presented here is no doubt somewhat caricatural, but it does suggest the existence today of twc big "families" in appropriate technology: the "industrialised country family", which is concerned largely with environmental questions, natural resources and the technologies of the post-industrial society, and the "developing country family" which gives much more attention to the problems of poverty, social equity, employment and basic human needs. There is much overlapping between these two families, and their genetic and cultural backgrounds are not fundamentally different. Furthermore appropriate technologies developed by one of these two families can in many cases be considered as equally appropriate to the concerns of tht other: this is the case for instance of many technologies in the field of energy, as well as in agriculture. When looking, as this paper does, at the criteria of a technology's appropriateness, it is important to bear in mind the differences between these two "families" and to realise that what is appropriate to one of these families will not necessarily be considered in the same light by the other. What we will do here is try to identify a certain number of criteria of appropriateness which are common to both families.

SOME CRITERIA OF APPROPRIATENESS

"Systems-Independence" of New Technology

The first criterion we shall examine here might be called the "systems-independence" of a new technology. This some-

what obscure term can perhaps best be explained with the help of a few examples. The first is that of the high yielding varieties (HYV) of rice developed by the International Rice Research Institute and which are one of the mainstays of the Green Revolution in the humid tropics. One central feature of this new technology is its dependence on a. wide range of supporting services and technologies. First on water: these HYVs require irrigation (rain-fed HYVs are still at the development stage), which means that they car. only be used by farmers who are already growing irrigated rice (and these are usually the more affluent farmers, or those living in the most developed regions of the less developed countries). The second is on fertilizer- and pesticides. The third is on mechanisation, which is needed in order to meet the high demand on labour. And the fourth is on supporting services such as drying equipment (crops maturing during the rainy season cannot be sun-dried, but require diesel-powered driers). There is no doubt that these HYVs are in themselves a remarkable piece of bio-logical technology, but their diffusion is contingent upon the availability of a wide range of supporting services and subsystems. in other words, it is a highly "systems-dependent" type of technology. This in itself is not necessarily a drawback, but it clearly limits the number of potential beneficiaries, notably among the poorest farmers in the least developed regions.

A second example is that of the methane-gas plants developed among others in India. Here again, this is an extremely in-genious technology, but like the HYVs of rice, it is very system-dependent: the farmer who wants to operate such a domestic plant must have at least two or three cows to pro-vide the raw material, he must have an easy supply of water, and he needs a certain amount of land around his house, both to install the machine and to dispose of the fermented dung as a fertilizer. The systems-dependence of this particular technology limits its attractiveness to a rather narrow group of farmers, namely those who are rich enough to own several cows and have their own house and some land, and at the higher levels of income, to those who are not tied into an integrated sewage disposal system and into the electricity distribution network.

Another example is the case of powdered milk for babies. Despite claims to the contrary, this 19th century technology is extremely appropriate (one may think here of the ease of

storage and distribution) and it played a major role in bringing down infant mortality in the countries which are today highly industrialised. But this technology is highly systems-dependent: clean water must be available for mixing with the milk powder, and cheap fuel is needed to sterilise the bottles and the water, two conditions which are seldom fulfilled in very poor communities. If these two supporting services are absent, the inherently appropriate technology of powdered baby milk may become very inappropriate.

These few examples suggest that some types of technology are by nature more systems-independent than others. This is not to say that they are inherently better or more appropriate than technologies whose successful diffusion depends upon the presence of an important supporting infrastructure (education and training facilities, extension services, provisions for credit or new forms of social organisation). Nor does it imply that systems-independence is a feature that can somehow be engineered into a new piece of hardware at the design stage. It does however point to the fact that in the innovation process, the key to success lies not only in the intrinsic qualities of a particular technology, but in many cases in the presence of a wide range of supporting services. This seems to be particularly true in the case of technologies aimed at meeting basic needs. When trying to evaluate the appropriateness of a particular technology, one should consider riot only the technology as such, in the form of a clearly identifiable piece of hardware, but also all its supporting software. It is also important to realise that in many cases, a trade-off may occur between hardware and software: if the supporting package is highly effective but the hardware of average quality, innovation can be easier to achieve than in the case of an excellent piece of hardware without any such supporting services.

Image of Modernity

People buy a product or use a specific technology because it is economically attractive, socially useful or technically appropriate; but they are also influenced by its symbolic value, and by their perception of the product's modernity. In developing countries imported products and technologies very often have a better image than local products, and national trade policies which seek to limit

imports in order to promote indigenous industries may ultimately contribute to enhancing the image of these foreign products - because of their growing scarcity. Development experts and appropriate technology proponents are quick to deplore and sometimes to deride this attraction for things foreign, which is seen as a manifestation of cultural imperialism on the part of the industrialised countries and of social alienation on the part of the developing countries. What is not always realised is that this positive image of foreign and modern products or technologies, which entails a number of drawbacks, can also be an important feature in the process of development. Rather than try to pass a judgement - and the judgement is invariably negative - it may be better to try to exploit this cultural feature of the innovation process. TWO examples can be given here to illustrate both the positive and the negative approach.

The first is that of the small-scale sugar plants now operating in India. These small plants designed by the Planning and Action Research Institute in Lucknow embody what by any counts can be considered as a particularly appropriate technology (high labour-intensity, competitive production costs, low investment per workplace, high quality of end product). Of interest here is the fact that the designers perceived very clearly that consumer preference was shifting away from traditional sweetening agents like gur and khandsari to the more modern (and nutritionally perhaps less appropriate) white crystal sugar. As a result, these small-scale sugar plants were designed specifically to produce a high quality white crystal sugar similar to the one made in the large-scale modern plants. This was undoubtedly one of the important unrecognized factors in the success of this major innovation in appropriate technology.

Contrast this with the inexpensive high protein instant food developed by the subsidiary of a large multinational American food firm for sale in Latin America. The success of this new cereal was evident in a number of countries (a testimony, incidentally, to the ways in which large multinationals can be encouraged to develop appropriate technologies), but in one particular country the innovation was a complete failure. Subsequent investigations showed that this failure did not result either from the quality of the product or its lack of attractiveness in terms of

taste, but rather to the fact that it was deliberately marketed as a poor people's food.

it night be suggested here that in many cases one criterion in the design of appropriate technologies for basic needs is that cc modernity. This is not to sav that the aim of the poor people in the developing countries should be to imitate the life style and consumption patterns of the rich in the industrialised countries or of the local elites in their own country. Even less are we trying to suggest that the only path to development is that followed by the countries which are today highly developed. The fact is however that in many instances the drive which motivates people to improve their living conditions can be satisfied by technologies which, in addition to their intrinsic qualities, also carry with them the image of modernity. One of the very difficult problems here is not to transpose from abroad new technologies which are both modern and appropriate, but to design locally technologies which are consonant with the society's culture, values and resources [2].

Individual Technology Versus Collective Technology

Many of the technologies required to satisfy basic human needs are of a collective or community nature: this is the case with water supply systems, sewage systems, electricity distribution services, and many others. Others can be either collective or individual: in the case of housing for instance, there is a choice between individual dwellings or apartment complexes. And some technologies are essentially individual in nature: this is the case of most durable consumer goods. Clearly this distinction between individual and collective technologies is somewhat arbitrary, and in most cases there is an element of each mode in every technology: an automobile embodies a more individual technology than a railroad or a bus, but its operation requires certain collective services (e.g. roads, maintenance services, etc.). An electric stove is a more individual technology than a gas stove tied to a village-level gas plant, but it is clearly more collective than a butane cooker using rechargeable containers.

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[2] See Chapter 3.

The distinction made here between individual and collective mode does not imply that one mode is inherently superior to another, but rather suggest; that this may also be an important criterion in determining both the appropriateness of a technology and the directions in which the innovation process might be channelled. It is also one of the criteria which tends to be overlooked in the traditional economic evaluations of a technology's appropriateness.

This can be illustrated in the case of the diffusion of low-cost water purification and supply systems in Thailand and the Philippines. The technology, developed in Thailand, is both simple and appropriate: turbid water from canal; or rivers is purified in a village plant with a filtering medium made from agricultural wastes (rice husks or coconut husks), and small quantities of chlorine are later added to the purified water. This technology requires a basic community infrastructure: arrangements must be made for sharing the costs of operation, and one or two persons must be entrusted with the running of the plant. This technology was tested in a number of villages both in Thailand and tne Philippines, and interestingly enough was much more successful in the Philippines. In Thailand, where social allegiance is more to the extended family than to the community, a significant proportion of users dropped out of the scheme (which meant that the cost of water for the other families had to be increased), the villages were reluctant to pay the salary of the plant's operator, and there were often major difficulties in allocating the limited quantity of purified water to the participating families. In the Philippines by contrast, the operation of such plants proved to be much easier, largely because of a long-standing tradition, nurtured perhaps by religion, of community participation.

The same problem can be found in the field of agricultural mechanisation. In many cultures, co-operative forms of organisation of the mechanisation process are extremely difficult to implement, and the more appropriate strategy may be to introduce small machines that can be individually owned and operated, rather than the larger machines that require a co-operative form of organisation. And if large machines (e.g. bulldozers, large tractors, etc.), are absolutely required, for instance because of the particular nature of the terrain or the structure of the land holdings, it is possible to design individual modes of operation for machines which in other cultures would more appropriately

be used on a collective or co-operative basis. For instance by financing tractor hire systems (the machine is owned by an individual, but farmed out by the hour or day, with a driver, to the farmers who require its services).

Slum rehabilitation is another typical field where choices can be made between collective and individual modes of innovation. Relocating slum dwellers in high-rise apartments can be successful (as in Singapore, a Chinese Confucian culture), but in many cases, the new dwellings gradually degrade into high-rise slums. But very often, with small individual houses which leave room for improvement and enlargement, the process of relocation or rehabilitation often leads to further improvement and development. One very interesting example in this respect is what happened in the city of Cali in Colombia, where the provision of basic services, cheap credit and technical extension services were instrumental in the upgrading of slums into middle class areas.

What these examples suggest is that the mode of operation of a new technology - collective or individual - is often a crucial element in the success or failure of an innovation. When designing a techcolagy, account must be taken cf the culture of the group for which this technology is intended, and this criterion is probably a much more important determinant of success or failure, and hence of a technology's appropriateness, than generally suspected.

Cost of Technology

Few people would disagree with the statement that one of the essential features of an appropriate technology is its low cost. This is particularly true when it comes to technologies aimed specifically at meeting basic human needs. However, while there may be a general agreement about this worthy principle, it is well to note that the issue is in fact much more complex than generally suspected, and conflicting approaches to the cost elements account for a large share of unsuccessful innovations in appropriate technology.

Just to illustrate the problem, let us return for a moment to the case of the Indian mini sugar mills mentioned earlier. In terms of production costs, it can be observed

that the kilo of sugar from these mills is slightly cheaper than that from a modern large mill. This cost advantage however is not due only to the inherent efficiency of this process, but also to a number of exogenous factors. One is the lower taxation rate. Another is the lower transportation cost of cane from the plantation to the mill and of refined sugar from the mill to the village store. And the third element is the lower depreciation allowance for capital investment. These are factors over which the mill owners have little if any control, and what is more, they can change rather abruptly, thereby modifying the underlying economic assumptions about this technology's efficiency.

If one considers things in a long-term perspective, -the cost equation becomes even more complex. The small plants employ a lot of labour, and it can be expected that the general rise in the country's income level coupled with a deliberate policy of increasing the income of the lowest paid workers, and the growing unionisation of the labour force, will contribute to raising the labour costs of the small mills somewhat faster than those of the large modern mills. In other words, their costs will increase rather rapidly, and the economic justifications for such a technology may not be as compelling ten or fifteen years hence as they are today. This is particularly true of appropriate technologies such as this one which stand so to speak at the periphery of the modern industrial sector and which have to compete on the open market against the technologies, organisational power and financial resources of this sector. The problem is undoubtedly somewhat different in the case of appropriate technologies aimed specifically at meeting the basic needs of a very poor population: costs and benefits are rather difficult to measure in purely economic terms, ideological and moral factors are particularly important, and social efficiency is usually more meaningful than private efficiency.

Here it may be useful to draw a page from the accounting books of modern industry, and notably from service-oriented industries such as telecommunications. Accountants of the national telephone authorities are now accustomed to measure the cost of any piece of equipment not simply in terms of purchase price but in terms of total life cost of the product. As a result depreciation charges, maintenance costs, repairs and expected useful life become more im-

portant in the calculus of efficiency than the initial and somewhat narrow production or purchase cost. In the same way, it may be useful here to envisage some more sophisticated accounting methods for measuring the value to envisage some more sophisticate3 accounting methods for measuring the value of appropriate technologies. This concept of total life cost would for instance clearly bring to light the fact that the relatively low reliability of many appropriate technologies makes them less attractive than a short-term estimate of present operating costs would suggest (and this indirectly explains the market failure of many apparently appropriate technologies) and would pave the way to a much more serious attention to this problem of reliability and durability.

Technologies aimed at solving the major problem of basic human needs arc presumably aimed at the poorest people. Leaving aside for the moment the issue of social acceptability? it is clear that one of the critical elements is that of cost, or if placed in another perspective, that of the price charged to the user or consumer. Evidence seems to suggest that a large proportion of the low-cost appropriate technologies now available to met certain basic needs (in housing, food, shelter, health, etc.) are still much too expensive for the very poor. In the same way that one of the basic problems in nutrition is not the lack of food, but the inability of people to pay for the food they need. One can either try to raise the income of the poorest people in order to allow them to purchase what they need to meet their basic needs, or else develop technologies or products which are much lower in cost and price than is the case today. The cost decreases which are required here are not of a few percentage points, but of one order of magnitude at least, and this presents our innovation systems with a major challenge which in most cases is still far from having beer? met.

One of the difficulties here is that when it comes to certain types of basic needs the innovation system in appropriate technology does not seem to be subject to the same experience curves that can be observed for instance in modern industry. Nor does it seem always able to benefit from the same advantages of scale. The experience curve theory states that production costs per unit decrease in proportion with the cumulative number of units produced. The rates of decrease vary of course considerably from one

industry to the other, but the general pattern can be verified empirically from a wide range of sectors (e.g. automobiles, computers, aircraft, machine tools, etc.).

In the case of appropriate technologies aimed at meeting basic needs these two phenomena of experience curve and economies of scale may operate in a rather less effective way. One possible reason for this is that appropriate technology, particularly when it is conceived of as a tool for self-help, often represents a "one-of-its-kind" type of technology. 'The farmer who is taught to build a more appropriate water storage tank or to use a new inexpensive material for roofing his house, will in most cases do the work that is required for his own needs, and stay at that. In the same way, one can help thousands of poorpeople to build a latrine and sewage pit, but if there are economies of scale, they can be found, in the teaching and extension process, rather than in the production process itself.

This method of operation, characteristic of self-help projects, is psychologically very important in that it shows the beneficiaries that they can improve their lot and master at least some aspects of their life. But it also means that every self-made piece of equipment is burdened with the additional costs (and often the technical deficiencies) which are associated with the first product of a batch.

The existence or absence both of learning effects and economies of scale is probably an important criterion in selecting technologies and in initiating development projects. To take a somewhat hypothetic example, it might be worth putting more emphasis on the development of family size low-cost water purification units which can easily be transported from a regional manufacturing unit, than on the larger, untransportable (and therefore difficult to duplicate) village-level plants built by the villagers themselves. The question here is not only whether a particular technology is inherently subject or not to the effects of learning and economies of scale, but also whether the mode of production, the system of diffusion of innovation and the method of operation of the extension service is not in itself a more important variable in this respect than the technology as such. And the criterion of appropriateness which might be suggested here is that of sensitivity of a technology (including all the software which accompanies it)

to the effects both of learning and economies of scale.

Risk Factor

Any innovation involves a certain amount of risk: for the industrialist who launches a new product, for the farmer who purchases a new machine or tries out a new crop, for the consumer who buys a new house or moves to a different job. The interest of any innovator, whatever the level of sophistication and complexity of the innovation, is to try to minimize these risks. In the case of a new product, the consumer will turn to a well-known manufacturer with a high reputation, and the farmer will closely watch others who are experimenting with a new crop or a new way of doing things.

In the case of appropriate technology, three general observations can be made. The first is that this problem of risk is largely if not totally absent from discussions about the choice of technology, the innovation mechanisms required to promote innovation, or national development policies. The second is that in the case of technologies geared specifically to the poorest income groups, the risk of any particular innovation is inherently much greater than in the case of the population at large: the lower the income, the greater the relative risk for a given innovation or technology. And the third is that a new technology (and most appropriate technologies belong to that category) almost always involves greater risks than a well-established technology, even if it is economically and technically much more attractive. Risk is a very important criterion in determining the appropriateness of a technology, and it is little more than a statement of the obvious to say that the most appropriate technology is also the one that involves the minimum amount of risk for the user.

If this is accepted as a valid criterion of appropriateness, it is possible to start designing technologies and their supporting services and subsystems with this objective of risk minimization in mind. Clearly, all designers of new appropriate technologies somehow have this objective in their mind, even if only in an implicit way, just as an engineer does in any modern industry. But what is not always fully realised is that the level of risk - economic, social, cultural or technological - involved in any particular new technology depends not only on the inherent design

qualities of this technology (this might be called the internal risk) but also on the ways in which it fits into the local production system, the local culture and the available supporting services (this might be called the external risk).

Let us consider for a moment the new types of low-cost transportation vehicles developed by several research centres for the rural areas of the developing countries. These small, rugged and inexpensive vehicles (such as those of the International Institute of Tropical Agriculture in Nigeria or of several industrial enterprises in the Philippines) are in many ways very appropriate. But what must be realised is that both the internal and the external risks involved are considerably greater than in the case of conventional vehicles. The internal risk stems from the novelty and somewhat experimental nature of this technology. The same problem can of course be found in all sectors of modern industry: purchasers of the first models of a new automobile for instance are almost always plagued with the teething troubles characteristic of any new vehicle. As for the external risk, it results in large part from the fact that the supporting services that might alleviate the internal risk (i.e. maintenance and repair services, supplies of spare parts, etc.), are simply not available, at least for the moment.

Internal and external risk tend to operate in a synergistic way, which can be either positive or negative. If the design of a new product or a new technology is sufficiently good to reduce the internal risk to a minimum, it tends by way of consequence to reduce at the same time the external risk (a very reliable machine for instance needs only minimal supporting services). Conversely, a high degree of internal risk puts very heavy burdens on the supporting services, a phenomenon which in turn contributes to reducing the effectiveness of these services, and hence to increasing the external risk.

Another important factor to consider here is that the internal and external risks of any new technology tend to become proportionately much greater when attempts are made to introduce at the same time several other inter-related technologies. To put things in a rather extreme form, one might say that the risk involved in an innovation increases not linearly with the number of new technologies involved

in that innovation, but as the square of that number. This can be illustrated with the case of an integrated energy supply system for villages now being tested in at least two very poor countries. The idea here was Co satisfy all the energy requirements through a set of apparently very appropriate technologies: a solar pump for drawing water from the aquifer, bio-gas plants for the supply of cook:ng fuel and the disposal of animal dung, and windmills for the production of electricity. All three technologies are rather experimental, and largely untested in that particular social and economic environment. Quite apart from the fact that the cost of these pilot projects is totally out of proportion with the resources of the local communities, it can be observed that none of these technologies is operating satisfactorily. For instance, the new grain mill introduced to make use of the available electricity produces a flour of a rather different texture than the one made by manual crushing, and no one wants to eat it; as for the solar pump, its main effect has been to multiply water consumption by a factor of ten, at least during the time when it happens not to be laying idle because of technical problem. The whole innovation having been conceived as a system of interdependent technologies, the failure of any of them directly affects all the others. In such a case the overall risk of failure of the whole system is not equal to the sum or the average of the risks characteristic of each component, but to the rate of risk of each component multiplied by the rate of risk of all the others.

Without going into the rather complex issue of risk measuremen-t, it can be observed that this notion of risk is not only economic (e.g. what are the chances that a new piece of equipment will perform as effectively as anticipated?), but also technical (e.g. what is the risk of technical failure over a given period of time?). Furthermore, risk also depends on social and cultural factors. Certain new technologies, because they are well tested, may have a very low technical and economic risk, but may ultimately fail completely because the social and cultural factors were neglected. This is particularly frequent in the case of technologies related to food production nnd consumption, and also but to a lesser ex-tent, to technologies related to housing.

What these few examples suggest is that risk is one of the important determinants in the appropriateness or inappro-

priateness of technology. And as we have tried to show, the risk can be either internal or external, it is not only economic and technical, but also social and cultural, and account must be taken of the fact that the risks of an innovation which involves a large number of components or subsystems tends to be considerably greater than in the case of an innovation embodying a single new technology.

If the ideal appropriate technology is often the one which involves the minimum risk to the users (particularly in the case of people who belong to the poorest and most underprivileged social groups), it is also worth pointing out that high risk in itself is not always necessarily a negative feature. In the industrial sphere in particular, the high risk of an innovation can be partly balanced if not totally outweighed by potentially very high economic rewards, and it can be observed that dynamic young entrepreneurs are often attracted by ventures where both risk and potential rewards are far above average.

It should also be noted that if low risk is given an exaggerated importance in determining the appropriateness of a new technology, there is a danger of stifling the innovation process and, when different solutions are available to meet a particular need, of favouring systematically the well-tested technology, which in many cases is an imported technology rather than an indigenous innovation. Since one of the main aims of the appropriate technology movement is precisely to foster greater local self-reliance and alleviate some of the most conspicuous problems of what might be called the addiction to foreign technology, it would be inadvisable to look at the risk factor as an important criterion of appropriateness.[3]

Evolutionary Capacity of Technology

One of the many reasons why traditional technologies are not as competitive as modern technologies is that they are relatively static. This ix not to say that they do not or cannot benefit from any innovations. But the process of innovation, when it does take place, is generally slow, and

[3] For a discussion of self-reliance, see Chapter 2 below.

in most cases too slow to keep up with the pace of innovation in the modern sector. In the case of appropriate technology, which is often an intermediate between traditional and modern technology, the patterns of innovation are often closer to those that can be found in tha traditional sector than to those of the modern sector. In other words, many of the new technologies developed by appropriate technology groups do not have a sufficient evolutionary capacity, and innovation tends to be conceived of as something that happens once and for all.[4]

The problem here lies not so much in the nature of technology as in the culture and philosophy of the appropriate technology movement. What seems to be happening in effect is that its reference framework is the innovation system in traditional technology, rather than the innovation system in modern technology. Because of this orientation, there is a tendency to overlook the inherent dynamism of innovation in the modern sector, and to design technologies which are in many cases more appropriate than the traditional technologies they seek to replace, but which in the long run stand little if any chance of becoming competitive relative to modern technology.

Another reason for this is that appropriate technology, at least in the current sense of the word, is a fairly new concept. Developing new sources of energy for the villages, inexpensive water supply systems, more efficient small-scale plants for rural industries or new types of simple agricultural machinery is in itself a very complex task (contrary to what is usually beiieved) and partly for this reason, it is rather difficult for the innovators in appropriate technology to perceive that what they have developed, often with great difficulty and using much ingenuity, is transient and provisional.

Appropriate technology, if it is to have an evolutionary capacity, will in many cases (notably when it deals with production technology as opposed to self-help technology) evolve into a larger scale and more capital-intensive type of technology, which is precisely the type of technology

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[4]See Chapter 3.

(with its associated philosophy, work patterns and social relations) to which the appropriate technology proponents are seeking a valid alternative. Illustrative of this problem is the story of the small-scale egg tray making machine developed by the Intermediate Technology Development Group. Attempts to improve this ingenious design resulted in the development of a better machine which employs half as many people as the one it replaces. This may well be a small example, but it is probably rather more typical than one would suspect. This indirectly suggests that the evolutionary capacity of a technology is not something inherent in the technology itself. Rather it is a feature built into the philosophy of those who innovate. And in the case of appropriate technology, there may well be some sort of a mental block against a system of permanent innovation which might lead to larger scale and less labour-intensive types of technologies.

Symbolic of this problem is the major focus of appropriate technology strategies on the issue of employment, and specifically on one particular aspect Of the employment equation, namely the cost per workplace. This concept of cost per workplace has been extremely fruitful, and points to some very fundamental issues, notably to the fact that societies with very limited resources cannot afford to invest large sums for each job created if they are to improve the overall employment situation. Without wanting to belittle the major importance of this criterion of appropriateness, it is interesting to observe that considerably less attention has been given to the other side of the coin, namely output per employee. If output is low, incomes accruing to the workers will also be low, and the only way to increase incomes is to ensure that the productivity of these appropriate industrial or agricultural processes wiil also increase.

Rather than use investment cost per workplace as one of the mostimportantcriteria Of atechnology'sappropriateness, it might also be worth considering output per worker, and more specifically output over a long period of time. Indirectly this would help to measure the evolutionary capacity of a new appropriate technology, and serve as feedback to the innovation process.

Consider for instance the case of a country with a per capita income level in the range of $200. A new industrial

plant with an average investment per workplace of $500 is in many respects more appropriate than a much more capital-intensive plant with an investment per workplace of $20,000. These two plants will in all probability have very different levels of productivity per worker. If the output per worker of the first plant is around $1000, this may be fine for the time being, but the crucial question here is whether this smaller scale and more appropriate technology can, in some way, be upgraded so as to push output per worker to $2000 in five or ten years time (the figure being measured here, of course, in constant terms). If output per worker ten years later is still likely to be no more than 81000, then it is probable that this is not as appropriate a technology as initially thought. And the main result of this innovation will have been to create another type of ghetto, not entireiy unlike that which characterises the traditional sector in many developing countries.

There are good reasons to believe that one of the criteria of a technology's appropriateness is its evolutionary capacity. However, because of the complexity of measuring what constitutes a technology's evolutionary capacity (the term may be clear, but its practical measurement is extremely complex, and probably very subjective as well), it might be easier and more simple to use a substitute yardstick, namely output per worker over a relatively long period of time. If this output is likely to remain static, the technology is probably less appropriate than initially envisaged. One of the functions of this yardstick however is not simply to make rather theoretical long-term comparisons, but rather to bring innovators in appropriate technology to think not only in terms of today's needs and resources, but also in terms of building up a system of permanent innovation in appropriate technology.

Single-Purpose and Multi-Purpose Technology

Another criterion of appropriateness which would deserve closer attention is that of the range of applications of a technology. Is a "multi-purpose" technology more appropriate than a "single-purpose" technology? This concept can be illustrated by the case of small-scale agricultural machinery. One of the most successful and appropriate types of machine now being diffused on a large-scale in sev .al

Southeast Asian countries is a small power tiller which can be used for a number of different purposes: designed initially for tilling, it can also be attached to a water pump, it can serve to power a rice drier, and can be fixed to a small trailer and used as an inexpensive means of transportation. Because it can be operated by an individual farmer for many more hours per week than either a small truck, a diesel pump or an ordinary tiller, it is an extremely economical machine. If different machines had to be used for each of these functions, problems of maintenance, supplies of spare parts and servicing would be more difficult to handle. Clearly, the fact that such a machine can be used for a wide variety of functions also means that none of them can be carried out quite as efficiently as with a more specialised machine. In the same way, a multi-purpose dam, aimed simultaneously at flood control, irrigation and electricity generation, may be less efficient in each of these functions than a more specialised dam, but in overall terms less expensive, and relatively more efficient because it can fulfill several functions.

Some types of technology may be inherently more multi-purpose than others. But in most cases, as illustrated by the Southeast Asian tillers, the multiplicity of functions is something that can be built into a new technology at the design stage: if such a tiller is to be used also as a transportation vehicle, it must among others be more powerful than would be required if it were used only for tilling.

One interesting case of a technology which is multi-purpose by nature rather than by design is ferro-cement technology (i.e. cement reinforced with wire mesh, or natural products such as jute or bamboo). The same basic technology can be used for making irrigation pipes, water tanks, food storage vessels, and with a few minor modifications (e.g. in the proportion of cement to other materials) it can be used as a roofing material and as panels for house construction. The major advantage of this multiplicity of applications is that once a poor farmer, or for that matter a village craftsmen, is taught the basics about this technology and about one or two major applications, he can apply this knowledge to a very wide range of other technical problems.

Clearly the search for multi-purposeness in technology

should not blind us to the inherent advantages of certain extremely narrow and specialised appropriate technologies. One example here might be that of very low-cost disposable syringes that are designed in such a way that they physically cannot be used a second time, thus obviating one of the major health problems in poor countries seeking to promote mass vaccinations, namely, the multiple use of disposable syringes that cannot be sterilised after they are used the first time.

What these few examples suggest is that the concept of multiplicity of applications needs to be considered more systematically than it is at present. A multi-purpose technology is not inherently better than a single-purpose technology, but this criterion is worth exploring and might serve as a useful guideline in the design of new appropriate technologies.

CONCLUSION

The above discussion leads us to conclude that no technology however good, can score high marks in the light of all the criteria discussed in this paper. Some sort of balance needs to be found among the potentially relevant criteria.

This paper is not a conclusion in the debate about the criteria of appropriateness. It should be seen first and foremost as a set of questions, not as clear-cut answers, and our aim here has merely been to suggest that the emerging second generation in appropriate technology will have to raise questions which until now have been somewhat neglected, or at least analysed primarily in economic terms. Economics is of paramount importance, but there are also a number of other elements which must be considered more carefully and more systematically.

Chapter 2
TECHNOLOGIES APPROPRIATE FOR A BASIC NEEDS STRATEGY

A.S. Bhalla

INTRODUCTION

In the current debate on national and international aspects of development, three types of questions are increasingly coming to the forefront:

(a) What is the meaning of the basic needs (BN) concept, approach and strategy of development?

(b) What production structure and technology-mix are appropriate for such a strategy? and

(c) How can the implementation of a basic needs strategy be reconciled with the implementation of a New International Economic Order (NIEO)?

The present crisis in the world economy and the inequitable distribution of wealth and resources between nations is also reflected in poverty and squalor within nations, particularly in the developing countries. The implementation of a NIEO in an increasingly interdependent world is possible only if structural and institutional changes at the international level are accompanied by changes in national policies and programmes to eliminate poverty and fulfil basic human needs. The basic needs of the poor of the world cannot be satisfied without reshaping the global

[1] Chief, Technology and Employment Branch, International Labour Office, Geneva.

economic order; in its turn, the new Order would not be worth aiming at if the poor did not benefit from it.

The concept of basic needs is not new. What is novel however is a systematic focus of attention on the fulfilment of basic needs, especially of the poor target groups, in a specified short time-span, as one of the vital objectives of development plans, policies and programmes. If basic needs are to be provided for in a shorter time-span than the conventional growth strategies would permit, emphasis on the pattern and style of growth becomes much more crucial than on overall growth per se.

We argue that a basic needs approach is in fact a more comprehensive view of development, as it calls for a greater emphasis on indigenous technology generation within developing countries, a larger capacity of the productive system to absorb the benefits of science and technology, and a wider spread of the benefits of growth through decentralised production and consumption planning.

More appropriate technologies are needed by the developing countries regardless of the type of development strategy adopted. A basic needs objective, defined as improvement of access to goods and services through appropriate institutions, adds additional dimensions to the concept of appropriate technology. Thus, the focus of attention should be as much on technologies for marketing, distribution and transport as on technologies for production.

This paper is concerned with an inquiry into what constitues a concept and strategy of basic needs; how a basic needs strategy is different from the conventional strategies of development, what the implications of such a strategy are for production planning, commodity-mix and technology choice and development. It starts with an outline of a basic needs approach and strategy and goes on to sketch its possible technological content. Special emphasis is laid here on the implications of national/sub-regional policies of (collective) self-reliance and the New International Economic Order (NIEO) for productivity-raising and employment-generating technical change in the rural and urban informal sectors. We also consider examples of the types of technologies the generation and utilisation of which would be necessary for basic needs fulfilment. Finally, we examine the crucial questions of

national and international action.

A BASIC NEEDS APPROACH AND STRATEGY

In its simplest form, a basic needs approach can be defined as a type of development that attaches a special weight to the fulfilment of basic needs, both material and non-material, in a given society and aims at meeting this objective in the shortest tine-span. Since the basic needs of the poorest are less likely to be fulfilled in the normal course of development, they should be identified as the priority target group. In this sense, this approach to development is not fundamentally different from "employment-oriented" and "anti-poverty" approaches. It also aims at rapid growth, more equitable income distribution and removal of poverty, but the paths taken to achieve these goals may be quite different.

To achieve these objectives the "income" or "poverty" approach may not necessarily ensure the fulfilment of basic needs of the bulk of the population. For one thing, income-generation alone may not ensure minimum private consumption and provision of essential public services. Additional income may be spent on food items of lower nutritional value which may be supplied by mass-production methods. The income approach has tended to neglect the need for the supply Of appropriateproducts to ensure that the purchasing power is actually translated into needs fulfilment. On the other hand, a basic needs approach brings access to goods and services to the forefront of development objectives. It attaches special importance to finding out the reasons for the failure of goods and services to reach the target groups for whom they were intended, and to the need for ensuring their availability.

Access may be made possible in a number of ways, one of which is employment-creation. Through the generation of incomes, employment-creation provides an opportunity for the poor to have access to education, food, shelter, clothing, etc. Employment is a direct means of generating incomes for those who without work would have to depend on doles or support from extended households. Employment-creation may also be a better means of redistributing incomes than straight government transfers in the form of doles. For one thing, the possibility of corruption is

less likely when income is redistributed through employment than through subsidies.

In a somewhat different manner, employment also enters as a labour input necessary for producing goods and services for which demand is created through generation of incomes to the poor. However, the employment and production aspects are difficult to separate in the case of the self-employed whose income may be directly related to the productive activity in which they are engaged. The fact of being employed for a wage or on "own-account" also gives a sense of recognition, pride and participation. Qualitativeaspects of employment, that is making work more human and congenial, apart from the monetary compensation it carries with it: may be an important consideration related closely to the sense of participation and recognition.

However, employment-generation as such need not necessarily ensure either access to goods and services or fulfilment of basic needs. Even apart from non-fulfilment of needs for public services, constraints in the supply of private consumption goods such as foodstuffs could lead to inflationary pressures. It is therefore essential that increased incomes to the poor are matched by a corresponding availability of basic wage goods.

It follows that both generation of employment and incomes are necessary but are not a sufficient means of ensuring access to goods and services.

Lack of access is due not only to an inadequate supply of available goods but also, and often, due to faulty distribution system. An emphasis on the supply of goods should therefore involve (a) overcoming the supply constraints by ensuring fuller utilisation of available productive capacity as well as expanding this capacity, (b) improving distribution channels and delivery systems, and (c) avoiding waste and hoarding, etc.

Unequal access to private goods and public services may result also from the prevailing structure of unequal income distribution. Empirical evidence shows that several countries which witnessed rapid growth and equitable distribution, enabling fulfilment of basic needs (e.g. Korea, and Taiwan between 1950 and 1975) started with "relatively equal asset and income distribution; many of those that

experienced rapid, inequitably distributed growth began with sharply unequal income distribution"[2].

Thus, basic needs fulfilment is a socio-economic and political problem as well as a technological one. structural changes and political commitment are essential prerequisites of a basic needs strategy. Even in countries like India and Sri Lanka the minimum needs-based programmes proposed by the planners in the past were not always fully implemented. The failure to implement these plans and programmes seems to have been due to the absence of necessary institutional reforms. Lack of administrative structures and capacity, required particularly to implement intricate programmes, tend to prevent fulfilment of basic needs targets. Traditional types of administrative systems and structures are often inadequate to implement decentralized programmes in rural areas requiring local knowledge, cultural identity, and a sense of motivation. They are equally inappropriate for ensuring the delivery of public services to the target groups.

Both poverty-oriented "income" strategy and "BN" strategy are aimed at removing inequalities within given societies. These inequalities may range from inegalitarian income distribution to the non-economic inequalities of status, such as unequal participation in decision making, freedom of choice, authority and access to it, and satisfaction from work and recognition from employment. While a poverty-oriented strategy is confined almost exclusively to e alleviation of economic inequalities, a basic need; strategy also encompasses elimination of at least some of the non-economic inequalities. The latter is a necessary, but perhaps not a sufficient, condition for the satisfaction of the basic needs of the masses in the shortest possible time.

One way to alleviate inequalities especially of the non-economic type is to ensure wider participation of the potential beneficiaries of development in planning and de-

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[2] See David Morawetz: "Twenty-five years of economic development", Finance and Development (Washington, DC.), Sep. 1977. Also see Chenery, et. al., Redistribution with Growth, Oxford University Press, 1974.

cision making. Without popular participation the perception of development is likely to be lopsided. Unless people specify their needs (through a process of collective decision making or otherwise) any targets for supplying goods and services set by the central planners are at best likely to be either off the mark or geared to the needs of the social groups who are already much above the minimum level of poverty.

Where direct participation is not feasible in practice, articulation of poor people's needs can be ensured through such institutions as cooperatives, peasant organisations, communes, trade unions and similar associations.[3]

Popular participation enables decentralisation of decision making in planning and production. It can take several forms: for instance, it may imply that people themselves determine their basic needs. Secondly, it may mean that people participate in setting local targets for production and consumption, and ensure their implementation. Decentralisation in decision making facilitates autonomy at the local level. In most developing countries, one of the major constraints to the implementation of development programmes is an inadequate institutional and organisational structure. Under- a centralised system, transmission of a decision from the centre to the periphery tends to take time and is likely to get distorted somewhere along the line. On the other hand, decentralisation is likely to help overcome unnecessary bureaucratic and administrative delays.

Basic needs planning requires participation, decentralisation and local resource mobilisation combined optimally with a dose of central coordination and planning. The degree of local initiative and participation, the effectiveness of social and economic institutions, and the quantity

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[3] This, however, presupposes that these institutions are effective in representing the interests of the poor, that they are in regular and close contact with the larger poverty groups in the rural and urban informal sectors, and that they are useful instruments in organising the poor into an articulate political force.

and quality of indigenous material and human resources, will largely determine the nature of technology which in turn will affect the cost of provision of basic needs.

Fulfilment of basic needs cannot be the sole responsibility of national action by the developing countries. While it is the sovereign right of each developing country to define its own basic needs objectives and the means to fulfil them, the inclusion of basic needs as a part and parcel of a more equitable international (economic) order would involve re-shaping the aid and trade policies of the advanced countries, redefining the role of private foreign investment and of multinational companies and controlling the flow of the most advanced technologies from the North to the South. Re-orientation of these international measures is essential in order to make the efforts of the developing and developed countries compatible in launching an attack on world poverty. There is however no substitute for the full political commit-. ment by the developing countries themselves to the implementation of appropriate reforms and institutions to satisfy the basic needs of the poorest in particular, and of the population in general.

The implementation of basic needs by the developing countries may also require a more self-reliant development implying less dependence on the advanced countries. Self-reliance, both national and collective (interpreted in terms of co-operation among developing countries) is a prerequisite for improving the bargaining position of the developing vis-à-vis the developed countries. There is a parallel here with the organisation of the rural poor in a developing country. In the same way as the poor need to be organised into associations to raise their political power, the developing countries need to organise themselves into groups to overcome their weak bargaining position and to safeguard themselves against economic disturbances like recession and inflation in the advanced countries.

TECHNOLOGICAL CONTENT OF A "BN" STRATEGY

Be it the distribution of income and purchasing power, the composition of output, access to resources, inputs and outputs, all these variables have important implications for the choice and development of technologies in the developing countries. This paper does not claim to present

a technological blueprint for a basic needs strategy. It is a more modest attempt to outline technological implications of the following elements of a basic needs strategy:

(a) incomes to the poorest target groups;

(b) access to goods and services and inputs;

(c) physical production of goods and services;

(d) participation and decentralised production; and

(e) national and collective self-reliance.

We shall consider below the relevance of each of these components for technology.

Incomes to the Poorest

Generation of income to the poorest is possible in a number of ways, e.g. by employment, through income transfers by the government, through redistribution of assets such as land, and through a rise in the productivity of existing methods of production. The traditional techniques are no doubt employment generating but their productivity is often so low that they may be "inappropriate" for generating adequate incomes. In fact the technologies actually in use in the small and urban informal sectors may be too labour-intensive. Their adaptation through technical progress within these sectors may call for a somewhat higher capital to labour ratio, thus implying less employment intensity within the process itself. Thus, technological innovations for removing drudgery of women may well be labour-saving but income-generating, and hence desirable.

In the past, too much emphasis has 'been placed on international technology transfers and too little on technology gaps within developing countries. This has perpetuated the technological vacuum in the traditional sectors and has tended to widen the gap between the traditional and the modern sectors.

A basic needs strategy should aim at raising incomes of the poor through the development and improvement of traditional technologies in the rural and urban informal sectors. For

one thing, it may often be easier to modify and adapt existing technologies than to create them de nova. Secondly, the problem of accessibility to the poor is minimised when attempts are made to improve on the technologies to which they are already accustomed, but which without modifications might not generate reasonable levels of productivity and income. An ILO/UNDP project in Tanzania demonstrated that in a subsistence economy prevailing in the region considered, the initial cash outlays required for tractorisation or even for implements considered "intermediate" were well in excess of what the poor farmers could afford. The project therefore recommended that emphasis should be placed, at least initially, on the design and development of those village technologies which are more productive than the traditional ones, yet within the reach of small farmers and other poorest groups of the population.4

There is as yet some controversy regarding the extent to which it is possible to upgrade existing technologies through modifications and adaptation. There are those who argue that traditional technologies, even though inefficient (in terms of low productivity), may be appropriate in the context of the rural sectors on other counts, viz. the local needs and the skill patterns, not to speak of the socio-cultural environment. They believe that it is preferable to introduce improvements of these technologies through the application of "modern" scientific and technological know-how available within the so-called "modern" sectors of developing countries. Resent attempts to improve the bullock-carts and earth-moving methods (wheelbarrows, wooden stretchers, etc.) are but a few examples of the scope for upgrading the existing technologies. There is another school which would discard existing "traditional" technologies and argue for the use of "modem" technologies to enable a quantum jump in the standards of living of the population. Whether certain existing technologies can be adapted/improved or not is an empirical question which needs to be treated case by case.

4See George McPherson and Dudley Jackson, "Village technology for rural development", International Labour Review, February, 1975.

concentration on improvement of technologies alone as a means of income generation will at best be an insufficient solution.. Redistribution of i-vestment resources in favour of the hitherto neglected urban informal and rural sectors would be necessary at the same time to ensure that the small-scale producers have wherewithal to effect necessary technological improvements. This may call for redistribution of assets like capital and land to the poorest groups of society, along with a necessary public provision for R and D work to respond to their production and consumption needs.

Access

The capacity of the small farmers and small producers to innovate very much depends on their access to various inputs The experience of the Green Revolution has shown that in many cases the larger farmers benefited much more from the use of HYVs of rice and wheat than the small farmers. This does not imply that the new technology was inappropriate; rather the institutional arrangements for credit, land tenure and market structure were biased in favour of the landlords and the big farmers. The experience of Asian countries, notably India, Pakistan and the Philippines, shows that the small farmers had little access to such inputs as fertiliser, water, credit and technical knowledge. On the other hand, these inputs were made available to large landowners on subsidised rates to ensure that they innovated in order to raise agricultural production rapidly.

The experience of agriculture also applies to the industrial sector. Market imperfections, that is, factor price distortions in labour and capital markets, result in the relatively low cost of capital and a relatively high cost of labour facing the modern manufacturing sector, and a high cost of capital with a relatively low cost of labour in the "non-modern" sectors. Work undertaken on the urban informal sector under the IL0 World Employment Programme (WEP) suggests that the informal sector enterprises either do not have any access to credit at all, or they have a very limited access characterised by exorbitant interest rates and stringent terms and conditions. In the case of Ghana automotive repairs, only 6 per cent of the masters borrowed the initial amount necessary to start busi-

ness.5 Credit was the least important source of financing since the small enterprises had little access to credit institutions. One of the sources of financing was the masters' savings out of wages earned in the modern sector during the course of apprenticeship training there. Another was the customers. In the case of auto repairs, customers trust masters and make cash payments before repairs are done. This enables the masters to buy the necessary raw materials. Such pre-financing works to the mutual advantage of the repair shops and the customers. The shops obtain necessary materials without having to keep big amounts of inventory stocks: the customers are assured of low repair costs, at least lower than what they would have to pay to the large modern sector workshops.

Access to inputs can also be related to the access to product markets. The informal enterprises may be forced to sell goods to a single buyer or a small group of buyers on whom they have to depend for credit and other needs. Access to product markets can be further reduced if the small-scale enterprises have to compete with larger modern enterprises in the same market. However, this need not be the case when the "informal" and "modern" sector products are non-competing. A case study of tin cans in Thailand6 represents an interesting example of how seasonality of demand and small segmented markets worked in favour of small producers with low capital-intensity. Local demand for a variety of canned goods like fruit, vegetables and pickles led to the emergence of small-scale plants owned by local businessmen. In the early 1960s large foreign firms entered Thailand to produce canned dairy products and canned pineapples for the foreign market. The rapid growth of the "foreign" sector producing canned goods led a specialist can-making firm to enter the market in the late 1960s. Thus, a dualistic

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[5] A. Hakam, Technology Diffusion from the Formal to the Informal Sector: Automotive Trade in Ghana, WEP Working Paper (WEP 2-22/WP.35), ILO, Geneva, July 1978.

[6] R. Bell, et. al, Industrial Technology and Employment Opportunity, ILO, Geneva, 1976 (mimeo).

structure of can-making industry has emerged: with the informal segment characterised by low product quality, low income local markets, lower wages, limited access to credit, and use of labour-intensive "semi-manual" techniques. The modern sector caters largely to the high income domestic and foreign markets. The large firms have not entered the markets of the informal producers partly because a sizeable proportion of the production of these firms is for their own use. Secondly, the pattern of demand in the informal sector requires production of a different kind: a larger number of different shapes and sizes of open-top cans to which the automated high-speed equipment of the large-scale modern sector is not geared.

The question of access is also in some ways related to information and knowledge about the efficient technologies developed either within the rural and urban informal sectors, or those available and in use in the modern sector. This raises questions about the need for linkages with producers in the rural and urban informal sectors through extension services and other means of diffusing new and adapted technologies. Agricultural extension services have already been well established in many developing countries. There is an equally urgent need for industrial extension services to reach the small informal sector enterprises in order to assist them in product and process adaptations and in the use of new technology. Another method of raising the technological levels in these enterprises is to improve their linkages with the modern sector through subcontracting which makes technological improvements among subcontractors possible. Watanabe[7] has distinguished between three types of linkages:

(a) input linkages which refer to supply of raw materials and machinery. Such linkages may for instance take place between petty garment producers end suppliers of textile fabrics or sewing machines;

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[7] See S. Watanabe, Technological Linkages between Formal and Informal Sectors of Manufacturing Industries, WEP Working Paper (WEP 2-22/WP. 34), ILO, Geneva, March 1978.

(b) market linkages between parent firm and sub-contractors which, unlike the above, supply the same end product to the same customers; and

(c) technological linkages which imply flows of technology and skills between the two sectors.

Not enough is yet known on the precise form and the extent to which linkages exist between formal and informal sectors, on the manner in which entrepreneurs and workers in the informal sector acquire skills, the extent to which such skills are adequate for innovations in the sector, on ways to encourage the transfer of technology from the formal to the informal sector, and on whether such transfers are necessarily beneficial to the development of the latter.

The experience of Japan suggests that rapid industrialisation was made possible to a large extent by close collaboration between the large-scale and small-scale sectors, with the former helping the latter to upgrade and adapt their technology. In the case of China, it is reported that, at the earlier stages of development, linkages were mainly one-sided, with modern industry providing the rural industry with the necessary technology. When rural industry developed, these linkages became mutual, and in the third stage of industrialisation the two sectors became more or less integrated. The improvement in the quality standards in the rural sector permitted an expansion of the subcontracting system.[8] These are but two examples of the positive aspects of inter-sectoral technology transfers. There may however be negative factors at work too. The flow of technology from the modern to the traditional and informal sectors may actually displace the latter technology, thus resulting in considerable unemployment. Secondly, the modern sector technology may be too advanced and hence inappropriate for the rural and urban informal sectors. Thus, while improvement of technologies in the urban and rural informal sectors should be an important aim in a basic needs strategy, this goal could perhaps be better achieved by local innovations within these sectors through public R and D support, and through access to

[8] See Jon Sigurdson, Rural Industrialisation in China, Harvard University Press, 1977.

finance capital.

Another aspect of access with a technological dimension is the provision of access to public goods and services. Be these inputs or outputs, access is often prevented due to the lack of adequate delivery systems to channel such services to the urban and the rural poor. Improvement in delivery of government services calls for an investigation of the desired pattern of output and the infrastructure requirements, the use of technology and the cost of making these services and infrastructure available to the poor under different organisational and technological forms. For example, the provision of safe water for all, recommended at the World Employment Conference, is one of the goals of a basic needs strategy. A large majority of people in developing countries do not have an easy access to safe water supply. A major constraint to the development of adequate water supplies and water treatment facilities is the shortage of funds. There is therefore a need to develop and implement technologies which minimise the cost of water treatment and water distribution systems. This is particularly true for rural areas where diseconomies of scale raise production cost of treated water per unit of output, and where people may not be able to afford treated water unless it is subsidised by the government.

In the final analysis, access to inputs is tied up with asset redistribution and payments system (i.e. who determines who gets what sort of work and with what tools/equipment/land). Thus, the modern sector's privileged access to capital and other inputs need not necessarily be due to factor price distortions which are often believed to cause the use of inappropriate technologies. it may well be the institutional factors and unequal pattern of income distribution that determine factor prices much more than market forces.

Physical Production of Goods and Services

The question of ensuring access is not very meaningful without a production structure that has the capacity to ensure the availability of those items of private and social consumption which are essential for implementing basic needs targets.

A basic needs strategy implies a production pattern and a product-mix different from the one under a conventional growth-oriented strategy. The objective of satisfying private and social consumption requirements of the bottom 20-30 per cent of the population requires a very different consumption bundle of goods and services from the one that would obtain if equal weight were given to the requirements of the rich and the poor.

There are those who argue that the pattern of consumption and of industrialisation (i.e. the type of product-mix) largely determines the choice of technology. Implicit in this argument is the assumption that very few goods can be produce; with more than one technique of production. At least in certain sectors technical choice is possible even without changing the composition of output. Since the basic needs strategy gives higher priority to the production of goods and services to be consumed by low-income groups, it requires the development of technologies which can produce simple goods with simple "characteristics" at low cost.

Basic needs targets need to be established in physical quantities of goods and services so that shortfalls in their fulfilment can be measured regularly. Goods and services may be defined in the form of their principal characteristics, e.g. calories, cubic metres of space or metres of cloth. Although the basic human needs for food, shelter and clothing are universal, the ways and the extent to which these needs are fulfilled will depend, by and large, on the physical availability, characteristics and distribution of these goods. In a basic needs strategy, goods may he considered "inappropriate" if they represent "characteristics" which are beyond the reach of the poor target groups, or are not wanted by them.

A basic needs strategy will require more emphasis on product development and adaptation than is generally placed on these aspects of technology in production planning. Since products are indivisible in the sense that the purchase of a given product implies the acquisition of a number of characteristics simultaneously, production planners may have to allow for product substitution: choice in favour of products which do not have excessive characteristics or standards. Standards and characteristics could be defined as "excessive" if they were beyond the reach of the consumers below a certain level of income, or if they were

unwanted by a set of consumers whose basic needs bundle of consumption goods does not include these characteristics.

Just as the basic needs targets are not determined for all times but need a constant revision to take account of change in incomes and living standards, so do the characteristics change with rising material standards. Therefore what are "appropriate" standards today may no longer be appropriate a few years hence. It is necessary that like basic needs targets the product standards and characteristics be revised periodically.

Since individuals demand products with a number of characterisitics, a technology component of a basic needs plan can be described and analysed in terms of product innovations referring to a particular bundle of goods required for the fulfilment of basic needs. These innovations may take the Corm of development of new products, or adaptation of existing ones. A major effort would be required to (a) adapt end products to lower or different specifications, simpler packaging, modelling, etc., and (b) improvement of quality of traditional and unsophisticated products. The end purpose is to ensure that unnecessary characteristics are dispensed with, and products are made to require less maintenance. Similarly, greater emphasis will need to be placed on "utility" versions of modern sector goods, and a reduction in the production of "luxury" goods. A number of foreign car manufacturers established in the Philippines have introduced "Asian car" models "in order to increase the local content of productior without raising costs or sacrificing quality to any appreciable extent. An extreme case is provided by one manufacturer in whose car bodies bamboo and wood, which are in plentiful supply in the Philippines, are used".[9]

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Having considered the three principal characteristics relating directly to technology choice and development, we

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[9] ILO, Technologies for Basic Needs, by Hans Singer, Geneva, 1977, p. 54.

now examine two additional features of the strategy, namely (a) popular participation in decision making, and (b) collective self-reliance and technical co-operation among developing countries (TCDC). Both these features have implications for the organisation of production and its distribution.

Participation and Decentralised Production

Popular participation in a basic needs strategy essentially boils down to decentralization of production and to planning from below. Production and consumption planning can be either centralised or decentralised, or a. combination of the two. With perhaps a few exceptions (e.g. Sri Lanka and China) most planning in developing countries is highly centralised. Investment allocation, production and consumption targets, balances between demand and supply, are all considered by national planners on the basis of certain assumptions about aspirations of the population within the framework of declared goals of planning.

A distinction needs to be made between planning and decision making. Many countries have centralised plans but effective decisions are taken at the local level, while in others the reverse may apply, e.g. where large state corporations or multinational companies make important decisions.

In any developing society, there are a number of diverse decision-makers ranging from large-scale producers including national and multinational enterprises, national governments (who in certain cases also participate directly in the production process through state-owned corporations and public enterprises), to self-employed individuals in family enterprises, co-operatives or extended households in the urban informal and rural sectors. All these groups influence technology choice and development through their participation in economic activity. One may therefore ask the question: what is new, that a basic needs strategy really calls for? A move towards this strategy implies that:

(a) the weight of small-scale producers at the grass-roots level increases;

(b) those who do not directly participate in a productive economic activity also have a say in matters that influence their welfare;

(c) scope for self-employment and household modes of production where ownership and decision-making are combined should he increased; and

(d) the rural poor who form the bulk of the population are organised in order to carry a political weight which will enable them to articulate their needs.

In a conventional development strategy, resource allocation is skewed like the income distribution with the result that the national resources and assets are controlled by small groups of powerful vested interests. These resources are therefore used largely to satisfy the demand pattern which serves their interests, leaving the basic needs of the bulk of the population unfulfilled, both in terms of techniques (confining employment to few) and products. A shift towards a basic needs strategy makes it necessary to ensure not only greater access to resources but also greater control over them. These are in fact the prerequisites for the development and application of technologies appropriate at the grass-roots level. The centralised nature and structure of social institutions and patterns of ownership can often inhibit the implementation of technological alternatives that are known and may be socially as well as technically desirable.

In principle, the cooperative forms of organisation and the framework of household production may be much more advantageous for the utilisation of socially desirable employment-creating technologies. This is so because work is done largely outside the wage system, so that reward for work is in the form of greater output rather than wage-payment. The cooperative and household modes of production have another advantage over the wage system, namely that workers do not feel alienated. Organisation of production in a large number of small enterprises in a household framework is much more likely to ensure that the income generated is appropriated by family or cooperative members than by the large-scale producers under a more centralised production system.

Decentralised production also helps promote learning-by-

doing types of innovations outside the formal R and D institutions. In the past, in most developing countries appropriate technologies have been neglected both within and outside the formal R and D system, partly because of a heavy dependence on developments in the advanced countries. Imported modern technology, by destroying the traditional small-scale productive activity, often prevents learning-by-doing by the semi-skilled and skilled artisans. It also tends to orient the educated and scientific elites of the developing countries towards the problems and standards of the rich countries. The result is a sense of inferiority and a tendency to imitate rather than innovate. The encouragement of decentralised production at the local level should help overcome these negative tendencies.

The experience of Sri Lanka, with the District Development Councils (DDCs), and more recent attempts of the Indian Government at block-level planning, both reflect a realisation that the development effort at local level alone can be successful in estimating people's needs and aspirations, as well as the availability of resources and their mobilisation. The DDCs in Sri Lanka represented one type of institutional framework that enabled local population to participate in political, social and economic activity, and to rely, in so far as possible, on local skills, locally developed machinery and technology. What was initially a purely technical/administrative unit was subsequently reorganised into a politically based programme with the appointment of a local government nominee or a member of parliament as the chairman of the DDC. This politicisation seems to have been based on the recognition that a political commitment and support at the local level is essential for the implementation of policies and programmes.

Decentralised production and technological development do not imply elimination of planning at the national level, although too much detailed planning might not be necessary if the right kinds of policies are introduced. What the basic needs strategy implies is an aggregation of local, district and provincial plans which reflect more realistically the aspirations and needs of the people for whose benefit planning is designed. Such an aggregation helps the central planners to cross-check their own notions of what the local resource availabilities and skills are for producing the target product-mix with the appropriate tech-

nology-mix.

An effective mix of central and local planning needs to be combined with adequate and timely plan implementation. An efficient administrative system is a prerequisite to the successful implementation of any plans or policies. A development strategy based on decentralisation and dispersal of economic activity tends to make much greater demands on the administrative structure and capacity in the developing countries. An adequate administrative structure for a basic needs strategy will require appropriate local institutions at the district and block levels. It would also require adequate communication system whereby information and decision signals can be exchanged promptly between the national level and the province, district or county. Successful development and diffusion of technologies through decentralised organisation presupposes a proper coordination and dovetailing of production and investment plans at different administrative and economic levels.

National and Collective Self-Reliance

Self-reliance at the national level may imply lesser dependence on the advanced countries for import of technologies and products. It does not however mean total autarky or independence. Collective self-reliance and technical cooperation among developing countries are simply an extension of "local" and "national" self-reliance to a sub-regional and regional level. It provides for the exchange of technologies and goods among developing countries without however excluding trade and technology transfer between developed and developing countries as equal partners. It also implies generation and adaptation of indigenous technology with a view to developing a strong national technological capability within developing countries. Weak science and technology systems in developing countries make them dependent on the advanced countries in two principal ways: (a) they are forced to use advanced technologies from the developed countries regardless of their appropriateness, and (b) the weak bargaining and negotiating position of developing countries either reduces their access to modern technology or raises the cost of technology transfer.

Collective self-reliance can be defined in terms of a reduction of "technological dependence" of the developing

countries on the advanced countries whose problems and resource endowments are very different. Technological dependence may be disadvantageous and harmful to the objectives of a basic needs strategy in several ways. First of all, it reduces control over technological decision-making and thus conflicts with the objective of participation at all levels. In a study of totally local-owned firms in Argentina which buy their technology abroad, Sercovich concluded that the nature and "content of technology agreements is such that most of the power of independent decision-making is taken out of the hands of the local owners and managers".[10] Secondly, it may hinder the indigenous development of scientific and innovative capacity.11 Free transfer of technology from the advanced countries tends to reduce the motivation of the developing countries to develop their indigenous technology. Even if they have such motivations, they cannot withstand the dominance and competition of imported technology without the "infant-industry" protection to local technology. Further, contracts governing the transfer of technology also inhibit local R and D to develop indigenous technology and adapt imported technology.

Promotion of technological independence may imply redirection of existing North-South links. It may also require greater national self-reliance. There is controversy on whether cutting off ties with the advanced countries is beneficial to LDCs in respect of a self-reliant technological development. The experience of countries like China suggests that the discontinuation of Russian technical assistance and supply of equipment in the fifties stimulated local technology development during the Great Leap Forward

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[10] F.C. Sercovich, "Foreign technology and control in the Argentinian industry" (Ph.D. thesis, Sussex University, 1974) quoted in Frances Stewart, Technology and Underdevelopment, 1977, p. 131.

[11] See A.S. Bhalla, "Transfert de technologie, technologie appropriée et emploi", Revue Tiers-Monde (Paris), janvier-mars 1976.

period.[12] This was perhaps made possible by the existence of local capacity to innovate.

National independence combined with "horizontal" 'co-operation among LDCs is likely to be much more conducive to the building of national technological capability and development of technologies appropriate for the socio-economic conditions of the developing countries. Such an exchange between Third World countries would also reduce the costs of technology transfer by raising their bargaining position. Furthermore, in the case of small-sized countries, the national units of R and D may be too small to be economically viable; sub-regional R and D among a group of LDCs may promote economies of scale.

TCDC in the field of technology can take many forms. First, flows of technological information among developing countries need to be improved through exchange of technical personnel and know-how. Such information may cover available technological alternatives, sources of technology supply, terms and conditions of their transfer, technology policies, and existing research and development facilities.

No institutional machinery at present seems to exist for specialised exchange among LDCs. However, the sub-regional groupings like the ASEAN and other bodies of the developing countries like the Group of 77 and the Non-Aligned Group provide a rudimentary beginning towards collective self-reliance. While it is true that untii recently the LDCs did not make a political commitment to appropriate technology, this position has witnessed a welcome change. Countries like India and Sri Lanka have declared appropriate technology development as their official policy. The ASEAN have put appropriate technology on the agenda of their ministerial meetings on a regular basis. At the ASEAN Labour Ministers meetings in Baguio (Philippines, 17-19 May 1976) and Pattaya (Thailand, 24-25 May 1977), the participating countries agreed to co-operate with each other in promoting the development and transfer of appropriate

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[12] See A.S. Bhalla, "Technological choice in construction in two Asian countries: China and India", World Development, Match, 1974.

technology. They underlined the need for governments "to establish a national organisation charged with promoting the use of appropriate technology throughout the decision-making apparatus of the public sectors. This organisation could have its representatives in each government ministry who would assess every opportunity in the ministry for introducing appropriate technology at each decision level".[13]

The Group of Non-Aligned Countries has also been preoccupied with action needed for the application of appropriate technology in developing countries. At their Fifth Summit Conference in Colombo in August 1976, the Group elaborated an "Action Programme for Economic Co-operation" of which appropriate technological development formed a prominent part. At their meeting in New Delhi (7-11 April 1977)[14] the Bureau of the Non-Aligned Group of Countries decided to set up an Intergovernmental Working Group on the Applications of Appropriate Technology.

More recently, the First Conference of Labour Ministers of Non-Aligned and Other Developing Countries (Tunis, 24-26 April 1978) drafted the Tunis Action Programme which contains a number of activities for further horizontal co-operation in the fields of employment, training and education, and appropriate technologies.[15]

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[13] Report of the Special Meeting of ASEAN Labour Ministers, Baguio City, Philippines, 17-19 May 1976, pp. 154-155.

[14] Report of the Bureau on the Meeting of the Non-Aligned Group of Countries, New Delhi, 7-11 April 1977 (NAC.5/BUR.1/DOC.2/REV.2).

[15] Action Programme of the Tunis Conference - First Conference of Labour Ministers of Non-aligned and Other Developing Countries, Tunis, 24-26 April 1978.

TECHNOLOGIES APPROPRIATE FOR BASIC NEEDS SATISFACTION

It follows from the foregoing that appropriate technology is a concept which implies a suitable policy framework and a broad-based pattern of development. It is not a tool-kit of a selected number of technologies with technical and engineering specifications which could fit in with the requirements of all Third World countries. Peculiarities of local conditions (economic, social, ecological, etc.), differences in socio-economic systems and institutions, and specific production and consumption priorities, all these factors rule out a "standard tool-kit" approach. However, although it is wrong to look for particular technologies as appropriate for all climes and times, it is possible to examine broad priority areas in which technologies should be developed and upgraded in a basic needs-oriented strategy. The following are some of the examples of the types of technologies that would require special emphasis:

A. Pre-harvest technologies

(a) tools and equipment for ground preparation, planting, weeding and harvesting;

(b) water supply and irrigation technologies, e.g. equipment for storing, lifting and moving water.

B. Posi-harvest technologies

(a) food-processing and agro-based technologies;

(b) food preservation, techniques of packaging, etc.;

(c) food storage technologies;

(d) low-cost transport modes in rural areas for marketing of agricultural produce.

Although precise definition of basic needs and the technologies required to provide them will vary from country to country, depending on its over-all production and consumption priorities, food will perhaps be one of the most prominent basic needs in most if not all developing countries. Therefore, research and development on technologies appropriate for food production, its marketing and distribution, and its processing and preservation, deserve priority.

Among the pre-harvest technologies, tools and equipment for crop cultivation and irrigation are perhaps the most significant topics of research and design engineering. At present, what is readily available on-the-shelf is either the most modern and sophisticated agricultural machinery (big tractors, combine harvesters and the like) or the most primitive hand tools with very limited life and low productivity. There is a virtual absence of "intermediate" technologies with productivities higher than the traditional tools, yet within potential reach of the small and the medium farmer. While rapid innovations have been witnessed in the biological technology, in the form of HYVs, appropriate technical innovations on the mechanical side have lagged behind.[16]

Little is at present being done to design equipment for upland cultivation or animal-drawn equipment. These small-scale farm tools/equipment deserve much greater attention in a basic needs strategy: they can be designed for local manufacture with economical labour-intensive methods. Take the example of recent attempts at the design of simple hand-pumps for lifting water for irrigation. A hand-pump is much cheaper than the currently available diesel pump which apart from its expensiveness also raises problems of maintenance due to shortage of

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[16] There are scattered examples of development and modifications of agricultural implements. The International Rice Research Institute (IRRI) has designed low-cost tillers, threshers and dryers more suited to small-scale rice-farming in South-East Asia.

spare parts. Manually operated shallow tube wells for irrigation (MOSTI), though a relatively new type of irrigation technology, are already being used in Bangladesh.

However, appropriate innovations are required for raising productivity of technologies currently used for the design and construction of small-scale irrigation works. Also, use of appropriate materials is necessary for lining canals, open wells, and low-cost tube wells.

Much hardware required to upgrade traditional technologies can in principle be manufactured locally in small-scale engineering workshops. For example, various types of devices for lifting water from streams and wells, and several agricultural tools and equipment are known to be produced locally. However, their manufacture is not always economically and technically efficient. The major obstacle to their local manufacture stems from deficiencies and inadequate supplies of materials of uniform quality rather than from any lack of know-how. There is therefore a greater need for research on materials engineering and metal-working technology.

We have argued that upgrading of traditional labour-intensive technologies should be a cornerstone of a basic needs strategy. A massive technological transformation that this involves clearly requires machine-fabrication facilities and well-established metal-working industry. Supply of adequate materials and inputs such as iron and steel, coal, and fertilisers, would be desirable. What is even more important is their appropriate distribution to the small-scale producers at reasonable prices. There is thus a need for adequate linkages between large-scale modern and the small-scale informal sectors. A basic needs strategy does not therefore imply a complete shift to the small-scale sector; instead, it underlines the need for a better integration of different sectors of the economy so that the productivity and technology gaps between different sectors are i-educed.

Under a basic needs strategy capital goods sector has an important role to play. Machine tools and other capital goods are desirable not only for rapid accumulation but also for improvement in indigenous technology and adaptations of imported technology. These industries, in

particular, the machine tools manufacture (which incidentally is more labour-intensive than is often assumed) are the main sources of technical innovations.

Externalities through learning and diffusion of innovations to different sectors should facilitate bridging of the technology gaps between the large-scale and the small-scale, and between modern and non-modern sectors.

Research also needs to concentrate on the ways in which technologies can be developed to lower capital-labour and energy-labour ratios without appreciably raising unit costs. This raises the related question about the extent to which "down-scaling" of products and processes is possible. Experience to date shows that food-processing industries/technologies can in principle, operate economically at small-scale, although many innovations and adaptations have not yet been applied. For example, in Thailand, need has been felt for small-scale rice-stabilising units. Currently, the edible oil contained in bran obtained from milling of rice degenerates due to delays in its shipment. This degeneration can be prevented by stabilisation of bran prior to oil extraction, in small-scale plants located in rice-growing areas.[17]

Differences in product markets (due to differences in scale, product characteristics, consumer tastes and product standards) together with decentralised production structures, can open up possibilities for the use of relatively labour-intensive techniques which need to be further explored within the framework of a basic needs strategy.

One of the reasons for lack of access to food, processed as well as unprocessed, is the absence of adequate preservation and storage facilities. The perishability of many food items imposes a need to explore appropriate techniques for preservation and storage which would enable food preservation over time, that is, from periods of abundance to periods of scarcity. The scope for longer

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[17] UNIDO is currently developing a small-scale rice-stabilising unit for use in Thailand.

preservation thus provided can Enhance the value of food and food products in terms of the satisfaction of basic needs.

Appropriate canning and packaging techniques would be desirable to prevent fresh food from perishing, and thus to raise food supplies for minimum nutritional standards. The historical experience of the United States with "home-canning" of local produce suggests that new decentralised production systems can be combined with the use of simple relatively labour-intensive techniques to promote preservation and packaging of food.[18] An interesting feature of the home-caring production system is the re-use of cans. In rural situations of developing countries, where location of use of cans and of canned goods is identical, this re-use is likely to reduce costs by intensifying the use of material. Depending on the can costs, canning (for preservation) could be done at the household level or in small communal "centres" serving a. group of households.

Techniques of foodgrains storage is another area of research that deserves a high priority. Significant quantities of foodgrains are lost in the developing countries before they ever come to be processed for consumption. A number of factors account for this wastage: poor storage and transport facilities, lack of organised marketing effort, poor management of supply and distribution, and lack of information on prices and quality of product on the part of farmers and government officials.

The appropriate choice of technology in grain storage itself on a wide scale can generate both direct and indirect employment. Improvements in the technique of small-scale storage by farmers near the point of cultivation, and choice at the regional and national level between bulk silos and bagged floor (warehouse) storage for grain depots

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[18] For an interesting analysis of this subject, see C. Cooper and M. Bell: Industrial Technology and Employment Opportunity, ILO, Geneva, 1976 (manuscript), Appendix 2 on Product Markets, Structure of Production Systems and the Choice of Techniques - A Speculative Case Study.

are the two types of choices, for example.[19]

The next stage after storage is transport and marketing. Appropriate modes of transport in rural areas are required to enable speedy shipment and delivery of wage goods and social services. The goods transport requirements of farmers cover on-farm transport of seeds, fertilisers and building materials, etc., and marketing of produce from the point of collection at the farm to local market or roadside. The cost of transport modes must be low so that small and middle farmers can afford to buy or rent them. It has been shown that for short haul the cost of such primitive modes as donkeys, wheelbarrows and headloading is relatively quite high in view of their extremely low productivity (slow speed). On the other hand, ox and donkey carts and pedal-powered vehicles (commonly in use in parts of Asia) offer a potentially low-cost transport to the small landholder. Nevertheless, very little attention is at present being paid to the improvement of designs and speed of such transport modes as bullock carts. Increasing emphasis has been placed on low-cost rural access roads to the neglect of the type of vehicles best suited for these roads.[20] Absence of low-cost rural transport in the LDCs forces farmers to rely on such expensive and inappropriate means of transport as headloading. There is an urgent need therefore to promote R and D work on the improvement of design and manufacture of such vehicles as handcarts, animal-drawn carts, bicycles and tricycles.

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[19] See ILO, Appropriate Technology for Employment Creation in the Food-Processing and Drink Industries of Developing Countries, Geneva, 1978.

[20] See J.D.G.F. Howe, "Some thoughts on intermediate technology and rural transport", ODI Review, No. 1, 1977; and IBRD, Appropriate Technology in Rural Development: Vehicles Designed for On-Farm and Off-Farm Operations, April 1978 mimeo).

A SUITABLE POLICY FRAME

Policies and programmes of action to apply technologies appropriate for a basic needs strategy can be considered at three different levels: local (or micro), national (or macro), and regional or international. While at the limit action is to take place at the national level, there are often factors and decisions beyond the direct control of the LDCs themselves. Nature of aid and types of trade (access or lack of it to the markets of DCs) are international factors which can have direst bearings on the development of national technological capacity in the LDCs.

National and Local Policies

Government policies have an important influence, both positive and negative, on the choice and adoption of technologies. An appropriate policy can raise the supply of technologies and widen the available range by encouraging their importation and/or indigenous development. Similarly, it can make some technologies more attractive to entrepreneurs than others by raising their profitability. Perhaps even a more important role of the government lies in providing a socio-political climate and an economic structure conducive to the widespread use of appropriate technologies.

Such macro-economic policies as tariff structure, credit policies, minimum wage legislation, import licensing and quota systems, influence the direction of research and development and the pattern of technological innovations. Many of these policies, though designed and intended for different purposes, tend to distort factor prices in such a way that capital-intensive techniques may become more profitable than the otherwise technically viable and available employment-generating techniques.

Appropriate policies may include: maintenance of official exchange rates at their equilibrium value, removal of interest rate ceilings, tax incentives which favour employment and discourage capital use, etc. In most developing countries, tax holidays and accelerated depreciation are

introduced with the objective of stimulating investment. In order to ensure the use of more appropriate employment-generating technologies, tax rebates may made conditional on companies providing costing of alternative labour-intensive production process at the time of replacement or expansion. Choice of a more capital-intensive alternative in spite of lower costs at prevailing market prices could disqualify a company for tax rebate.[21]

The impact of government economic policies on the choice of techniques cannot however be examined exclusively in terms of factor price distortions. The widespread adoption of appropriate technologies requires an appropriate industrial structure and inter-firm competition (in mixed economies) on which governments exercise control through financial, industrial and trade policies. Thus, although a favourable price and incentive structure may be a necessary condition for the use of appropriate technology, it is not sufficient in itself.

Even where correction of price distortions is desirable, vested interests whose incomes are likely to be affected as a result may be so powerful as to block the necessary policy changes.

Little is at present known about the importance of vested interests in blocking or facilitating policies that may not be in their direct interest. Motivations and interests of different decision-makers - family enterprises, large private producers, multinationals, public corporations, etc. - are varied and may often be in conflict. Even when the economic effects of policies are quite similar, the distribution of political and social implications for these groups may differ widely. The prevailing technology-mix and the structure of production derive from socio-economic and political objectives of countries. The extent to which the government policies reflect decentralised production

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[21] H. Pack, "Policies to encourage the use of appropriate technology", in USAID, Proposal for a Program on Appropriate Technology, US Government Printing Office, Washington, July 1976.

structures, "down-scaling" , and labour-intensive technical change, will therefore largely depend on the nature of these sccio-political objectives.

Inquiries into the appropriate links between central and local planning are also desirable. What types of institutions, governmental and semi-governmental, at the local level will ensure that the decentralised production is not hindered by lack of stimulus and resource inputs needed from higher levels of administration? What types of information are needed by the central planners about the local resources and needs to insure that central plans are consistent with local plans? What are the administrative and political implications of decentralising planning from the top? All these questions merit serious consideration.

Appropriate technology development requires policy interventions to stimulate action on both demand and supply sides. On the supply side, policies concerning R and D will have to be restructured. In the context of basic needs strategy, national policy for R and D should give a much greater priority to small-scale producers, e.g. the small farmers, the village blacksmiths and other craftsmen, and rural/small-scale industries in the informal sector. The objective of the national R and D plan should be to narrow the technological gaps between the formal (modern) and informal sectors. This would involve redistribution of the total volume of R and D resources so that institutions dealing mainly with small-scale and traditional production receive a much larger share of the total. It would also imply the location of such institutes in rural areas closer to productive activity. In other words, decentralisation of production implied in a basic needs strategy should go hand-in-hand with decentralisation of R and D systems and plans. Such decentralisation is likely to promote greater links between the real needs of the local community an2 the R and D activities. Secondly, it should also encourage the types of R and D which would tend to be ignored by the central R and D laboratories.

The existing science and technology institutions as well as the R and D institutes in developing countries, are concerned mainly with the over-all scientific and technological capacity. They are rarely concerned with labour-intensive and energy-saving technologies especially designed

for the benefit of the small-scale sector. A few new institutions relating to appropriate technology have also been established outside the framework of science and technology institutions. However, establishment of new institutions in itself will not be enough. It is equally necessary that the concept of appropriate technology pervades throughout the governmental decision-making machinery. The ASEAN proposal to establish national government organisations with focal points in each ministry (described earlier) is one of the mechanisms to ensure scrutiny of sectoral and macro-plans and projects in the light of alternative technologies.

R and D for the promotion of appropriate technologies at the local level should also be combined with the creation of local machine-fabrication facilities, which are essential for redirecting technical change in the labour-intensive direction. National policies may have to discourage indiscriminate import of capital goods in order to promote local production of equipment. Engineering workshop.? and repair shops in developing countries are often engaged in shop-floor innovations that are appropriate far improving traditional technologies. But very little systematic information exists about such innovations. Documentation of these innovations in the form of "technical memoranda" relating to specific economic activity to be written in simple and local languages of developing countries would go a long nay in providing access to available information on appropriate technologies.[22]

Work on appropriate skills and training for appropriate technology needs much more attention than it has hitherto received. National training plans should take account of potential for on-the-job training and learning-by-doing effects of decentralised production. Plans and policies will also be needed at the local levels to introduce tech-

[22]The IL0 WEP Programme on Technology and Employment is currently engaged in the preparation of such technical memoranda in collaboration with developing countries, as well as with UNIDO and the World Bank. See ILO, Programme on the Dissemination of Information on Appropriate Technologies, Geneva, February 1978.

nological elements in basic education in secondary schools and to prepare suitable training materials for schools and technical centres. Greater efforts will be needed to deliver training to scattered and remote rural areas through mobile training workshops and rural extension services.

The national and local policies have as much to do with the creation of market for appropriate technologies as for appropriate products. Policies concerning redistribution of incomes should stimulate demand for both appropriate technologies and products. More direct measures may also be necessary to reduce the importance of "Western-style" sophisticated products in order to promote simpler goods with simple characteristics. This may be done either through restrictions on advertisement and/or restrictions on the import of such goods. Consumer acceptance of indigenous products and technologies could be promoted through public information campaigns, appropriate advertisement, and fiscal incentives.

In the context of a basic needs strategy and collective self-reliance, it may also be necessary for the deveioping countries to be stricter about the inflow of private foreign investment and foreign technology. Domestic innovations, to be successful in their local markets, may need initial protection against competition from imported technology. Lack of such protection in many deveioping countries has partly prevented local innovations on any significant scale.

Protagonists of basic needs defend such government interventions on the grounds that, in their absence, production of "basic needs" goods and services is unlikely to occur. There is no unanimous view on the degree of intervention or its feasibility. The critics of a basic needs strategy argue that interventions are often as inefficient as lack of them. Without entering into ideological issues, we maintain that a certain minimum of government intervention is required in a basic needs strategy if only to make sure that the poor target groups are helped to articulate their felt needs. It is the responsibility of the governments to bring appropriate technologies to the poor who may well be outside the market system.

National policies have an important role to play also in promoting technical cooperation among developing countries-

Policies to facilitate TCDC could include granting of special incentives and facilities by governments to their national enterprises (private or public) which import technologies from other developing countries instead of obtaining them from the advanced countries. The developing countries often have to pay excessive sums for the import of technologies from the advanced countries, since the same technology is often sold and paid for many times. A TCDC arrangement whereby one developing country government imports technology from another developing country may in principle reduce the payment of large sums by the recipient. Instead of private enterprises acquiring the same technology several times, the governments could acquire technology and license its use to private users.

International Policies

International influences on national decision making in developing countries take place through aid, trade, private investment and multinationals, etc. The implementation of a basic needs strategy and reorientation of technological change in a labour-intensive direction will call for reforms in all these directions. To take the case of the multinationals first; their main objective is to maximise profits. This goal is unlikely to be achieved through the manufacture and sale of "basic needs" goods which can easily be imitated, are not subject to brand names, and do not offer scope for rentals that are obtained from proprietary technology. For the food-processing industry (an industry of key importance in a basic needs strategy) for example, brand names and advertising seldom reflect significant nutritional improvements in products. Indeed, the branded products are often nutritionally inferior, as is the case of sifted maize flours. They involve numerous minor changes in products combined with more elaborate packaging at increased coat to the consumer. It may be desirable to discourage such practices of product differentiation by both foreign and local firms through the taxation of advertising associated with such practices.

There are a number of ways in which multinational companies could contribute towards R and D in the host countries. First and foremost, greater effort is required to decentralise R and D from the parent companies to their subsidiaries in developing countries. Host countries could

stipulate that a certain proportion of the net revenue of subsidiaries of foreign firms be used for local scientific and technological research. However, this presupposes that the host country's own R and D priorities favour the neglected small-scale and traditional sectors. If this were not so, and if the location of R and D by the multinationals in the LDCs led to an "internal" brain drain (employment of local scientists and engineers in pursuits irrelevant to the needs of the LDCs), little could be contributed to the development and implementation of appropriate technologies.

Secondly, the governments of the industrialised countries should be encouraged to subsidise prices at which multinational enterprises are able to make relevant technological know-how available to the Third World countries. Such subsidised research should "focus on increasing the ability of Third World countries to expand employment opportunities, to satisfy basic needs and to promote self-reliant styles of development.[23]

Thirdly, efforts need to be made to encourage medium- and small-scale enterprises in the developed countries to transfer their technology to the LDCs which could be more relevant to the latter's needs.[24] These enterprises are less concerned with world-wide operations. They might therefore be more willing than the larger companies to share their technology with the LDCs.

&orientation of aid policies would also be necessary. Although, in a self-reliant development pat;? the importance of aid from the advanced countries may diminish, reliance on it will not completely disappear. It is therefore essential that priorities and criteria used by the aid

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[23] Jan Tinbergen (co-ordinator), Reshaping the International Order, A Report to the Club of Rome, Dutton, New York, 1976, p. 155.

[24] A.S. Bhalla, "Small industry, technology transfer and labour absorption", in OECD Development Centre, Transfer of Technology for Small Industries, Paris, 1974.

donors shouid be consistent with the declared goals of development set by the developing countries. It has been observed in the past that technological choices embodied in technical cooperation projects financed by bilateral aid donors have at times been particularly capital-intensive in situations where labour-intensive alternatives would have been more suitable. Are such decisions by the donors irrational, political, inevitable? Do the aid donors succumb to the prestige factors which are often attributed to the national governments in developing countries? Can the information base for technological choice in project planning and appraisal be improved at the headquarters of the donor agencies and at the headquarters of the consultants which these agencies use? Do aid donors finance local costs? Answers to these questions are currently being sought by the ILO through a detailed investigation of aid donors' practices, and through a study of a selected number of aided projects in the developing countries.

There are a number of ways in which aid can be channelled more fruitfully towards the application of appropriate technology. First of all, aid should generally be untied: it is now well known that local cost financing facilitates more appropriate technology choices.[25] Secondly, greater aid should be linked specifically to the development of national and local technological capability within the developing countries. This may mean supply of equipment and staff expertise for science and technology institutions, support to the on-going appropriate technology centres in the developing countries in addition to those in the advanced countries which are already receiving adequate financial support. Thirdly, the bilateral and multilateral donors supporting the Regional Technology Centres should link their aid particularly to the promotion of technologies suited for the production and distribution of "basic needs" goods.

International trade policies can play an important role

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[25] In October 1977, the OECD Development Assistance Committee (DAC) approved a set of "Guidelines on Local Cost Financing", which is a welcome development.

in ensuring the availability of goods so crucial in a basic needs strategy. However, we have argued that "Western-style" products manufactured and consumed in the advanced countries may not always be relevant for basic needs satisfaction of the poor target groups. Under these circumstances, trade among developing countries, particularly in consumer goods, may be more desirable than trade between LDCs and DCs.

Within the framework of TCDC, a joint action on the part of developing countries will be necessary to establish regional marketing organisations, improve transport facilities and product quality in order to enable export of products, especially those manufactured by small-scale industries, to neighbouring countries.

The developing countries could also promote the adaptation and use of advanced technologies by creating multinationals of their own in such fields as energy, transport and pharmaceuticals.

Another area for international action is the "unpackaging" of technology imports. Ability to import different elements of technology from different sources would enable the developing countries to adapt technology to local uses and to benefit from the learning process involved in such adaption. International agreement in the form of a code of conduct on technology transfer (work on which is in progress under the auspices of UNCTAD) should help to bring about such unpackaging.

CONCLUDING REMARKS

We have stated in this paper that a basic needs strategy is a more comprehensive view of development. It is a strategy whose objectives have been somewhat redefined to concentrate on the material and non-material welfare of those target groups who are below the average for the economy as a whole. One can just as well argue that the objectives of earlier development strategies have been more or less similar, if not the same: it is the instruments to achieve these objectives and the time horizon that are altered in a basic needs strategy. For example, as much emphasis is placed on consumption planning as on production planning, more stress on decentralised production than on central control, on popular participation than participation

only by the privileged few, on redistribution of incomes and assets rather than purely on fiscal incentives. The fulfilment of basic needs of the bulk of the population is likely to he achieved only marginally through price and market mechanisms alone. Reforms in the incentive:: structure must be accompanied by the necessary institutional reforms.

Appropriate products and appropriate techniques will both require a pride of place in an appropriate technology strategy for a needs-based development. Technological self-reliance essential in such a strategy would require greater national political commitment and greater technical co-operation among developing countries. International action is designed only to assist the developing countries to implement their goals of development for their societies. Unless national and international policies and action programmes are developed in harmony, there is not much hope of implementing the declared goals in the foreseeable future. This implies that the objectives of basic needs policies (largely a national concern of the LDCs) should be consistent with the establishment of a New International Economic Order (a joint concern of the LDCs and DCs).

PART II
Existing Institutional Framework

Chapter 3
NATIONAL AND REGIONAL TECHNOLOGY GROUPS AND INSTITUTIONS: AN ASSESSMENT

A. K. N. Reddy

INTRODUCTION

Appropriate technologies can be defined as those technologies which advance the socio-economic objective of development, the latter being viewed as a process which is primarily directed towards:

(a) the satisfaction of basic human needs (starting with the needs of the neediest, viz., the urban and rural poor);

(b) endogenous self-reliance through social participation and control;

(c) harmony with the environment to ensure the long-term sustainability of this development process.

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[1]Constructive comments on the first draft of this paper were received from Frances Stewart and Ajit Bhalla, to both of whom the author wishes to express his sincere thanks. The author also wishes to thank M.K. Garg and J.N. Powell, and Ajit Bhalla, who subjected the second draft to a number of useful criticisms.

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All the three crucial aspects of appropriate technology, viz., choice, generation and dissemination, must be interlinked, possibly through a mechanism such as shown in Fig. 1. Some aspects of this inter.-relationship are discussed below.

In principle, the process of technology diffusion within one country can be guided by general guidelines which can be derived from the experience of other countries; but, in practice, effective guidelines - and the corresponding institutions to implement these guidelines - are best generated endogenously to suit the traditions, institutions, skills and history of the particular local, sub-national and national environment. The next best alternative is to utilise guidelines from similar countries in the sub-region and region, and from institutions covering these areas.

Implemented technologies have inevitable impacts on the process of development in general, and on the lives of the urban and rural poor in particular. Thus, a monitoring of these impacts must influence the criteria for the choice of appropriate technologies - the criteria must be modified and improved, or validated and confirmed. These improved and/or confirmed criteria must be linked, on the one hand, tc the choice of technology, and on the other, to the development of technology.

The process of choosing appropriate technologies involves the screening of a bank or list of available technologies with the aid of improved and/or confirmed criteria.

In so far as the criteria must be developed in close association with the dissemination of technologies, and with the monitoring cf the impacts of this dissemination, it follows that the effectiveness of the technology selection process is enhanced to the extent that it is done at the national level, and perhaps even at the sub-national and local levels.

Neighbouring countries in the sub-region and region, as well as distant countries facing similar developmental tasks, and institutions dealing with these countries can play an important role by supplying information on available technologies, and thereby enlarging the national bank of technologies from which apprcpriate technologies are chosen. Nevertheless, the main thrust for the enlargement of the

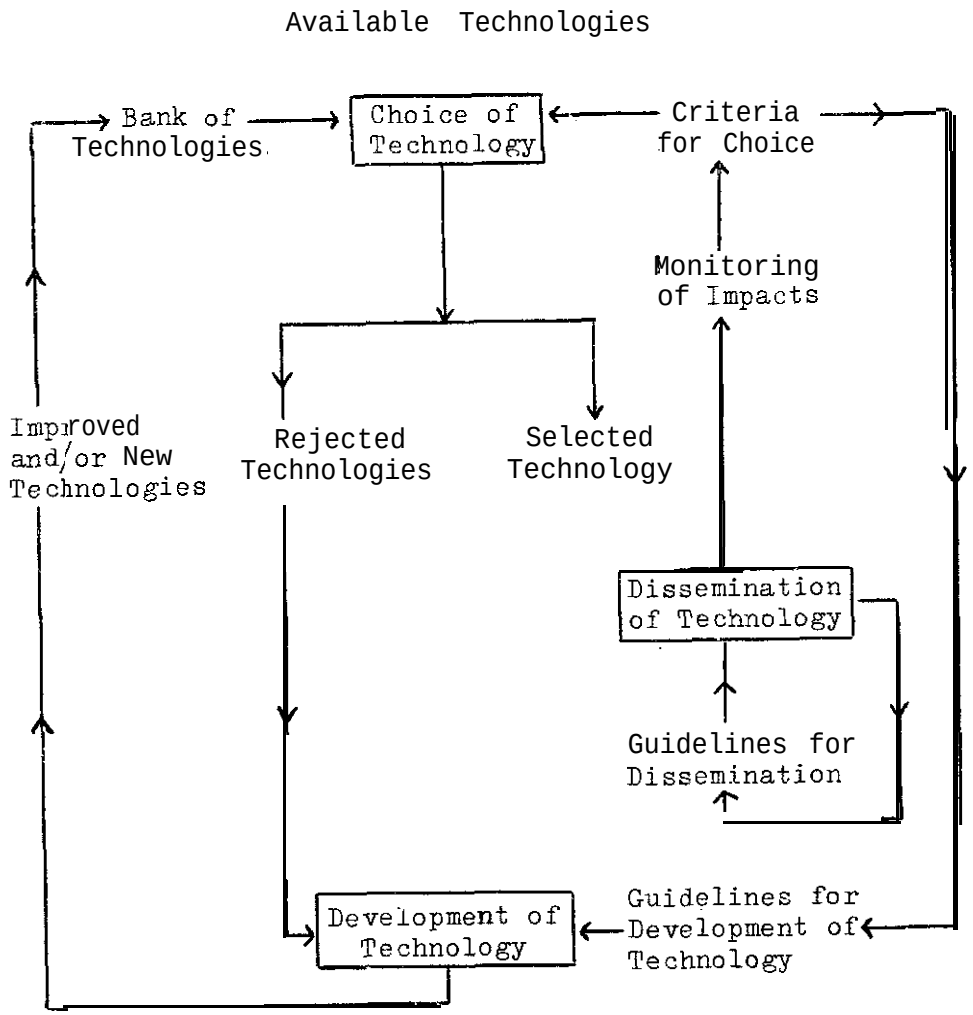

Fig. 1: Inter-relationship between choice, development and dissemination of appropriate technology.

bank of technologies must come from the internal development of technologies, particularly because this process of technology development must be coupled closely, on the one hand, with the choice of technologies, and on the other hand, with the dissemination of technologies.

The above discussion leads to the conclusion that overwhelming emphasis must be placed upon the development of national capability in the selection, generation and diffusion of appropriate technologies, with external inputs to these three processes playing a supportive or catalytic role. Not only is this national capability essential for the ultimate effectiveness of these processes of choice, generation and dissemination; it is the inescapable basis for the self-reliance of countries. In fact, this national capability should be the essential precondition for international action to play an effective role.

In this context, three crucial problems must be posed:

(a) Does national capability for the generation and dissemination of appropriate technologies exist in the developing countries?

(b) Upon what factors does this capability depend?

(c) What steps need to be taken to generate and/or strengthen this capability?

The purpose of this paper is to present a discussion of these problems. In order to initiate the discussion with an empirical basis, an outline of some on-going activities in appropriate technology is provided. This outline includes an indication of some of the problems with directories of appropriate technology organisations; it also contains a brief description of a limited number of these organisations. An assessment of their efforts requires the use of valid criteria, and in order to generate such criteria, models for the development of appropriate technology and for its dissemination are suggested. A set of tentative criteria are then derived from these models. These criteria are used to arrive at a preliminary assessment of institutions dealing with appropriate technology. Some critical shortcomings and limitations of national efforts in the development and dissemination of appropriate

technology are also highlighted. The identification of these bottlenecks leads to the recommendations for international/global action.

APPROPRIATE TECHNOLOGY GROUPS AND INSTITUTIONS

Appropriate technology is engaging the attention of a very large number of organisations. Several lists of such organisations have been prepared, and still others are under preparation. For example, lists have been prepared by TRANET (Transnational Network for Appropriate Technologies, USA), by the Commonwealth Secretariat, and by ITDG (Intermediate Technology Development Group, Ltd., London) on behalf of the United Nations Environment Programme. Also, the IL0 publication on "Technologies for Basic Needs" (1977) includes an appendix on "Institutions dealing with Appropriate Technology".

To indicate the dimensions of such lists, the first version of the ITDG-UNEP directory refers to about 50 appropriate technology organisations in Asia (including the Middle-East and the Far-East) and about 75 in Africa, with a worldwide "head-count" of about 275 organisations.

There are several problems with such lists. Firstly, they are overwhelmingly based on explicit declarations of interest in appropriate technology. But, like the character in Moliere's play, some institutions may be working on appropriate technologies without being aware of it, in which case they may not find a place in the list. Also, many institutions which are included in the list may turn up with technologies appropriate for rural areas rather than technologies specifically appropriate for the rural poor, when in fact the latter are only a sub-set of the former. Thus, the question of which institutions to deem as "appropriate technology institutions" needs to be resolved.

Secondly, the question of lists is complicated by the fact that there is a growing appropriate technology "movement" as part of the "counter-culture" in developed countries; and many groups which cannot easily find a place in the set up of conventional technology, enlist in this new movement. Further, the presence of such "off-beat" groups often repels conventional institutions which may otherwise have far greater potential for generating and disseminating appro-

priate technology. Conversely, the appropriate technology "movement" often tends to exclude established institutions of education, science and technology on the grounds (invariably justified!) that such institutions are predominantly concerned with western technology. The compilation of a directory of appropriate technology institutions is, therefore, not such a simple and objective matter.

Thirdly, the question of the potential for generating and diffusing appropriate technology is a crucial one. It may be as important to encourage (with suitable measures) established institutions of education, science and technology to commit themselves to appropriate technology as to buttress groups which can only achieve limited success. 'This is particularly important in those developing countries which have already built up significant systems of education, science and technology.

Consider the case of India for example. "he country has 115 institutions of university status, 44 national laboratories of the Council for Scientific and Industrial Research, 28 laboratories of the Indian Council for Agricultural Research and 8 laboratories of the Indian Ccuncii for Medical Research with a total of over 10,000 personnel with postgraduate qualifications. Despite this, the usual appropriate technology list only mentions 17 organisations in India with perhaps about 250 qualified personnel altogether. Thus, assuming that "AT potential" can be gauged by the number of trained personnel, the Indian potential for generating appropriate technology must be at least 53, and perhaps 100, times that suggested by the above-mentioned directories of appropriate technology organisations.

This type of discrepancy is a crucial issue to international organisations which are striving to promote national capability for the generation and dissemination of appropriate technology - should the "AT potential" of a country be judged by the mainstream of education, science and technology, or by the list of appropriate technology organisations however far from the mainstream these organisations may be'? Of course, an either-or approach may be quite misleading, and the actual and potential contributions of both groups of organisations must be harnessed.

Without pre-empting the resolution of this important issue, one important conclusion can be drawn: the conventional

institutions of education, science and technology in developing countries are contributing far less to appropriate technology than is commensurate with their potential.

Focussing on the appropriate technology institutions mentioned in the lists, it is quite obvious that a description of all these institutions would be quite pointless. Hence the description of a limited sample of ten institutions has been assembled below in order to initiate discussion on the assessment of appropriate technology activities. It is neither claimed nor intended that the sample covers all geographical regions and/or the most effective appropriate technology organisations.

1. Appropriate Agricultural Technology Cell (AATC), Bangladesh.?'

"This Cell was established in 1975 under the administration of the Bangladesh Agricultural Research Council. The objectives of the Cell cover: development and promotion of labour-intensive and capital-saving machinery and tools and implements for agricultural production, manufacture of implements through greater utilisation of local resources, development of appropriate drying, storage, processing and milling facilities to prevent post-harvest losses".

"The principal activities that the Cell undertakes are the collection and dissemination of information on appropriate technologies for the rural sector and initiation and promotion of research on rural technologies through grants to researchers in universities and other institutions. Working groups are established in the following fields: draught power, irrigation, fertiliser uses and agronomical methods, post-harvest operations, and agricultural workshops".

"Although this Cell is at present small with limited number of projects, it is proposed to expand work into such fields as animal husbandry, village-based industries, rural housing, etc. A proposal for an autonomous institute of

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3 See Hans Singer, Technologies for Basic Needs, Appendix B: "Institutions dealing with appropriate technology" ILO, Geneva 1977.

Appropriate Agricultural Technologies is also under consideration."

2. ASTRA (Cell for Application of Science and Technology to Rural Areas), Indian Institute of Science, India.

ASTRA was created in 1974 within the Indian Institute of Science (which is one of the oldest and prestigious institutions in the country) in order to serve as an agency for increasing the Institute's awareness of rural problems; and play a key role in correcting the present urban bias in the educational, research and development programmes of the Institute, so that a significant fraction of these programmes acquire a rural orientation. ASTRA's programme is concerned with the development and promotion of appropriate technology for the satisfaction of basic needs, defined in terms of access to inexpensive essential goods and services for the unemployed and underemployed rural poor.

The first phase of the programme of activity includes:

"(a) the development and testing of village-oriented technologies on the Institute campus;

(b) the establishment of an Extension Centre in a village near Bangalore; and

(c) the transfer of developed and tested technologies either to the village through the Extention Centre or to other rural development agencies."

The approach used is not only to derive appropriate technologies for the rural poor by merely simplifying the modern techniques used in urban areas, but also to start from the observation and study of rural traditional techniques, and therefrom to improve them and increase their efficiency. The initial phase of ASTRA thus involves extensive grass-roots learning and field surveys in order to identify the most crucial problem- of the rural poor and the technical solutions to be investigated.

In three years of existence, ASTRA has grown as an active inter-disciplinary group working on a wide range of problems relevant to rural areas.

The following four categories of ASTRA's work may be mentioned:

(a) Sponsored work, in which 9 projects (biogas technology, windmills, bullock carts, rural energy consumption patterns, community biogas plants, bamboo conservation, energy planning, hand pumps and village ecosystems) involving 17 faculty members and 15 project assistants have been supported to the extent of about $100,000 for periods ranging from 9 to 36 months by 4 agencies (Tata Energy Research Institute, Department of Science and Technology, Indian Council for Social Science Research, Karnataka State Council for Science and Technology);

(b) Faculty research, in which 7 topics, including vapour pulse pumps, silk worms, alternative energy sources, small-scale soap production, low-cost building construction, rural housing and educational aids for science teaching, are being investigated by 8 faculty members;

(c) Student dissertation projects, (as part of the Master of Engineering course requirements) in which there are 11 investigations on modelling of biogas units, sodium silicate from rice husk, plastics from castor oil, edible cellulose from rice husk, cellulose fibre from groundnut shells, energy survey of building materials, rammed earth construction, soil cement blocks and stabilisation, solar airconditioning and heat pipes;

(d) Ungra Extension Centre work, in which the design of all the new ultra-low-cost buildings (dormitory, library-cum-office, faculty and labour housing, seminar hall) has been completed and construction work has started, the survey of rural energy consumption patterns is almost complete; a windmill has been installed, and the study of a village as an ecosystem has commenced.

The highlights of ASTRA's work during 1975-76 are:

(a) The successful identification, in collaboration with the Karnataka State Council for Science and Technology, of the causes of widespread failure of handpumps for village drinking water borewells, the suggestion of modifications to prevent these failures, and the successful field testing and dissemination of these

modifications;

(b) The successful development and field installation of an innovative, low-cost, vertical-axis, Savonius type windmill for water pumping; and

(c) The construction on the Institute campus of a low-cost building, and its regular use as a laboratory for the study of solar airconditioning and biogas technology.

3. Appropriate Technology Development Organisation (ATDO), Pakistan.

ATDO came into existence in July 1974. It was originally attached to the Ministry of Science and Technology which transferred it to the Planning Commission in April 1975. Some nationalised banks came forward with funds and help to enable ATDO to start its development work. To popularise the possibilities of development based on appropriate technology, ATDO organised in March1975 an exhibition in which a low-cost house, hand-made match manufacture, a biogas plant, a high-extraction screw-type cane-crushing machine, and other appropriate technologies were displayed. Development work was also initiated on the manufacture of hand-made paper and of paper pulp from banana trunks, and on biogas plants and windmills.

During it; second year of operation, ATDO was able to secure office accomodation, but technical staff became available only towards the very end of the second year. Continued funding from nationalised banks permitted further progress on the projects which it had taken up during the first years, as well as the initiation of work on new projects, such as under-soil irrigation through earthen pitchers and PVC pipes, low-cost housing and primary schools, ox-driven implements, paddy dryers, insecticides from paddy waste and simple low-cost hydroelectric plants.

The third year of ATDO's existence is significant for four reasons:

(a) In April 1977, ATDO was declared an autonomous body in order to overcome a number of procedural, financial and administrative problems which were making its task of technology development extremely difficult;

(b) The dissemination of a few technologies, for example, hand-made match manufacture , hydroelectric generating plants based on water wheels, and screw-type can?: crushing machines, was initiated;

(c) Development work on some other technologies, for example, roofing for low-cost housing, windmills and under-soil irrigation, reached the stage of completion;

(d) ATDO also commenced a number of new R and D programmes on ferro-cement boat-building, rural assembly of transistor radios, candlesticks and chalk-stick manufacturing, hand-operated multi-spindle spinning machines, hand-made paper manufacture, etc.

A striking feature of ATDO's approach is the great stress laid on the importance of people's participation. By spreading the concept of appropriate technology and demonstrating such technologies, it is believed that the people can be motivated to undertake development for themselves. ATDO has even advertised in the daily newspapers calling for suggestions from the people - and incidentally secured an overwhelming response to this People's Participation Scheme. Another example of ATDOs success with popular participation in the development of appropriate technology is the technical contributions elicited from a local blacksmith in the designing and fabrication of an animal-drawn Fresno Scraper for land-levelling and earthmoving.

With the achievement of autonomy, the stage seems set for even more significant contributions from ATDO, provide3 that it can stimulate and sponsor high quality technical work on a much larger scale.

4. Council of Scientific and Industrial Research (CSIR), India.

The CSIR which was founded in 1944 is today on? of the major scientific agencies in India with an annual expenditure of around $30 million in 1974-75. Under its purview are 44 research laboratories manned by about 5000 scientists working in areas ranging from aeronautics and electronics to food technology and environmental engineering. Whereas its basic orientation has been towards indigenous industry which it has assisted in the drives for import-substitution and

greater productivity, the CSIR embarked on a major rural development project in 1974. Project Karimnagar is an experiment where the development of a backward area (viz., the district of Karimnagar of area 11,800 kms and population 1.96 million) is being attempted through the application of science and technology. The aim is maximum utilisation of available resources following an integrated approach. Marshalling expertise and technologies from its various constituent laboratories, CSIR is implementing an integrated development plan for appropriate technologies in agriculture (in collaboration with the Indian Council for Agricultural Research), public utilities such as roads, housing, buildings and public health and industry (agro- and mineral-based industry). The Karimnagar experiment is now undergoing a rigorous evaluation for mid-course correction, if necessary.

5. Development Technology Centre (DTC), Institute of Technology, Indonesia.[4]

"The Development Technology Centre (DTC) is a flexible, self-supporting organisation based at the Institute of Technology Bandung (ITB) in Indonesia. Established in 1973 by a decree of the Rector of ITB, DTC consists primarily of ITB professors and staff members who are interested in conducting research and development programmes related to national development."

"The focus of DTC activities is the application of a wide range of appropriate technologies to meet the challenges of unemployment and underemployment in Indonesia. Priority concerns are the planning, selection and development of appropriate technologies and the specific skills necessary for integrated development".

"DTC programmes have received support from various sources, including Indonesia Government offices and banks, international agencies and foundations, local governments and organisations, and institutions of higher learning".

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[4] See SIDN Newsletter, Vol. 3, No. 1 (1976) published by the Georgia Institute of Technology, USA.

"Currently, DTC is involved in an extensive five-year programme in rural appropriate development technology in collaboration with the TOOL Foundation of the Netherlands. The programme will establish a technical information system; ardware development projects; a system of field stations for realistic testing and demonstration of hardware or software technologies; and an inquiry and extension activity complemented by publication, documentation, and training programmes. Also in progress is a joint study with the Council for Asian Manpower Studies on the relationship between local and small industries and a multi-national joint venture emphasising vehicle assembly."

"An important aspect of DTC's work is the training *and* development of entrepreneurs through achievement motivational training programmes."

"DTC also works on development of local power sources - solar energy, wind energy, bio-gas, micro-hydra, and integrated systems - mainly for the rural areas and in the form of autonomous or decentralised systems."

"Some sample projects in appropriate technology hardware development and testing are a nonelectric ice maker, an agricultural product dryer, a stone cutter for the cottage jewelry industry, and food processing technologies such as a Kemiri nut shelling machinery and coconut processing".

"Another area of activity involves technical needs assessment, regional development, and technology transfer studies. The goal is regionalisation of technology transfer through Regional Development Technology Centres."

"DTC presently operates a field station for the purpose of appropriate technology development and demonstration *in* and around Jogjakarta, Central Java."

6. East African Industrial Research Organisation (EAIRO), Kenya.[5],

The organisation covers three East African countries, namely

[5] With the break-up of the East African Community, this institution has been renamed as the Kenyan Industrial Research Organisation.

Kenya, Uganda and Tanzania, and is mainly oriented towards small-scale production units in the primary and secondary sectors. In particular food programmes in agriculture receive special attention through R and D efforts to promote appropriate cultivation in different geographical areas (e.g. substitution of sorghum and millet for maize in semi-arid regions). Technical innovations are also carried out in the industry (brickmaking, food-processing, energy).

The work of EAIRO is not biased in favour of the large-scale organised sectors as is often the case of many national and regional research institutions. Instead, it is in line with the basic needs approach. Many of the smaller research projects are initiated in response to demands from small-scale clients.

Some of the specific examples of innovations are:

(a) Development of a solar water heating system which can be manufactured locally by small-scale sheet metal enterprises and which could provide hot water for domestic use in rural areas;

(b) Reconditioning of disused kilns in the ceramics section for the manufacture of bricks and tiles;

(c) Development of techniques for the commercial manufacture of oriatiô, a natural dyestuff used in some dairy products;

(d) Development of techniques for using Kiisi stoneware for electrical insulators."

7. ESCAP Regional Centre for Technology Transfer (RCTT), India. [6]

The decision to establish a RCTT in India was the result of almost a decade of consideration, consultation and re-

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[6] See "Project Document on Regional Centre for Technology Transfer" (E/ESCAP/44/Add. 1, 7 March 1977).

commendation by the international community. Of the nine immediate objectives envisaged for such a RCTT, the following make specific reference to the development and dissemination of appropriate technology:

(a) "To set up a suitable clearing-house for intra-regional and inter-regional exchange of information and experience relating to technology development, adaptation and transfer, and to promote cooperation in such activities, including the joint adaptation and development of appropriate technologies";

(b) "To assist in carrying out studies on selected technological problems and on development of appropriate technologies of interest to several countries of the region."

The case for a RCTT rests on the crucial importance of developing countries having national centres that are concerned with technology development, adaptation and transfer, and inter alia, with promoting "interest in the concept of "appropriate" technology among government policy-makers and adminstrators, industrialists in public and private sectors, entrepreneurs large and small and the staff of the universities and technical institutes". Whereas some developing countries already have institutions and organisations which may be considered incipient versions of national centres, a large number have not even commenced the building of the required infrastructure. Thus, an immediate objective for the RCTT is "to promote the establishment of national centres" and "help strengthen their capabilities in this regard". This means that a crucial objective of the RCTT is "to function as the lynchpin of a network of national centres to be set up in individual countries of the region". In the specific matter of appropriate technologies, it is envisaged that the RCTT will "promote the exchange of information and experience on such technologies and their transfer among countries in the region", and also "promote and organise regional cooperation in research and development of technologies appropriate to several countries of the region".

In short, "the functions of the RCTT and of the national centres can be analysed into two broad categories: technology information; and technology evaluation, adaptation and development. A third and equally important function

is the concept of using the regional centre for . . . sponsoring research into basic technologies required by the region."

Though there are specific and explicit references to appropriate technologies in the objectives and functions envisaged for the RCTT, it is clear that appropriate technology may not necessarily be its sole, or even predominant, concern. Further, there are possibilities of conflict between elements of the mandate - for example, the objective of promoting "the transfer of technologies adopted by developing countries within the region" can be inconsistent with the objectives of promoting appropriate technologies, if the technologies which have already been adopted are inappropriate.

Thus, the RCTT has potential for the development and dissemination of appropriate technologies, but the realisation of this potential depends largely on the emphasis placed on the different objectives and functions. At this stage, it is too premature to judge the issue because the RCTT is just in the process of being established.

Thus far, its organisational structure has been delineated - it will have a 14 member Governing Board, a Director who will be advised by a Technical Committee composed of the directors of national centres, and three divisions, viz., Technology Information, Technology Evaluation and Development, Management Personnel and Training, with supporting staff of professionals. A 34-month work programme - including pre-operational and operational phases, has been drawn up with a starting date in February 1977. ESCAP has been selected as the executing agency. Both the site for a permanent home, as well as a building to serve as a temporary home, for RCTT have been located in Bangalore, India, and the project is operational.

8. International Rice Research Institute (IRRI), Philippines.[7]

The International Rice Research Institute (IRRI) was

[7] See CGIAR - Consultative Group on International Agricultural Research, (undated).

established in 1960 to conduct research in all aspects of rice production, and in particular the development of improved rice strains and rice farming methods. "IRRI won early celebrity with the development of IR8 end the host of semi-dwarf rices that soon followed." These "varieties rapidly became the most widely grown in the tropics, and today about a fourth of the world's rice land is planted to semi-dwarf rices of the IR8 type."

"The technological advances that doubled yields in some places were developed by inter-disciplinary teams concentrating primarily on genetic manipulation of the tropical rice plant. Agronomists, pathologists, entomologists., geneticists and other scientists worked together to produce a range of high-yielding rice varieties to feed more people from the same land". IRRI scientists achieved this remodelling of the rice plant (a) "by collecting and screening thousands of varieties of rice from across the world", and (b) manipulating, through cross-breeding, the genes that control each favourable trait.

When the first IRRI rices were proved in experimental plots, "the Institute set about developing extension and demonstration techniques to get these rices into the hands of farmers and to teach farmers how to grow and protect them." What has come to be known as a "package of practices" was developed, in which all the inputs (seed, fertiliser, insecticide) and the instructions for their proper use, were elaborated. There was also the invisible part of the package, viz., the institutional support involving technical assistance from extension agents, credit through government programmes, guaranteed selling price, etc.

In its first ten years, IRRI has had a substantial impact on rice production in the developing countries. It realised, however, that many major problem remained to be solved. The most outstanding problem concerns the fact that "despite significant increases in rice productivity in areas where farmers are assured of water control and chemical inputs, the new rice technology has bypassed most less prosperous areas." In many of these areas, the semi-dwarf rices are too short to grow in the vast deep-water regions along the mighty rivers. Similarly, high-yielding rices are needed for the salty soils of coastal marshes and of irrigated land in arid regions, and for the

drought-prone regions where upland rice is grown. Also, "the improved rice developed for all areas must be resistant to major insects and diseases."

To meet this challenge, IRRI has formalised an institute-wide Genetic Evaluation and Utilisation (GEU) programme as "an inter-disciplinary rice improvement effort, linked with national programmes in Asia, Africa and Latin America, to jointly develop and evaluate improved rice and technology for all rice-growing areas. Nine inter-disciplinary teams of plant breeders and problem-area scientists, such as pathologists, entomologists, physiologists, and soil and cereal chemists, work together to develop rices that are genetically adapted to "agronomic characteristics; resistance to insects, diseases and drought; tolerance to adverse soils, deep water, floods and extreme temperatures; grain quality; and higher levels of protein. "To develop improved rices, each team first identifies varieties that have other favourable traits. The progeny of these crosses are tested under severe stresses, so that scientists can select experimental lines that can withstand harsh conditions." This work is actively in progress, and the results achieved thus far are promising.

IRRI also "collaborates with economists and agronomists in rice-growing countries to develop a methodology for the monitoring of problems that slow down the farm adoption of improved rice varieties and technology. Scientists conduct experiments on farmers' fields, survey farmers to determine biological and socio-economic constraints and analyse markets and input prices." "Agro-economic teams seek answers to such problems as why rice production has substantially *increased* in many new regions where the new varieties are planted, but not in others. Or why many farmers who have accepted the new rice varieties still do not use accompanying chemical inputs. Once answers are determined, scientists can tailor research to develop varieties and technology to overcome the production constraints."

To intensify food production, farmers in developing countries need tools and technology to speed up certain agricultural operations, such as land preparation, threshing and drying. But "many of the machines designed for large-scale farming in the developed countries are too costly and complex for farmers in the rice producing

countries. Besides, they are not easy to service and maintain because spare parts are scarce and expensive. Finally, the machines cannot be economically manufactured in low volume in developing countries because they are designed for capital-intensive mass production."

IRRI has sought to tackle these problems through its Farm Machinery Development Programme which was started in 1965. The programme aims at developing farm machines that satisfy two major conditions:

(a) Designs must be compatible with the technical and economic needs of small farmers who use them;

(b) The manufacture and servicing of the machines must be within the technical capabilities of indigenous small and medium-scale machine shops. IRRI gives drawings, designs, and limited technical support free of charge to manufacturers. By 1975, about 11,000 IRRI-designed machines, including its 5-7HP power tiller, axial flow thresher, batch dryer, and power weeder were commercially produced by small manufacturers in Asia. These machines are meant primarily for the 2-10 hectare farms, it being assumed that the traditional manual and animal-drawn farm implements are adequately serving the needs of the less-than-2-hectare size farms. If this assumption is not valid, the IRRI Farm Machinery Development Programme will bypass the poorest farmers who can benefit most from improvements in productivity.

To enhance the programme's effectiveness, IRRI established in 1976 regional industrial extension offices in Pakistan and Thailand. The IRRI-PAK Agricultural Machinery Programme, for instance, aims at introducing IRRI-designed machines to farmers and manufacturers in Pakistan and the neighbouring countries. Since, however, most of the IRRI machines were originally developed for wet-land farming practices, the IRRI-PAK programme is focussing on modifying and adapting these machines for dry-land farming conditions. Currently, the emphasis is on disseminating the axial flow thresher, the root-zone liquid applicator and the diaphragm pump.

IRRI's experience has helped chart a new course in institutional development. It influenced the subsequent

formation of the other agricultural institutes under the programme of the Consultative Group on International Agricultural Research (CGIAR) as well as their nature, staffing patterns and directions of programmes.

There is, however, another perspective from which the performance and effectiveness of IRRI should be examined. IRRI is located on grounds adjoining the campus of the University of Philippines, Los Baños, (UPLB) which has done pioneering work in rice research. Several questions arise: (a) could not the achievements of IRRI been attained by UPLB if the latter had been given selective and critical support so that its activities acquired an international dimension? ; (b) would not this alternative strategy of introducing a major international component into UPLB's rice research have involved far less investment?; (c) what effect has the presence of an international institution like IRRI with its lavish equipment, international salaries, etc., had on the morale of UPLB - has IRRI stimulated UPLB to greater heights or overawed it into a psychology of inferiority and ineffectiveness? Detailed studies on these questions have not yet been carried out, but first impressions indicate that international institutions like IRRI undermine the self-confidence of national institutions and have a debilitating effect on national capability.

9. Korea Institute of Science and Technology (KIST), Korea.[8]

"The Korea Institute of Science and Technology (KIST) is a large, multi-disciplinary contract research organisation located in a metropolitan sity of Seoul, Korea. It is a wholly autonomous and self-sustaining institution engaged in the research and development of science and technology for the benefit of the Korean . . . industry and economy . . . KIST was formally created in February 1966 and the dedica-

[8] See Nam Kee Lee, Technological Development and-Role of R and D Institutes in Developing Countries - The Korean Case, World Employment Programme Research Working Paper (WEP 2-22/WP.25), December, 1975.

tion ceremony . . . took place in October 1969 . . . Six years after KIST initiated its R and D activities", it was viewed as "a viable research institute".

"KIST is unique in several aspects; its threshold size is adequate enough to include diversified areas of technology and to conduct effective research works; its research laboratories are rightly sized, weil-equipped, and adequately funded and so is competent enough to compete with foreign source of technology. Government support has been consistent and adequate enough to overcome major difficulties . . . The input expenditure? for KIST to date amount to a totai of $24.1 million to build, equip and endow the Institute."

"KIST, an the largest R and D institute in Korea, has piayed an important role in the transfer, adaptation and development of appropriate technology in Korea's bid for rapid industrial development . . . KIST has adopted the contract research system by which KIST is held responsible for the execution of the required research under contract with local sponsors, and for the submission of progress reports periodically. After the study is over, all research results as well as supporting data, information and patents become the sole property of the sponsor."

"The research activities at KIST are organised to cover six general subject areas such as mechanical engineering and metallurgy, electrical and electronic engineering, chemistry and chemical engineering, food and feed research, techno-economics and other supporting services including computer service department, technical information services, chemical analysis laboratory, material testing laboratory, machine shop, pilot plants and library. In 1974 KIST performed contract research work on a total of 204 items: electrical and electronics accounted for 17 items (representing 16.9 per cent of total research contract amount in 1974), mechanical engineering 17 items (17.3 per cent), chemistry and chemical engineering 36 items (12.8 per cent), food and feed research 6 items (6.2 per cent), metallurgy and materials 18 items (12.2 per cent), and miscellaneous services 96 items (34.6 per cent) respectively."

"The staff of KIST includes 852 members as of September 1975 in which four (0.5 per cent) are in top management, and 196 (23 per cent) in research . . . In addition to

above regular staff, about 100 part-time investigators, engineers and advisors are employed to help the KIST research activities."

"As a result of KIST's efforts to develop new products and new processes for the local clients a total of 131 patent applications had been filed by the end of 1973 in which 13 were the applications for foreign patents."

"What has been accomplished so far at KIST has clearly indicated that the major role and activities of the Institute have been heavily concentrated on (a) the identification and selection of appropriate technology far the local clients, through its technical survey and feasibility studies; (b) the adaptation of existing technologies to meet specific local needs through applied research and technical services; (c) the development of appropriate and relevant technologies to suit the intrinsic conditions of local industry through indigenous research activities."

In 1978, KIST is altering its main thrust of activity. Having jargely "delivered the goods" as far as Korean industry is concerned, it is defining new missions. In particular, it is involving itself in Korean science and technology planning, and in the Saemaul Undoug (New Village Movement) programmes of the government. With regard to the latter, it is engaged in a major experiment in Cheju island. Assembling a large inter-disciplinary team, it is addressing a wide variety of rural settlement problems, including alternative sources of energy, housing, sanitation, water management, etc. This commitment to a rural region and to Saemaul Undoug is bound to transform the character of KIST and make it a leading organisation for rural appropriate technology.

10. Technology Consultancy Centre (TCC), University of Science and Technology, (Kumasi), Ghana.[9]

"The Centre was established in 1972 to serve as an inter-

[9] ILO, Technologies for Basic Needs, op. cit., Appendix B.

mediate between the University specialists and the potential users in the public, and has become largely involved in small-scale industries. The Centre participates in the research efforts by providing technical know-how and assists in the testing cf new products in pilot plants. It also provides technical assistance to firms in terms of quality control, commercial production, access to credit and equipment improvements."

"The Centre has developed a reputation for stimulating grass-mote development through the application of intermediate technology. Some of the examples of such work include the upgrading of existing craft industries such as textiles, wood-working and pottery. The development of appropriate processes includes: manufacture of spider glue from cassava starch and alkali from Plantation peel - the raw materials which are in abundant supply in Ghana; and manufacture of broad-looms for village weavers. In the case of the manufacture of glue, the Centre provided technical know-how, production plant and a financial loan to the entrepreneurs. In addition, the Centre has established three production units on the University campus for the manufacture of nuts and bolts, soap bars and broadlooms for weaving. A soap pilot plant is the largest single project of the Centre which is engaged in commissioning seven small-scale soap-making plants (ZOO-500 bars Per day) using mostly local raw materials and serving rural markets."

"Recently, a programme has also been launched for the establishment of craft centres in some 40 Ashanti villages. Other rural non-farm activities include glass bead-making coconut products, brass casting, and the local manufacture of such agricultural equipment as Pumps, driers, and bullock carts."

* * *

A limited number of institutions dealing with appropriate technology have been briefly described above. The task now is to assess whether such institutions have the capability to develop and disseminate appropriate technology. Such an assessment, however, should not be done arbitrarily; it must be based on a valid set of criteria. Since, however, there is no accepted set of criteria, an attempt will be made below to present a model for the development and dissemination of appropriate technology, and to derive therefrom a tentative set of criteria with which to assess appropriate technology institutions.

TOWARDS A FRAMEWORK OF ANALYSIS

Development of Appropriate Technologies

A fundamental assumption underlying the framework to be proposed here is that the pattern of technology is shaped by, and in turn shapes, the society in which this technology is generated and sustained. More specifically,, technology responds to social wants[10] which are in turn modified and transformed by technology through a causal chain, or rather causal spiral, which can be schematically represented as shown in Fig. 2.

Some features of the conceptual scheme represented by Fig. 2 are elaborated below.

(1) Though the majority of the innovations underlying the industrial revolution of the eighteenth and nineteenth centuries came from craftsmen and artisans working outside the framework of formal institutions of learning, the present situation is quite different. Today, it is the institutions of education, science and technology, including the research and development laboratories of the government and of public/private sector industry, which are the main sources of technological innovation. Hence, the emphasis given to institutions in the scheme (Fig. 2). By and large, spontaneous non-forma! innovation (as distinct from minor testing, modification and adaptation) by the people and extra-institutional groups is believed to make a negligible contribution to the stream of technology generation. Perhaps this is because most innovations today require large inputs from the accumulated heritage of scientific and engineering knowledge which unfortunately is only channelled through the formal institutional process. (Whether this victual exclusion of the populace from the innovative process should continue to be the case is another matter.)

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[10] Quite deliberately, the neutral word "wants" has been used at this stage. The resolution of "wants" into "demands" and "needs"is discussed later.

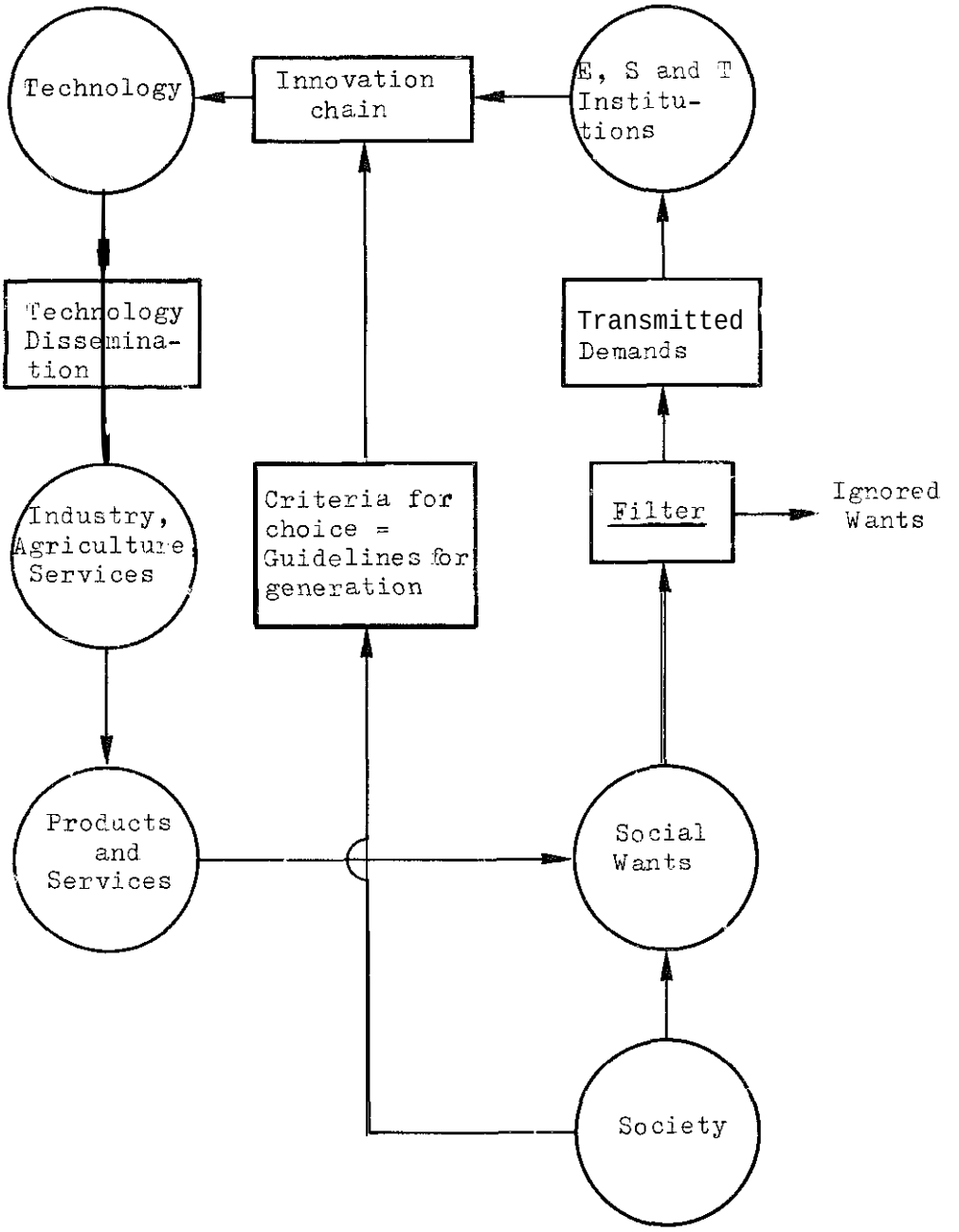

Fig. 2: Generalized scheme for the development of technology

(2) All social wants are not necessarily responded to by the institutions responsible for the generation of technology, viz., the educational, scientific and technological institutions. There is a process of filtering these wants, so that only some of them are transmitted as demands upon technological capability and the rest are bypassed by these institutions. In other words, there are ignored wants which institutions do not seek to satisfy by research and development.

This filtering process is usually operated by decision-makers, firstly, in the bodies which control the research and development institutions, and secondly, within the institutions themselves. These decision-makers are either conscious agents of social and economic forces, or are unconsciously influenced by these forces.

In untempered market economies, only wants which can be backed up by purchasing power become articulated as demands upon the research and development institutions and the remaining wants are bypassed, however much they may correspond to the basic minimum needs of underprivileged people. Thus, like all commodities in these economies, technology too is a commodity catering to the demands of those who can purchase it, and ignoring those who cannot afford it.

(3) The generation of technology involves the so-called "innovation chain" which is the sequence of steps by which an idea or concept is converted into a product or process. This sequence of steps varies with the circumstances, but can often be schematically represented thus:

Formulation of research and development objective ⟶ idea ⟶ Research and Development ⟶ Pilot-plant trial ⟶ market survey ⟶ Scale up ⟶ Production/ product engineering-+ Plan fabrication ⟶ Product or process.

(4) It is essential to note that socio-economic constraints, and environmental considerations, if any, enter the process in an incipient form even at the stage of formulation of the research objective, and then loom over the chain at several stages. These constraints are in the form of guidelines or preferences or paradigms, for example, "Seek

economies of scale!"; "Facilitate centralised, mass production!" "Save labour!"; "Automate as much as possible!"; "Don't worry as much about capital and energy (in the days before the energy crisis) as about productivity and growth:"; "Treat polluting effluents or emissions as externalities!", etc. (These guidelines for generating technologies are only another representation of the criteria for the choice of technologies - guidelines stand in the same relation to the generation process as criteria to the selection process).

Thus, every technology that emerges from the innovation chain already has congealed into it the socio-economic objectives and environmental considerations which decision-makers and actors in the innovation chain introduced into the process of generating that technology. It is in this sense that technology can be considered to resemble genetic material for it carries thr code of the society which conceived and nurtured it, and, given a favourable milieu, attempts to replicate that society.

(5) The technology that emerges from the innovation chain will became an input, along with land, labour and capital, to establish an industry or agriculture or a service, if and only if the aforesaid socio-economic and environmental constraints are satisfied. Thus, it is not only the technical efficiency of the technology, but also its consistency with the socio-economic values of the society, which determine whether a technology will be utilised.

(6) Social wants are not static. The products and services that are produced create new social wants, and in this process, the manipulation of wants through advertising, for example, plays a major role, and thus the spiral:

Social wants ⟶ Products/Services ⟶ New Social wants ⟶ . . . .

The widespread generation of appropriate technologies depends, therefore, upon the fuifilment of three important conditions:

(a) A filter which transmits basic human needs, particularly the needs of the neediest, (viz., the urban and rural poor), to the technology-generating institutions;

(b) The introduction of a new set of guidelines into tho innovation chain, a set which is consistent with the criteria of appropriateness; and

(c) The existence of the requisite technological capability (trained and competent personnel, laboratories, workshops, test facilities, etc.) to complete the innovation chain.

The crucial question, therefore, is to what extent these conditions are satisfied in the developing countries. An exploration of this question can begin by noting that a causal spiral of the type represented in Fig. 2 is too simplistic in many ways, but particularly with respect to the social homogeneity that it implies. In point of fact, almost every developing country is polarised into a dual society[11]; an elite consisting of the richest 10-20% of the population, which usually includes industrialists, businessmen anti feudal landlords, politicians, bureaucrats, rich peasants, professionals such as doctors, engineers and scientists, and the bulk of organised white-collar labour; and the poorest 80-90% most of whom live in the rural areas, and the remainder in urban slums. In other words, dual societies are characterised by islands of affluence amidst vast oceans of poverty. Thus, in effect, a developing country consists of two "societies", which may not be spatially isolated from each other, but are separated by a wide chasm of incomes, consumption patterns, attitudes and life styles.

At the same time, the elite of developing countries practice a philosophy best described thus: "all that is rural is bad, all that is urban is better and all that is foreign is best", which means that there is a strong influence of the life styles of the developed countries upon the life styles of the elite in the developing countries. Hence, the technology-society interaction scheme of Fig. 2 must be elaborated.

A simple version of such an elaboration is shown in Fig. 3 (which is closely related to that proposed by Herrera)[12]

[11] Dual societies are not to be confused with dual economies.

[12] Amilcar 0. Herrera: Scientific and Traditional Technologies in Developing Countries, Chapter 13; Martin Robertson, The Art of Anticipation, London, 1975.

It is necessary, however, to make a few comments about this schematic representation.

(1) Little significance must be attached to the sizes of the circles, though,

(a) in the case of the row: Society, the circles l-l, 1-2 and l-3 have been drawn very approximately according to the relative size of the populations; and

(b) in the case of the rows: Educational, Scientific and Technological Institutions, and Technology, the circles 3-1, 3-2, 4-l and 4-2 have been drawn very approximately according to the relative magnitudes of the R and D expenditures.

(2) The problem of the urban poor in developing countries is indeed a serious problem, and a more visible one to city-dwellers and foreigners. Nevertheless, it must be mentioned that:

(a) in most countries, the number of urban poor is much smaller than that of the rural poor;

(b) being subject so much to the powerful demonstration effect cf the life styles of the urban elite, the urban poor share to a considerable extent similar aspirations; and

(c) the survival of the urban poor in the slums of metropolises generates many infrastructural requirements (e.g. services such as shelter, water, sanitation) which, for reasons of population and housing density, generate demands for technologies similar to those for the elite.

(3) Whereas there is a tremendous overlap between the wants in developed countries and those of the elite in developing countries (cf. circles 2-1 and 2-2), it is a characteristic of a dual society that there is virtually no overlap between the wants of the elite and the rural poor (cf. circles 2-2 and 2-3). The wants of the elite tend to be modelled on the pattern of the developed countries, in contrast to the rural poor whose wants correspond to the very basic minimum needs

of food, shelter, clothing, health, employment, etc.

(4) In dual societies, the bulk of the decision-making is in the hands of the elite who are, therefore, responsible for the filtering process which selects some wants for onward transmission as demands upon the educational, scientific and technological institutions, and shelves other wants. In most cases, this elitist filtering process functions in such a nay that:

(a) the wants of the elite are almost wholly transmitted as demands requiring technological answers; and

(b) the wants of the poor are largely ignored even though they are an expression of urgent basic needs.

Since it is the satisfaction of these basic needs which constitutes the essence of development, it follows that an elitist filtering process is incompatible with development.

(5) The demands of the elite are picked up by educational, scientific and technological institutions through the agency of industry in the developing country, and industry in developed countries, both of which sense in these demands a major market. It is important, however, to note that industry in developing countries is of two categories:

(a) indigenous industry which derives its technology from the national, educational, scientific and technological institutions; and

(b) industry which may be owned, by government, native entrepreneurs or multinational corporations (or by two or three of these in different ratios), but which is based on imported technology generated in the institutions of developed countries.

Between these two categories, the linkage of the demands of the elite is very much stronger with the second category of local industry, viz., that based on imported western technology developed by the educational, scientific and technological institutions of the developed countries. This is why the strong linkage 2-2 -3-l is shown with a

continuous line and the weak linkage 2-2 ⟶ j-2 with a dashed line.

(6) The operation of the filtering process to block the transmission of most of the wants of the poor, i.e., the basic minimum needs of the majority of the poverty-stricken population, from the educational, sientific and technological institutions is emphasised by the absence of a linkage between the circle 2-3 and either circle 3-1 or circle 3-2. Of course, the linkage is not zero - for instance, when the poor suffer from communicable epidemic diseases, the elite is also vulnerable, and such needs of the poor are obviously responded to effectively. Thus, the filtering process is not conducive to development, and particularly to rural development which in most developing countries must constitute a major aspect of the development process.

(7) In the absence of institutions to develop technologies to meet the needs of the rural poor, the latter have no choice except to fall back on traditional technologies based on the reservoir of empirical knowledge accumulated through the centuries. (cf. the linkage 2-j ⟶ 4-3 and 4-3 ⟶ 2-3). The urban poor are generally victims of rural impoverishment who migrate to metropolitan slums. As such they not only carry over some of their traditional technologies, but they are also forced to depend on urban technologies. In addition, they innovate with the waste materials and garbage dumps of the urban elite.

(8) There is very strong linkage 3-1 ⟶ 3-2 between the educational, scientific and technological institutions of developed countries and those in developing countries, the latter being modelled very closely on those of the former. In fact, these institutions in developing countries derive their patterns for research and development, including its emerging ideas, trends and fashions, stream of inspiration, experimental techniques and instruments, criteria of excellence and source of recognition, from the counterpart institutions in the developed countries.

(9) In the generation of technology, the educational,

scientific and technological institutions of developing countries invariably start with imported western technology an a starting point and as a model, hence the linkage 4-1 ⟶ 3-2. Thus, they emerge (linkage 3-2 ⟶ 4-2) after a process of imitation, adaptation and innovation (the innovation, rarely!) with a technology which has been described as naturalised, i.e., adapted western technology.

(10) The satisfaction of the demands of the elite is much more through western technology (this strong linkage is shown by a continuous arrow 4-1 ⟶ 2-2) than through naturalised technology (this weak linkage is shown by the dashed arrow 4-2 ⟶ 2-Z).

The above discussion of the technology-society scheme in developing countries leads to important conclusions regarding the problems associated with the generation of appropriate technology in these countries.

Firstly, the characteristics of these dual societies are such that the filters do not emphasise the transmission of basic human needs, particularly the needs of the neediest (the urban and rural poor), as demands upon the technology-generating institutions. The magnitude of the R and D funding for problems related to basic needs is usually a clear indicator of this bias, for it is very often significantly less than that for problems related lo defense, to glamorous technologies and to those aspects of the industrial, agricultural and services sectors devoted to the demands of affluent elites. Even if this funding bias did not exist, and even if these institutions made deliberate efforts to respond to the basic needs of the urban and rural poor, there is a serious problem in the identification of these needs. This problem arisen because the areas in which the urban and rural poor live, i.e., the slums and villages, are not virgin territories uncontaminated with the demonstration effect of urban life styles. So, it is not simply a question of asking slum-dwellers and villagers what their needs are - such a "questionnaire" approach only results in their demanding needs similar to the urban elite. For example, villagers invariably ask for urban-style houses with reinforced-concrete-construction (RCC) roofs, even though they are well aware that the thermal comfort of such "modern" houses is often less than

the traditional thatched-roof houses. This request arises from their clear understanding of the defects of traditional thatched roofs, which catch fire, leak, harbour rodents, insects, and reptiles, are susceptible to termite attack, and require frequent replacement though thatching material is often scarce. This understanding results in their feeling a need for an alternative roofing material without the disadvantages of thatch as they use it, but the only alternative which they perceive is an RCC roof. Their lack of awareness of the range of possible roofing materials, i.e., of the technical options, becomes an important reason[13] for the discrepancy between felt needs and perceived reeds. The discrepancy is serious because these perceived needs usually require expensive western or naturalised technologies, and therefore cannot be satisfied by capital-starved developing countries.

Secondly, the intellectual domination of the developed countries over the educational, scientific and technological institutions in the developing countries leads, in the latter, to a virtually unexamined and unquestioned introduction of alien and inappropriate guidelines, preferences and paradigms into the innovation chain, for example, the implicit faith in "economies of scale". Unfortunately, these guidelines are largely unexpressed and unstated. In fact, the participants in technological innovation are rarely conscious that they cannot avoid using preferences. The net result of not revealing, exposing, and evaluating the guidelines used in the process of technological innovation in (or for) developing countries is that the participants in innovation fall back on the preferences of the industrialised countries. But the factor endowments of developing countries may be fundamentally different from those of developed countries. Under these circumstances, the transfer of all those preferences related to factor endowments is incompatible with development. Besides, developed countries have largely satisfied the elementary minimum needs for most of their populations, hence their technology has been increasingly oriented

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[13] There are social reasons, too - in stratified societies, the material appartenances of the upper strata become status symbols avidly sought after by the lower strata.

towards other objectives (mainly towards non-essential luxuries and military applications). In developing countries, however, the main preoccupation has to be with elementary minimum needs from which large segments of their population are disenfranchised. Thus, guidelines and preferences related to products and services must necessarily be different in developing countries.

Thirdly, there is the problem of the thrust of technological capability. The task of generating appropriate techrology appears to be impeded (a) by the type of technological capability that developing countries have and are currently growing; and (b) by the nature of linkages that their educational, scientific and technological institutions have and are forging with domestic and foreign societies.

Thus, most developing countries have followed a standard approach of establishing universities, institutes of science and/or technology, technical institutes and industrial laboratories modelled on the corresponding institutions in the developed worlds, with even their staff emulating counterparts in the industrialised world. As for the institutional linkages, Fig. 3 shows that the strongest links are with the demands of the elite, with counterpart institutions in the developed world, and with western technology. Furthermore, because of the inevitable financial stringencies, these institutions - like naturalised technologies - become, at best, cheaper and cruder versions of the corresponding western institutions, and at worst, complete parodies of the latter.

The reasons for this predicament are discernible from the technology-society interaction scheme for developing countries (Fig. 3). This predicament is an inevitable consequence as long as institutional linkages with the needs of the urban and rural poor and with traditional technologies are virtually non-existent (see the absence of arrows interconnecting circles 3-2 to 2-3 and 4-3), and are very strong with elite demands, with institutions in the developed world and with western technology (see the arrows interconnecting circle 3-2 with circles 2-2, 3-1 and 4-1). The situation is worsened by the fact that most teachers, scientists, and engineers are drawn from, and/or become part of, an elite which, in the dual societies of developing countries, is virtually cut off from its countryside and its rural poor, as well as from its slums and urban poor.

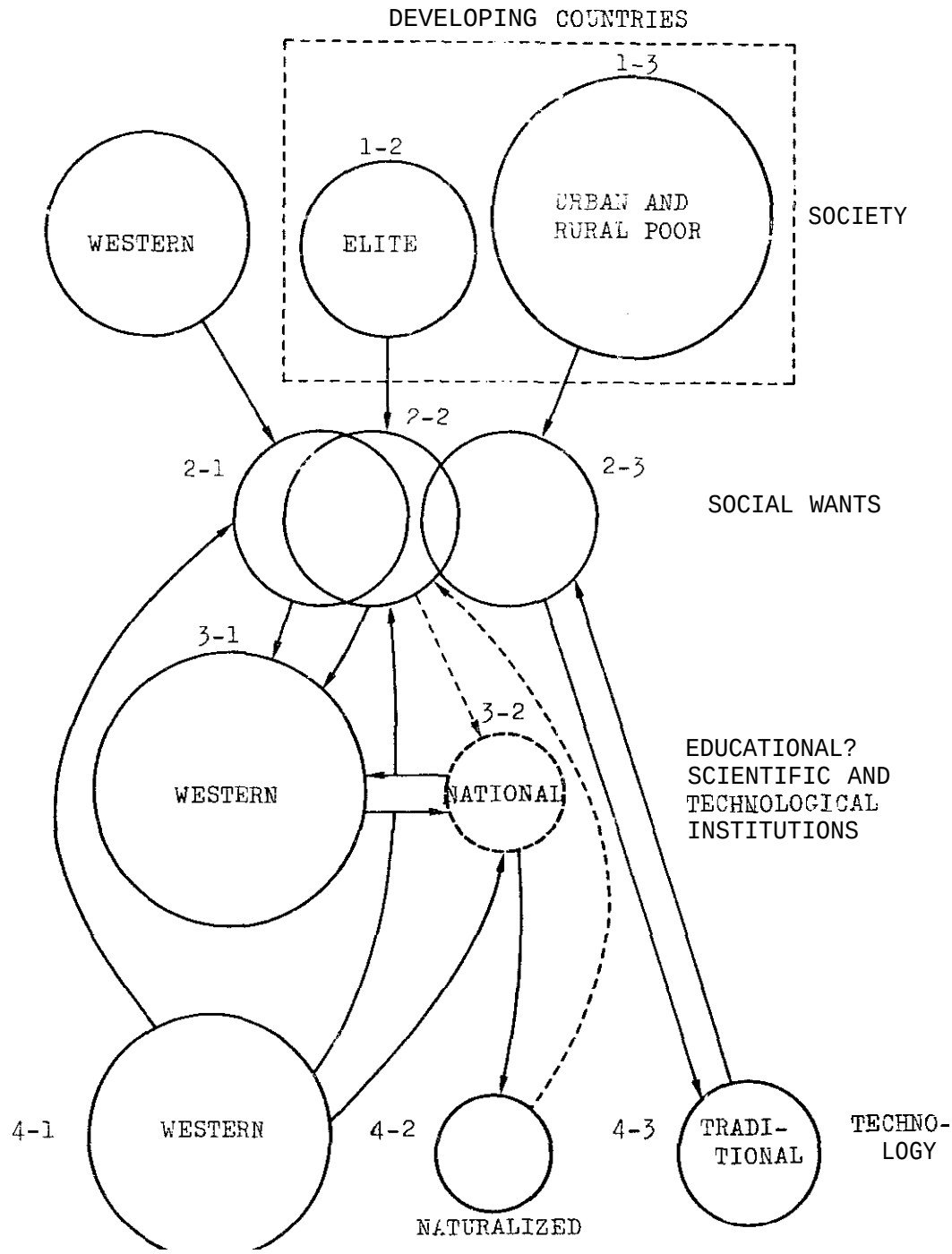

Fig. 3: Technology-society scheme for developing countries

Thus, the conscious attempt to emulate the institutions of the developed countries results in the educational, scientific and technological institutions of the developing countries acquiring patterns of technological capability distorted towards the problems preoccupying the developed countries, i.e., towards problems largely unrelated to the development needs of developing countries. This distortion is only accentuated by the large-scale attempt of developing countries to get their manpower trained in the developed countries, for the most significant result of such training is an increased alienation from domestic development tasks.

The analysis of the problems associated with the generation of appropriate technologies in developing countries suggests certain obvious prerequisites for the overcoming of these problems.

The first prerequisite is the establishment of clear-cut mechanisms to alter the filtering process so that the relevant institutions respond to, and are biased towards, basic human needs, especially the needs of the neediest. These mechanisms must be directed towards the creation of an awareness of these needs and a commitment to satisfy them.

The mechanisms of awareness creation must ensure the removal of the discrepancy between felt and perceived needs. One possible approach is represented in Fig. 4 from which it can be seen that both social science and technological inputs are necessary so that a response to perceived needs will lead to the satisfaction of felt needs. The social science input, which may well come from technologists qua sociologists, is required to identify the felt needs; and the technological input is essential to widen the range of perception of the target group by exposing it to a number of technological options of varying cost and acceptability, all of which satisfy the given felt need. It follows that the generation of appropriate technologies to meet the basic needs of the urban and rural poor requires, as a prerequisite, close interactions between these target groups on the one hand, and social scientists and technologists on the other.

The mechanisms for generating commitment to the satisfaction

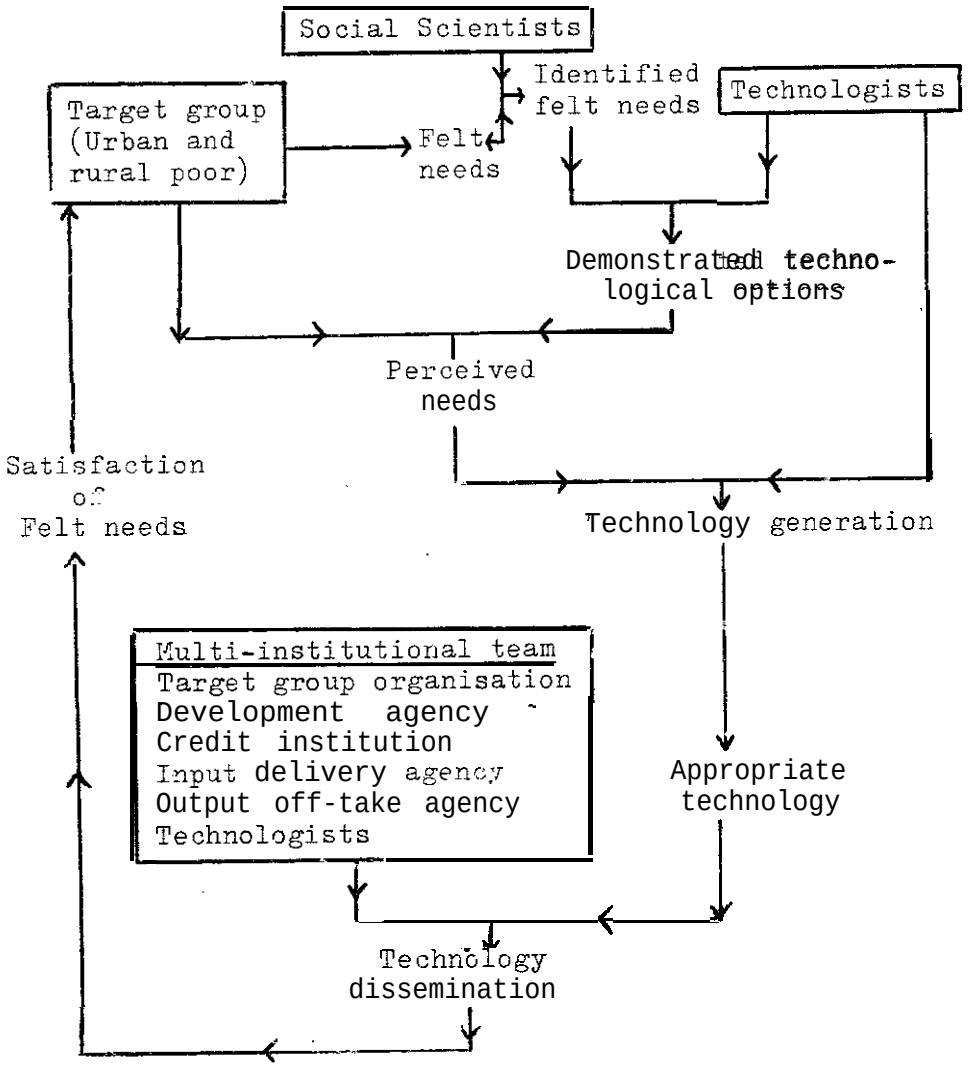

Fig. 4: Model for dissemination of appropriate technologies

of these basic needs must involve R and D funding policies biased towards these needs, the creation within educational, scientific and technological institutions of leaderships and core groups which catalyse an increasing shift away from the non-developmental demands of the elites, new incentive systems, etc.

The second prerequisite is that the scientists and engineers involved in the generation of appropriate technology should absorb and/or formulate the new guidelines, preferences and paradigms essential for the development of appropriate technology. Absorption is of course an easier process than formulation, but unfortunately the new guidelines, preferences and paradigms have not yet been elaborated and made explicit. This situation only increases the intellectual burden on (challenge to?) scientists and engineers, and compels them to understand the economic, social and environmental ramifications and implications of their areas of interest. This understanding requires in addition close contact with the prospective beneficiaries of appropriate technology, i.e., the population in rural areas particularly the poorest sections. It is clear, however, that several immediate steps must be taken:

(a) the prevailing guidelines must be made explicit;

(b) a new set designed to advance development must be formulated; and

(c) scientists and engineers must be instructed in the use of the new paradigms.

In short, a paradigm revolution must be initiated.

The third prerequisite, in view of the failure of the conventional approach to technological capability followed by developing countries, is an alternative strategy for their institutions of education, science and technology. One such strategy follows from Fig. 3. By analogy with the close laboratory-industry link well-known to be vital for successful industrial research, it consists of two parts:

(a) forging strong linkages between, on the one hand, the educational, scientific and technological institutions of these countries, and on the other hand, the needs of the urban and rural poor and their technologies; and

(b) drastically weakening the linkages of these institutions with elite demands and with institutions in the developed world catering to these demands.

In Practice, this alternative strategy is most effectively implemented by each institution committing itself to a neighbouring area[14], and to the generation of technologies appropriate to the development of that area. It follows from the understanding of development used in this conceptual analysis that a commitment to the development of a particular area must mean a commitment to the needs of the neediest, i.e., the urban or rural poor, in that area. Further, since the generation of technological solutions accessible and acceptable to the neediest is very often likely to come through a transformation of traditional technologies, a study and evaluation of these technologies in the neighbouricg area becomes an inevitable objective of the commitment.

The alternative strategy needs simultaneous implementation at a hierarchy of national, sub-regional and institutional levels.

The national or macro approach should be directed towards the preparation, on-going modification and refining, and implementation of development-oriented technology plans, in accordance with which the national R and D budget must be framed and apportioned. This technology planning should be linked with the process of selecting and choosing technology for development, so that better technological options than those available can be identified, and research and development work towards the development of these technologies can be initiated. Of course, insights into these alternative technological options can only emerge from greater sensitivity to the Problems of the urban and rural poor, and more intimate contact with their problems. Such sensitivity to needs and intimacy with problems cannot be attained by planning from the cloistered chambers of the national capitals of developing countries. Hence, what is

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[14] The size of this area can be a matter of convenience, it may be a slum, a village, a cluster of villages, the poor section of metropolises, a district or a province.

necessary is inputs from the grass-roots level, and herein lies the importance of work at the institutional or micro-level.

Virtually, all the educational, scientific and technological institutions of developing countries (for instance, most of those described earlier have, at least in an embryonic and rudimentary form, the multi-disciplinary competence to tackle the task of developing appropriate technologies for meeting the basic needs of the needy. These functioning institutions must, therefore, constitute the main basis for the generation of appropriate technology through a deliberate and formal commitment to the problems of development, and particularly to rural development. Such a redeployment of efforts with existing infrastructures is a far more effective measure than the creation of new institutions for appropriate technology.

A basic assumption underlying this new strategy is that institutional generation of technology will continue to play a major, but hopefully not exclusive, role in innovation for development. It is envisaged that the actual users and operators of appropriate technology, i.e., the poor people themselves, will have a crucial role in innovation, particularly in the continuous testing, refinement, and adaptation of new technologies. Indeed, it is hoped that a constant interplay between institutional and popular innovators will enhance the appropriateness of technologies. What is rejected in the new strategy is the argument that the institutions of education, science and technology in most developing countries are so moribund and irredeemable that only non-institutional voluntary groups can generate the new technology. Such groups may have a part in technology generation (as distinct from technology dissemination), but it can only be marginal[15], in view of the inevitable limits to their multidisciplinary expertise and their facilities for research and development. This judgement rests, however, on the valid assumption that the appropriate technology is not second-class technology and that its generation is not a trivial exercise. For example, innovative windmill design has been proved (of. ASTRA's experience) to require the same laws of aerodynamics as

[15] In contrast, their role in technology dissemination can be, and often is, decisive.

that used in the design of jet-fighter wings; the dimensioning of biogas digestors needs as much chemical engineering as the sizing of any chemical reactor; and an understanding of the stresses in bullock-cart wheels requires the same theory used for pm-stressed concrete.

The activities of institutions at the micro-level can be linked together interactively at the sub-national or meso-level, i.e., at the level of districts or groups of districts corresponding to the next higher level of local government. Here too the basic approach should be a commitment to the problems of a particular area of the country and to the problems of the poorest sections of the people in that area.

This strategy of generating technological capability and developing technologies through a commitment to a particular area , i.e., to the problems of the poor in that area, is likely to ensure satisfaction of the third prerequisite for the generation of appropriate technologies, viz., the growth of a new type of technological capability. In addition, this same strategy is also likely to satisfy the first two pre-requisites. Thus, the establishment of close links between educational, scientific and technological institutions on the one hand, and slums and villages and urban and rural poor on the other, is the surest way of creating awareness of the basic needs of the neediest. If this awareness is transformed into a commitment to development , then the institutional and personal filters will start responding to those social wants which correspond to the basic needs of the poorest. Without such response the generated technologies will not be compatible with development objectives. Similarly, it is only close contact with rural areas and those below the poverty line which will facilitate the formulation of new guidelines, preferences and paradigms necessary for the generation of appropriate technologies.

Dissemination of Appropriate Technologies

Turning from the technology-development process to the technology-dissemination process, it must first be noted that the dissemination of conventional western technologies is a process the modalities of which have been established over several decades. Further, the beneficiaries of these tech-

nologies are usually powerful and articulate groups expressing themselves through clear-cut market mechanisms. As a result, commercial enterprises can, through profit-seeking efforts alone, disseminate the technologies quite successfully. In contrast, the dissemination of appropriate technologies is a relatively more recent process and challenge. Aiso, its prospective beneficiaries are invariably weak and inarticulate sections of society, e.g., the urban and rural poor. These sections can rarely back up their needs with purchasing power, i.e., they do not constitute a significant market, and, therefore, the task of responding to their needs cannot be left solely to industry. Catalytic assistance from external sources is often essential and inescapable. The purpose of this external assistance should be to facilitate the technology implementation process with technological know-how, with credit for equipment and working capital, with input deliveries and output off-take, with managerial help and training programmes, and entrepreneurial leadership. In addition, the beneficiaries, e.g., the urban and rural poor, must themselves play an active role If the whole exercise is not to peter out for the lack of popular participation.

It follows, therefore, that the dissemination of appropriate technologies must be based on a multi-institutional effort involving development agencies (either government or voluntary agencies), R and D organisations, industry, financial and credit institutions, input (e.g., raw materials) delivery and product off-take (e.g., marketing) organisations, management and personnel training institutions - and, of course, organisations of the beneficiaries (e.g., cooperatives of the urban or rural poor).

This multi-institutional effort, which is so necessary for the dissemination of appropriate technologies, implies that a host of structures and procedures must be worked out for each appropriate technology. In particular, attention must be focussed on the procedures for the procurement of inputs and credit, for the off-take of outputs, and for the management of organisations, training, manpower and finances. In short, an entire hardware and software package must be worked out in detail for each appropriate technology, bearing in mind its specific features. Thus, the package for appropriate road-building technology nay be completely different from that fcr mini-cement plants.

Too often, inadequate attention is directed towards the elaboration of these total packages, the general tendency being to assume that if the hardware (machinery, equipment or process) has been developed, the appropriate technology will diffuse under its own steam. In all except a few cases, even this hardware is rarely worked out with the same turn-key, engineered, finesse as the technologies of the industrialised countries - in short, the hardware development is rarely thorough. Hut even when this is the case, successful technology diffusion depends on the elaboration of the software. It is this shortcoming that has proved to be one of the major obstacles to the dissemination of appropriate technologies, and until this inadequacy is overcome, the process is unlikely to gain much momentum.

The insufficient emphasis on the development of the software aspects of appropriate technologies is what may be termed an internal constraint on the successful diffusion of these technologies. In many circumstances, however, it is the external constraints which are of far greater significance. Of these external constraints, the most important one arises from the fact that the partisan vested interests of the elites (or powerful groups within elites) in the dual societies of developing countries are often inimical to the adoption and diffusion of appropriate technologies. In such an unfavourable environment, inadequacies in the software aspects of these technologies are only amplified, and used against them in decision-making.

The above discussion of the dissemination of appropriate technologies shows that, though this process must be coupled with that of technology development, there are crucial differences between the two processes. Unfortunately, a blurring of these differences takes place too often, and it is therefore necessary to make them explicit.

Firstly, the agents for the two processes are usually quite different - whereas R and II institutions (at the macro-, meso-, and micro-levels) are mainly responsible for technology generation, technology diffusion is usually the responsibility of a development agency, acting in coordination with the people, local self-government organs, R and D institutions, financial and credit institutions, and marketing organisations. Thus, technology generation can be achieved by the sole effort of R and II institutions, but technology diffusion must be a multi-institutional effort.

Secondly, the power structure need not necessarily be disturbed by the generation of technology, but it cannot but be affected by technology diffusion.

Thirdly, the levels of operation of the two processes are quite different - technology generation can be achieved at the institutional level; technology diffusion must be accomplished at the level of society (even a slum or a village is a mini-society),

Fourthly, and as a consequence of the above two differences the technology generation process is much more autonomous than the technology diffusion process, in that, given (a) funds for R and D; (b) sufficient awareness and commitment among those doing R and D; and (c) the absence of direct political hostility towards the R and D, the generation of technology appropriate for development can be accomplished successfully.

In contrast, technology diffusion cannot be achieved against the wishes of the ruling groups in society. And, where the technologies to be diffused are against the vested interests of the privileged - which, in dual societies, they often are, if they are indeed technologies appropriate for weaker sections - then the success of the diffusion depends on the particular balance of power between various groups in society 'The ruling group is rarely homogeneous, and if, within this group, some powerful sections, e.g., the urban elite, are not against the diffusion of appropriate technology for the rural poor, then the process stands a favourable chance. if, on the other hand, all the privileged sections are unitedly opposed to the technology, then the attempt to diffuse it is almost certain to fail; nevertheless the attempt must be made as an essential and integral component cf the struggle of the under-privileged and its allies for a more just and equitable society. Thus, a necessary condition for the successful diffusion of technologies appropriate for the urban and rural poor is a large measure of active political support from the rulers of society.

Finally, the role of the people in the two processes is quite different. Though close consultation with the people is vita.1 for obtaining better insights into felt needs, traditional solutions, local conditions, local materials and local skills, and though these insights are quite essential for ensuring the appropriateness of technology

(cf. Fig. 4), an R and D institution can in fact generate technology without the active participation of the people in the designs, calculations, experiments, fabrications, etc. In other words, appropriate (including socially acceptable) technology is unlikely to be generated by R and D institutions without close consultations with the people, but their active participation in the technology generation per se is not necessary. This is not to deny that widespread popular participation can raise the efficiency and appropriateness of technological innovation to a qualitatively higher level. Such popular participation should therefore be the objective, since an intimate interplay between institutional and popular innovators is an ideal state of affairs;

In contrast, the active participation and involvement of the people is a necessary condition for technology diffusion.

These distinctions between technology generation and diffusion, particularly between social consultation and single-institutional work for technology generation as distinct from social participation and multi-institutional work for technology diffusion, lead to some important perspectives and conclusions, with regard to the role and scope for appropriate technology institutions.

For instance, it is clear that institutions of education, science and technology can assume - and successfully discharge - the responsibility of generating technologies. If, however, these institutions also assume the responsibility for diffusion of technology, they must realise that:

(a) They will have to lead, coordinate and manage the concerted, action of a large number of institutions, viz., development agencies, local self-government organs, financial and credit institutions, marketing outlets, etc., and

(b) They are almost sure to deviate from their charters of education, science and technology.

Whether they are structured and competent to discharge this onerous responsibility is a moot question. In general, it would be unwise for educational, scientific and technological institutions to assume this responsibility for technology diffusion without being aware of all the implica-

tions and consequences. On the other hand, technology-generating institutions must be an essential part of the technology diffusion process - the vital need for their active participation in the process follows logically from the linkage between the technology generation and diffusion processes (cf. Figs.1 and 4).

In conclusion, therefore, micro-level institutions of education, science and technology can, and should, assume leadership in technology generation, but not in technology diffusion - they should only be members of the multi-institutional teams to diffuse technology.

This conclusion need not be valid in the case of macro- and meso-level institutions of science and technology, for example, national and sub-national councils or departments for science and technology, and institutions set up specifically for appropriate technology, Such institutions, by their very nature and responsibilities, are already removed from the laboratories, offices, drawing boards and workshops where actual R and D work takes place, and are, in fact, only promoting, catalysing and coordinating R and D work. Hence, macro- and meso-level institutions may be better equipped - compared to micro-level institutions - to lead the process of technology diffusion. But, for such leadership to be effective, it should be formally accepted by all the concerned institutions - development agencies, local self-government bodies, financial institutions, etc. Even in the absence of such a formal acceptance of the leadership of a macro- or meso-level institution of science and technology, the latter two types of institutions can still play a powerful catalytic role in the diffusion of technology. Between them, if size and complexity of organisation are in inverse measure of its speed and effectiveness, it may turn out that macro-level institutions are too ponderous and ineffective to play the catalytic role efficiently. Hence, the hope for successful technology diffusion lies in the hands of meso-level institutions, e.g., the sub-national councils for science and technology.

Of course, the strengths of appropriate technology institutions operating at various levels can be made to mutually reinforce each other ensuring that, on the one hand, the macro- and meso-level institutions sponsor

technology-generation projects in micro-level institutions, and on the other hand, the latter diffuse their technologies through the higher-level institutions. With this perspective, it follows that micro-level appropriate technology institutions can contribute to the dissemination of appropriate technologies by using the following mechanisms:

(a) Micro-diffusion in the specific region (slum, village, cluster of villages, etc.) to which they may be committed;

(b) Meso-diffusion by supplying appropriate technologies to meso-level institutions;

(c) Macro-diffusion through national, sub-regional and regional and international appropriate technology institutions;

(d) Long-term diffusion through education.4 programmes on the hardware and software aspects of appropriate technologies.

CRITERIA FOR ASSESSMENT OF GROUPS AND INSTITUTIONS

The above presentation of the factors determining the capability of institutions to generate and disseminate appropriate technologies serves as a basis for defining the criteria to be used in the assessment of these institutions.

The definition of criteria can be taker to various levels of detail, depending upon the ultimate purpose of the criteria. Since the purpose here is not to assess the capability of particular institutions, but to identify the general problem!: facing a large number of micro-, meso- and macro-level institutions in their task of generating and disseminating appropriate technologies it is obvious that the criteria must be neither too broad nor too detailed. Further, the extent of disaggregation of the criteria must be commensurate with the extent of information available about these institutions. The current lack of detailed information indicates that the criteria need only be disaggregated to an intermediate level.

Of course, there is considerable flexibility in this matter.

As the objective changes to an assessment of individual institutions, and as more information is acquired (e.g., through questionnaires and/or actual visits), the criteria can be made more detailed.

At the outset, three basic criteria regarding institutions can be formulated with the aid of the following questions:

(a) Is it the purpose of the institution to develop appropriate technologies, or to disseminate them, or both develop and disseminate them?

(b) Does the institution operate at the micro-, meso- or macro-level?

(c) Which basic needs - food, shelter, clothing, health, education, employment, energy - is the institution trying to satisfy with appropriate technologies?

If the objective of the institution is to develop appropriate technology, then further criteria must be listed to assess its capability with regard to this objective. These additional criteria must be generated from the three prerequisites for the development of appropriate technology viz.,

(a) the institutional filter must select the basic needs of the urban and rural poor and transform them into demands upon its research and development capability;

(b) the institution must absorb or generate new paradigms to guide its innovation chains towards the development of appropriate technologies; and

(c) the institution must develop a new type of technological competence and capability oriented towards satisfying the basic needs of the urban and rural poor.

With regard to the operation of the institutional filter, the criteria must be related to the institution's awareness of and commitment to the problems of the urban and rural poor. The importance of creating awareness leads to the following criteria:

Does the institution have mechanisms for making contact with the urban and rural poor?

Are these mechanisms of the direct or indirect variety?

Is the institution actually working in a slum/village/poor part of a. city/cluster of villages/district/province?

The commitment of the institution to appropriate technologies is revealed by criteria such as:

Is the avowed policy of the institution to emphasise the development of appropriate technologies?

What percentage of the institution's funding goes towards appropriate technologies?

Is the magnitude of funding, corresponding to this percentage, reasonably adequate for the technology development tasks it has undertaken?

Has the institution created incentives (material and/or non-material) so that those of its personnel working on appropriate technologies concentrate wholly on the task, and those who are not working on these technologies turn increasingly towards them?

The acquisition (by absorption from external sources and/or generation from internal sources) of guidelines for innovation conducive to the development of appropriate technologies depends very largely on:

(a) Understanding the felt needs of the urban and rural poor; and

(b) Defining, through in-depth studies, the economic, social and environmental constraints which the appropriate technology must satisfy.

These requirements correspond to criteria such as:

Does the institution possess in-house, the sociological expertise to define felt needs, or can it acquire this expertise by collaboration with outside institutions?

Does it have the combination of economic, sociological and environmental expertise to define the various constraints on technological solutions?

Does it make explicit the constraints guiding its innovations?

The criteria pertaining to technological capability are comparatively more straightforward and well-known. Nevertheless, it is worth stressing a few points regarding the level of technological competence and capability required for the generation of appropriate technology. These considerations arise from the fact that, invariably, appropriate technologies have been confused with "low" or "primitive" technologies. This confusion arises because, too often, the "advanced" character of a technology has unfortunately been judged either by the trivial criterion of "scale of production" or by the geographical origin of the technology (anything from the developed countries is ipso facto "high" or "advanced" technology), whereas in fact it should be determined by the extent of the scientific and engineering thinking that goes into research and development. An additional source of confusion is connected with the question of simplicity. For use by the urban and rural poor of developing countries, a technology (a product or a process) may have to be very simple, but this does not preclude the possibility of the R and D process (by which the product or process is arrived at) iron being ingenious and subtle. To quote the adage "any fool can make a solution complicated; it takes a genius to make it simple:"

It must be admitted here that many appropriate technology groups themselves have been responsible for initiating and perpetuating the belief that the technical capability required for the generation of appropriate technologies is of a lower order than that for western technology. (It matters little whether this is due to inadequate understanding or to a deliberate attempt to bypass the established institutions of education, science and technology in the developing countries.) The net result has been a widespread belief that appropriate technology is "second class" and not modern.

It is clear, however, from Figs.2 and 3, and from the discussion of the filter and guidelines appropriate for development., that the only difference between western technology and appropriate technology is the difference in the wants transmitted by the filter and in the set of preferences or paradigms guiding the innovation chain. Otherwise, appropriate technology needs the same rigour

and thoroughness and must be developed from as sound a base of fundamental science and basic engineering as is required for western technology. In fact, most appropriate technology may need a much stronger foundation in fundamentals because, after rejecting the technological paths well-trodden by the developed countries, there is often no choice other than going back to firm first principles.

The importance of this viewpoint must be seen in the context of hopefully well-meaning, but dangerous, advice that developing countries should not invest in basic research.[16] If such advice is acted upon, the result would be highly detrimental to the development of alternative technologies.

Hence a basic condition for the generation of appropriate technologies is that educational, scientific and technological institutions accept that appropriate technology is as modern and advanced and sophisticated as western technology.

In the light of these comments, the criteria related to technological capability are as follows:

> Does the institution have an adequate infrastructure (laboratories, equipment, workshops, pilot-plant/test facilities etc.) for carrying out the research and development work necessary for the generation of the hardware and software aspects of technology?
>
> Does it have technical manpower with adequate training, expertise and experience?
>
> Does it have the requisite information base to avoid unnecessary "reinventing the wheel"?

Even if the overwhelming emphasis of an institution is on the generation of appropriate technologies, it is almost certain tc have some intentions of disseminating its success. If so, there is a further criterion:

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[16] Even though the share of basic research in the R and D budget of most courtries is rarely more than 5-10%.

Does the institution have any links with technology disseminating institutions?

Turning now to institutions whose primary thrust is the dissemination of appropriate technology, several criteria can be listed, such as:

Does the institution interact with the prospective beneficiaries in the definition of felt needs?

Does the institution know, or have access to, a sufficiently wide range of technological options?

Does it expose these options to the beneficiaries so that attempts to meet perceived needs will result in the satisfaction of the felt needs?

Is the institution part of a multi-institutional technology dissemination team?

Does the team include, or have ready access to:

(a) a development agency?
(b) technological expertise?
(c) management expertise?
(d) financial and credit institutions?
(e) input procurement and product off-take organisations?
(f) a beneficiary organisation?

In the technologies that the institution is disseminating, does it work out total hardware-software packages, or does it ensure that the team has worked out these packages?

In the case of institutions committed to the generation-cum-dissemination of appropriate technologies, it is also necessary to ask at what level - micro-,meso or macro-level - is the institution participating in technology dissemination? Is it interacting with institutions which are structured to achieve this dissemination?

The criteria proposed above can be used for the assessment of the capability of national groups and institutions to develop and/or disseminate appropriate technologies. However, they apply equally well to three other categories of groups/institutions, viz., (a) regional/international institutions such as the International Rice Research Institute

(b) groups in the developed countries such as the Intermediate Technology Development Croup seeking to generate and diffuse appropriate technology for the developing countries, and (c) groups/institutions in the developing countries which run on the basis of expatriates and foreign inputs. The question, therefore, arises as to whether these three categories of groups/ institutions are related to the national capability of developing countries.

A regional/international institution can either strengthen national capability or weaken it depending upon whether it works through and/or with national institutions, or in competition with them. Very often, the vastly higher salaries and the much better facilities in regional/ international institutions have the effect of undermining the morale and confidence of national institutions, particularly because the latter tend to lose some of their best men to the former. Thus, a regional/international institution is clearly not a part of national capability. even of the country in which it is located.

The groups in the developed countries which seek to promote appropriate technology in the developing countries have done a great deal to spread the concept of appropriate technology. However, many of these groups are funded by the aid/foreign ministries/departments of the countries in which they are located, and this fact has sometimes created suspicions in the developing countries regarding their intentions. These suspicions - irrespective of whether they are justified or not - often result in appropriate technology being viewed as a motivated recommendation from the developed countries and not as an obvious conclusion from the predicament and circumstances of developing countries. This view tends to be aggravated by four tendencies of these foreign appropriate technology organisations:

(a) they work very largely through personnel from developed countries who are paid much higher salaries than their local counterparts;

(b) they invariably bypass established institutions of education, science, and technology in the developing countries and work with volunteer and non-governmental groups even though the latter

often have less technical competence than the former;

(c) with a few exceptions, the foreign appropriate technology organisations have not built up local information centres - in effect, they have retained control over appropriate technology information;

(d) there are very few examples of these foreign organisations initiating national efforts in appropriate technology and then withdrawing so that these efforts can grow in a self-reliant fashion.

Hence, effort by appropriate technology organisations in the developed countries must be viewed as international action which is not part of national capability and must be judged by the same criterion as other international efforts, i.e., do they strengthen national capability?

Finally, there is the question of groups and institutions which are located in the developing countries but which have a large component of expatriates and foreign inputs. Except in the few rare cases where these groups/institutions are completely manned by expatriates and foreigners, these groups must initially be considered part of the national capability. It is important, of course, to determine at an appropriate stage whether the expatriates are making themselves redundant by generating native ability or whether they are perpetuating their dominant position, and whether the activity survives and grows after the expatriates withdraw.

ASSESSMENT OF GROUPS AND INSTITUTIONS

The above criteria permit an assessment of the capability of groups and institutions to develop and/or disseminate appropriate technologies.

As a first step in this direction, a questionnaire (see Appendix) was addressed to about 180 appropriate technology organisations located in the developing

countries.[17] The list included voluntary non-governmental groups as well as established institutions. Of the approximately 75 responses (i.e., about 40%) which have been received, a detailed analysis[18] has been made of 51. Of this sample, 27 (53%) originated from Asia, 14 (33.3%) from Africa, and 9 (16.7%) from Latin America. Based upon these responses, and the impressions of a large number of institutions/groups mentioned in the appropriate technology directories, a number of tentative assessments are outlined below.

The large number of groups and institutions which have come up in the developing countries - most of them spontaneously - to develop and disseminate appropriate technology indicates the great deal of active interest in the concept. The formation of appropriate technology groups (e.g., DTC, TCC, ASTRA) within the framework of established institutions provides strong confirmation of a growing trend towards a new pattern of technologies.

The groups/institutions which have been analysed include all the categories: those that concentrate exclusively on developing appropriate technology (13%), those that disseminate it (11%), and those that are involved in development-cum-dissemination (76%). The fact that the last-mentioned category is predominant implies the widespread awareness of the importance of integrating the two processes of technology development and dissemination,

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[17] The author also visited a few institutions, namely. Technology Resource Centre, Manila; Institute of Small-Scale Industries, Manila; International Rice Research Institute, Los Baños; Asian Institute of Technology, Bangkok; Korean Institute of Science and Technology, Seoul: Technology Development Centre, Bandung; and the TOOL Foundation. Amsterdam.

[18] The author wishes to express his gratitude to Miss Lakshmi Reddy who rendered invaluable help with the coding and tabulation of the responses.

3. Similarly, all levels of operation - local (1 %), sub-national (22%), national (32% and regional/international (5%) - are shown by the institutions in the sample. In many countries, however, it appears that appropriate technology organisations do not operate at the national macro-level, and consequently, the widespread dissemination of appropriate technologies may perhaps be inhibited. It is in this context that the proposed national centres, to be established with the assistance of the regional centres, have a crucial role to play.

4. It has emerged clearly that the term 'appropriate technology" has different meanings to different institutions and groups. To almost half the analysed sample, it means appropriate to the area in which the group or institution works; to about 10%, it means appropriate to the sector (e.g., industry) with which the group or institution is concerned; and only to about 40%, does it mean appropriate to the poorest sections of society. (Of this latter category, 80% are concerned with the rural poor and only 20% with the urban poor.) Not too often does the definition of appropriate technology include an emphasis on basic needs, starting from the needs of the neediest.

5. Further, the concept of appropriate technology is generally restricted to production practices; it rarely extends to the appropriateness of products. Once again. this is because of the lack of a basic-needs emphasis.

6. The sectoral emphasis of tho appropriate technology institutions is as follow: industry - 38% (and within this category 70% concentrate on agro-processing industries); agriculture - 30%; health - 11%; education - 8%; transport, housing, etc. - 13%. Thus, agriculture and agro-based industries account for almost 70% of the activities of these institutions.

7. The activities of the institutions which have been surveyed seem to span the entire range of basic needs with 27% of their efforts being devoted to food, 11% to shelter. 5% to clothing, 8% to health, 10% to education, 21% to employment and 18% to energy.

However. there seems to be a comparatively large emphasis on alternative energy sources and devices, particularly windmills. Appropriate energy technologies are of course vital, and if this emphasis has been derived from a scrutiny of the felt needs of the urban and rural poor, then it is quite justified. Unfortunately. it is difficult to avoid the suspicion that the emphasis is a carry-over from the interests of appropriate technology groups in the developed countries, and a result of the presence of a large number of expatriates working on appropriate technology in the developing countries.

8. Only about half the groups and institutions have direct contact with the main target groups. Almost 80% of them have directed their activities towards the rural poor, in contrast, the urban poor are the oonoern of 20% of the groups/institutions. A mere 2% are doing field work in slums, in comparison with 64% in villages, and 34% in districts and provinces.

It seems ttat most small groups (many of which are voluntary and manned by expatriates) are in direct contact with the urban and rural poor - hence, the strength of these groups in technology dissemination. In contrast, very few of the larger establishments of education, science and technology have this vital contact, for example, in the form of field rtations or extension oentres - this shortcoming is responsible for the relatively poorer performance of these institutions at technology dissemination. It is noteworthy, however, that this shortcoming is being realised and that some of the most important institutional groups like DTC in Bandung are already operating field stations.

9. Even vhen large institutions of education, science and technology have declared interests in appropriate technology,[19] it appears that only a small percentage

[19] Of the groups/institutions which have been analysed, about 12% (which is not insignificant) have emphasised that appropriate technology is not the policy of their parent organisat ions .

of their funding (less than 5-10%) goes towards this objective.

10. When established institutions of education, science and technology in the developing countries turn, even partly, towards appropriate technology, they are able, even with a short gestation time of 2-3 years to make significant contributions to technology development (cf., DTC, TCC, ASTRA). This only confirms the view that there is an immense potential and capability for appropriate technology generation in the established institutions of developing countries.

11. On the average, a group/institution in the sample has completed 4 technology development projects, and is currently working on 11 such projects with a manpower complement of 13 technical personnel including 3 Ph.Ds. An average budget can be a highly misleading figure because a number of groups are working with $5000-10,000 per year, and others are running million-dollar operations. However, an indication of the order of magnitude is provided by the average figure of $230,000 per year per group/institution which was noted from 29 Asian and African groups. It seems that, for technology development, the manpower and funding seems to be totally inadequate in relation to the vast spectrum of technologies which need to be developed and the enormous magnitude of the tasks. In fact, 53% of the groups/institutions analysed stated that their funds were inadequate.

12. With regard to inoentives for work on appropriate technology, there is a vast difference between voluntary organisations on the one hand, and the established institutions of education, science and technology on the other. Whereas the former are able to attract manpower with extraordinary commitment, most of the latter have necessarily to deal with personnel the majority of whom have come into the institutions without a significant commitment to appropriate technology. Further, the incentive systems (the system of professional rewards and recognition, the criteria of excellence, etc.) in these established institutions usually operate away

from appropriate technology.

13. A significant 43% of the groups/institutions do not have in-house social scientists, and a quarter of these institutions do not have social science expertise available even through collaboration. Of the 57% of groups/institutions which do have social scientists, 87% of these are economists, 73% sociologists, 27% anthropologists and 17% political scientists.

Thus, very few of the institutions and organisations dealing with the development of appropriate technology have the sociological expertise (either in-house or available through collaboration) to define the felt needs of the target groups, e.g., the urban and rural poor. Even when there is an appreciation of the difference between felt and perceived needs, the identification of the felt needs is invariably done by scientists and technologists working as amateur sociologists.

14. A significant 26% of the groups/institutions admitted that they do not have the economic and sociological expertise to define the constraints which must be satisfied by a technical solution. There is little need for such expertise in dealing with western technology, because the constraints invariably percolate to the R and D laboratories and the technologists in them through market forces, but in the case of appropriate technologies, the prospective beneficiaries cannot articulate their demands through the market, and therefore there is no alternative to including the definition of these non-technical constraints as an integral part of the innovation process. In fact, the innovation process - its first step being the formulation of the R and D objective - cannot even commence until the constraints are specified.

15. Perhaps because of the situation described in items 13. and 14. above, most appropriate technology institutions do not make explicit the precise economic, social and environmental constraints they seek to satisfy in their innovations.

16. A large percentage (40%) of the groups/institutions stated that they do not have in-house laboratories and workshops. Whereas almost 50% claimed to have testing facilities, only about 30% possess pilot-plant facilities. Further, only 19% stated that their R and D infrastructure was adequate.

With regard to the infrastructure (laboratories, equipment, workshops. pilot plant/test facilities, etc.) necessary for technology generation, there is usually a vast difference between the small, often voluntary, organisations and the large established institutions of education, science and technology. The former usually struggle along with totally inadequate infrastructures; whereas the latter, in most developing countries, are sufficiently equipped for the task of generating appropriate technologies (however ill-equipped they may be for competing with western science and technology.)

17. The same disparity usually exists with regard to the training, expertise and experience of the technical manpower deployed on the tasks - as a rule, the best manpower of a developing country goes to its established institutions. This assessment must, however, be qualified in two ways. Firstly, the influx of expatriates into the generation of appropriate technology in developing countries is often associated with an influx of technical competence. Secondly, appropriate technology attracts a number of DIY (do-it-yourself) inventors, and in some situations, such practical men are more useful than the qualified experts whose theory-oriented training and status-consciousness (characteristic of dual societies) renders them unfit for down-to-earth tasks.

18. The question of information back-up is crucial to the whole task of developing appropriate technologies Hence the responses of the sampled institutions on questions related to information are important. 14% of the groups/institutions stated that they do not have a library to support their appropriate technology generation.. Further, 72% of those with libraries felt that these facilities were inadequate. Almost 80% of these

groups/institutions felt a need for journals, 66% for photocopies of particular papers, 62% for books, 47% for experts, and 40% for relevant bibliographies. These needs are emphasised by the fact that 96% of the groups/institutions stated that they sought to expand their expertise through the medium of written material and 86% through correspondence.

It seems therefore that most non-institutional groups and even many institutional groups are handicapped by a tremendous lack of necessary technical information on appropriate technologies. Even when such information is available, it is so poorly organised that it is invariably irretrievable. The net result is that acquisition of information is very much a random affair - the result of the grapevine, hearsay and chance contracts. This state of affairs is only aggravated by the fact that the available information systems are predominantly biased towards western technologies. and are located in the developed countries.

19. Appropriate technology information is not only embodied in literature, it also resides in resource-persons. It is no surprise, therefore, that 86% of the groups seek information through visits to persons working in the field, and 55% used visiting experts as a source of expertise.

20. In the case of technology dissemination, about 35% of the groups/institutions which were studied are concerned with the local level and have personnel living in villages. The remaining 65% are involved with national and sub-national operations.

21. With regard to exposing technological options to beneficiaries so that their perceived needs become realistic and feasible, about 25% of the groups/institutions always adopt the procedure of demonstrating options, and 50% follow this approach sometimes. But, 25% of the groups/institutions do not expose the various options. Thus, it seems that many groups and institutions get "hung up" on a few "pet" solutions, without exploring the full

gamut of possibilities. This is particularly the case with institutions which are also generating technologies, for they tend to become attached to, and developed "vested interests" in, the solutions which they themselves have generated.

22. About 75% of the groups/institutions lead the technology dissemination process, and three-quarters of those which do not assume this leadership, form part of multi-institutional teams. In doing the latter, 70% of the groups work with development agencies, 61% with beneficiary organisations, 48% with training organisations, 39% with industry, 32% with credit organisations, 23% with management organisations, and 18% with raw material procurement and marketing organisations.

23. About 90% of the groups/institutions devoted attention to training of personnel, 74% to raw materials procurement, 71% to organisational procedures, 63% to financial procedures, and about 50% to marketing. Thus, less attention is directed to all software aspects of technology dissemination than to the hardware aspects (equipment, process, etc.)

The preliminary assessment which has been made above of the appropriate technology efforts of groups and institutions in developing countries has revealed that there is national capability in the developing countries for the generation and diffusion of appropriate technology, but this capability is in the incipient stages of growth. besides, it suffers from a number of critical shortcomings and limitations which need to be overcome.

1 Even though a large number of institutions of education, science and technology have been established in the developing countries, the vast majority of them do not participate in the task of developing and disseminating appropriate technologies for the urban and rural poor. This non-involvement of established institutions in appropriate technology represents a mis-orientation of a valuable infrastructure which, if harnessed for appropriate technology activities, could make contributions of orders of magnitude greater than those currently being made towards these ends.

2. There are many factors responsible for this non-involvement of established institutions, including their preoccupation with the thrust of the technologies of the developed countries. But, one crucial factor is the absence of national technology policies which favour the development and dissemination of appropriate technology.

3. The appropriate technology effort, as judged by the number of projects, the ertent of funding, the development of manpower, etc., is quite inadequate compared to the enormous magnitude of the task, as indicated by the vast possibilities of appropriate technology and by the growing size of the population. This inadequacy extends over several aspects of the generation and diffusion of appropriate technology.

4. In the research, 8s distinct from the development, phase of the generation of technology, there are critical lacunae in the research infrastructures (laboratories, equipment, trained personnel, etc.) of groups which do undertake research, and in the linkages with research institutions of those groups which are not involved in research.

5. In the development, as distinct from the research phase of the generation of technology, there are limitations in the activities necessary to prepare the delivery of the technology on a turn-key basis. These limitations arise not only in pilot-plant trials, production engineering, etc., but also in the elaboration of all the software necessary for the technology to work, viz., raw materials procurement, organisational and financial procedures, credit, product marketing, training of personnel, etc. In other words, there is inadequate emphasis on total hardware-software packages for each technology.

6. The intrinsic appropriateness of generated technologies is partly limited by the absence of sufficient emphasis on 8 basicneeds approach to the concept of appropriate tech-nology.

7. It is also limited by the absence of sufficient inputs from the social sciences in the identification of felt needs, of various (economic and social) constraints on technical solutions, etc.

8. Yet another limitation arises from the inadequacy of direct contacts with the prospective beneficiaries.

9. The effectiveness of technology generation efforts is also handicapped by the information back-up required by appropriate technology groups and institutions.

In this matter of information, there are shortcomings not only in the organisation of the storage and retrieval of information, but also in its acquisition and dissemination. The acquisition problem is accentuated by one or more factors including its scarcity, cost and location (most appropriate technology information is situated in the developed countries). The dissemination problem is aggravated by the non-availability of reprographic facilities.

10. A crucial aspect of information flow is via people, and the difficulties of visiting active centres of appropriate technology, and of funding of the visits of experts and resource persons, constitute an important limitation of groups and institutions.

11. Such an exchange of personnel is particularly important for the dissemination of appropriate technology where the direct transfer of skills from experts to novices is often far more effective than the indirect transfer via documents. Unfortunately, finances for the funding of such exchanges of personnel, particularly between developing countries, is generally lacking.

12. Also lacking are field stations and extension centres and the corps of field and extension workers necessary to make such stations and centres effective.

13. The success of appropriate technology dissemination efforts depends to 8 large extent on the parallel functioning of such efforts at national (macro), state/province (meso) and local (micro) levels. The aim is to achieve 8 mutual reinforcing of efforts, the higher levels providing 8 favourable climate for the operation of the lower levels and the experience of the lower levels enlightening the perspective of the higher levels. A major shortcoming of current appropriate technology activities is the absence Of appropriate technology groups and institutions at all levels-local, sub-national and national-or when Such

groups/institutions exist, poor coordination of their efforts.

14. There also seems to be an imbalance in the coordination of appropriate technology efforts devoted to basic needs. In particular, there seems to be insufficient concentration on appropriate technologies specifically directed towards employment generation.

15. Finally, the linkage between the two sections of the appropriate technology movement, i.e., the established institutions of educetion, science and technology on the one hand, and the voluntary groups/non-governmental organisations on the other, is too weak even though their relative strong points are complementary.

CONCLUSIONS

The above discussion of the shortcomings and limitations of groups and institutions currently engaged in appropriate technology and potentially capable of contributing tc such work leads to the following questions:

(8) Is there a need for international/global action in the growth of national capability in appropriate technology?

(b) If so, what is the role for international/global action?

(c) What are the general and specific recommendations for such action?

The answer to the first question- hinges upon an assessment of whether every developing country can spontaneously, and on its own, grow its national capability in appropriate technology. The present situation is that there are 8 few developing countries which have the scientific and technological infrastructures "to go it alone". Even in the case of these countries, it is fairly clear that they have much to gain by interaction with similar efforts in other countries. Host countries, hovever, would be benefitted greatly if their endogenous efforts are supplemented by external assistance and inputs. Bilateral and multilateral relations can provide the required external

assistance and inputs. but these relations are very often bedevilled by problems of mutual suspicion, of maintaining equality and of differences on issues other than the common objective of appropriate technology. I" contrast, international/global action usually ed favourably by most countries. Thus, need for rnat ional/global action in building national capability in appropriate technology is based on two factors:

(a) national efforts tan be enhanced with external help;

(b) the most favourably viewed form of external help is from international/global sources.

The role for international/global action must be derived from the short-comings and limitations of groups and institutions currently engaged ir appropriate technology and potentially capable of contributing to such work. The basic guideline for elaborating this role is that international/global action should concentrate on helping national groups and institutions to overcome their shortcomings and limitations. In other words. the role of international/global action should be primarily supportive and catalytic. In playing this role, it should help the activities of groups and institutions currently engaged in appropriate technology vork, as vell as stimulate efforts by groups and institutions which are not presently involved but which have the potential for making major contributions.

Thus, international/global action should initiate policies, programmes and projects to strengthen current efforts in developing countries directed towards the development and dissemination of appropriate technologies, and generate new and additional efforts directed towards this same objective. These policies, programmes and projects should include Several specific components which are discussed below:

1. Continuous efforts must bs devoted to clarification of the conceptual framework of appropriate technology, particularly the introduction and propagation of a basic needs interpretation of the concept.

2. Special policies, programmes and projects must be designed to catalyse the commitment of the established institutions of education, science and technology (i.e.,

institutes of science and technology, universities, polytechnics, colleges, etc.) to the development and dissemination of appropriate technology. The success of this catalytic effort will depend, inter alia, upon the creation of national and international climates which are favourable to appropriate technology, as well as upon funding specifically directed towards appropriate technologies.

3. Substantial funding must be made available for current and new appropriate technology efforts so that the magnitude of the effort (number of projects, deployment of manpower, etc.) is commensurate with the enormous task.

4. The highest priority for the development and dissemination of appropriate technologies which are specifically directed towards employment generation in rural areas (because that is where the largest numbers of unemployed and underemployed are) and in relation to the agricultural sector (because that is the sector with which the bulk of the rural population is associated). It follows that employment-generation efforts must concentrate on:

(a) water management including water harvesting, storage, lifting and irrigation to increase the number of harvests per year and the yields per harvest;

(b) agro-processing industries to ensure that as much processing of agricultural products, by-products and residues takes place at or near the sites of agricultural production;

(c) decentralised energy production (preferably based on renewable energy sources) to power those agricultural and agro-processing operations for which the use of inanimate energy is appropriate.

5. In the funding of particular programmes and projects, the emphasis must be on support for field workers, extension workers, field stations, extension centres, pilot-plant facilities, exchanges of personnel and experts between groups, pilot projects; R and D back-up, etc.

6. Support must be extended for the working out of complete hardware-software packages for each technology.

7. An appropriate technology information system must be

worked out as rapidly as possible for the acquisition, storage, retrieval and dissemination of information on appropriate technologies. This system must not be centralized in the developed countries. Instead, it must be based on a network approach involving linkages between national, sub-national and local information centres in the developing countries, and must be accessible to all groups and institutions working in the field.

8. Provision must be made for increasing contributions from social scientists (of various disciplines including social anthropology) to the generation and diffusion of appropriate technologies.

5. The establishment, if necessary. in each developing country of appropriate technology groups and institutions at the national, sub-national and local levels, must be facilitated, and the coordination of the efforts at these various levels must be promoted.

10. The Regional Centres for Technology Transfer must be stimulated to make appropriate technology their main focus.

11. The accent must be placed on appropriate technology in the new emphasis on Technical Cooperation among Developing Countries.

APPENDIX

Questionnaire

(Strike out where inapplicable and put a ☑ mark in appropriate bores)

1. Name of Institution/Croup within institution:

   Year of formation: 19

   Name of Director/Convener:

   pull sailing/postal address:

2. Name organisation(s)/agency or agencies/institution(s) which sponsored your institution/group within institution?

3. What is your area of operation? National ☐, sub-national ☐, local ☐

4. What is the main thrust of your activities?
   Technology Development ☐, Technology Dissemination ☐, Technology Development and Dissemination ☐

5. According to your understanding, does appropriate technology mean:
appropriate for the needs of the area In which you are working ☐?
appropriate for a particular sector of the economy ☐?
Industry ☐, Agriculture ☐, Services ☐?
appropriate for the poorest sections of society ☐?
Urban poor ☐, Rural poor ☐?

Questions pertaining to Technology Development

6. For which sector are you developing appropriate technologies - Industry ☐, and in particular Electronics ☐, Metallurgical ☐, Agro-based ☐ Consumer Goods ☐; Agriculture ☐; Health ☐, Education ☐, Transport ☐; Other ☐
(Please name)

7. For which basic needs do you consider your technologies appropriate: Food ☐, Shelter ☐, Clothing ☐, Health ☐, Education ☐, Employment ☐, Energy ☐

8. Does your group/institution have direct/indirect contact with the urban poor/rural poor?

9. Are you doing field work in: a slum ☐, slums ☐, a village ☐, villages ☐, district ☐, province ☐?

10. Is appropriate technology a policy of the institution to which you are attached? Yes ☐ No ☐

11. How many appropriate technology development projects have you completed? ☐
are you currently working on? ☐ (please insert number)

12. If the list of these projects is given in a report, please send report; otherwise please list titles.

13. What is the annual budget for all these current projects (only approximate figures need be given)?

14. What percentage of your institution's total annual budget is set apart for appropriate technology projects? ☐ (please insert number)

15. Do you consider your funds for appropriate technology projects adequate? Yes ☐ No ☐

16. Does your institution provide special incentives for those working on appropriate technology projects, for example, by way of higher salaries ☐, faster promotions ☐, greater R and D funds ☐, greater prestige ☐? (Please mention any other incentive scheme)

17. Does your group/institution include social scientists?
Economists ☐, Sociologists ☐,
Anthropologists ☐, Political Scientists ☐

18. Do you collaborate with social scientists from other institutions? Yes ☐ No ☐

19. Do you have social science expertise to define the economic, social and political constraints which your appropriate technologies must satisfy?
Yes ☐ No ☐

20. Do you make these constraints explicit?
Yes ☐ No ☐

21. Do you have in-house laboratories ☐,
Equipment ☐, Workshops ☐,
Do you consider these facilities adequate?
Yes ☐ No 0
Pilot-plant facilities ☐, test facilities ☐
If not, do you sponsor work? Yes ☐ No ☐
If you sponsor work in other institutions, how many projects have you sponsored ☐? are you currently sponsoring ☐?

22. Do the institutions in which you sponsor R and D have adequate facilities? Yes ☐ No ☐

23. How many research scientists and engineers are involved in your appropriate technology development?
In-house ☐? Sponsored Projects ☐
(Please insert number)

Of these, how many Ph.Ds ? ☐ (Please insert number)

24. Do you have a library for your appropriate technology development work? Yes ☐ No ☐
Do you consider it adequate? Yes ☐ No ☐
If not. what do you need? Books ☐, Journals ☐,
Access to experts ☐, Bibliographies ☐,
Photo-ccpies of particular papers ☐

25. Even though your main thrust is technology development, do you have links with technology disseminating institutions? Yes ☐ No ☐
If so, are these links with industry ☐, government development agencies ☐, non-government development organisations ☐, farmers ☐? If links are with other types of institutions not in the list, please list.

Questions pertaining to Technology Dissemination

26. How many technology dissemination projects have you completed ☐? are you currently working on ☐?
(Please insert numbers)

27. If the list of these projects is given in a report please send report; otherwise, please list titles.

28. What is your annual budget for your technology dissemination projects (only approximate figures need be given)?

79. If your primary objective is technology dissemination, do you hare linkage(s) with technology development institution(s)? Yes ☐ No ☐.
If yes. please name institution(s)

If not, what is the source of the technologies which you disseminate - expertise gained by your staff before joining you ☐, literature ☐, visits to technology development institutions ☐, correspondence ☐, visiting consultants/experts ☐

30. Do you attemp dissemination at the national ☐, sub-national ☐ or local ☐ levels?

31. Who are the beneficiaries of your disseminated technologies? Industry ☐, government ☐, non-government organisations ☐, urban poor ☐, rural poor ☐

32. Do you interact directly with the beneficiaries before identifying their felt needs? Yes ☐ No ☐

33. Do you expose the beneficiaries to more than one technological option before disseminating a particular option? Always ☐, sometimes ☐, so far not ☐

34. How many personnel from your institution/group within

Chapter 4
ACTIVITIES OF THE UN SYSTEM ON APPROPRIATE TECHNOLOGY

W.M. Floor[1]

INTRODUCTION

A great variety of activities in the field of science and technology are being undertaken within the UN system. There are few subjects which are not covered by these activities. This work is done by all agencies at different levels throughout the world, ranging from preliminary studies to actual surveys and the setting up of institutes for R and D, as well as the actual execution of projects with a common component of science and technology.[2]

A large number of collaboration agreements exist between UN agencies with regard to problems of common concern, including reciprocal representation at meetings and the reciprocal right to propose items for the agenda of meetings. Still coordination in the field of science and technology within the UN system is badly needed. Apart from the management problems caused by the existence of hundreds of completely different activities, there is the question of the autonomy and technical competence of the UN agencies.

The problem of autonomous development of activities within

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[1] Member, Policy Planning Section for Development Cooperation, Ministry of Foreign Affairs, Netherlands.

[2] See for example. United Nations Economic and Social Council, Institutional Arrangements for Science and Technology in the UN system, E/C.8/29. ADD.I, 3 October 1975.

the various agencies with the resulting danger of overlapping, duplication, and unco-ordinated work is compounded by the different conetitutiono and membership of the agencies. An illustrative example is that of the ILO which is empowered to engage in a wide range of social and economic activities. Here overlapping occurs with agencies such as FAC (rural development), UNESCO (training/education), UNIDO (small-scale industries), WHO (workers' health standards), and UNEP (housing). The same can be observed with regard to the other agencies.

The fragmentation of science and technology activities is further accentuated by the lack of coordination at the regional and national levels. Such an unsystematic arrangement for assessing science and technology activities is illustrated by the different positions taken by different representatives of the same country in the various agencies.

No overall CR policy with regard to science and technology yet exists. Furthermore, appropriate technology has only recently received attention as a field of operation in its own right. It is therefore not surprising that the UN system lacks a suitable mechanism for ensuring a comprehensive perspective and focus for action on appropriate technology.

At present practically all R and D work takes place in the advanced countries. And R and D in the field of appropriate technology is only a small fraction in comparison. Under these circumstances, hardly any sizeable impact of UN activities under status quo can be expected. However, a unified system-wise science and technology policy, accompanied by mutually complementary inter-agency programmes, could lead to some significant results at least in a selected number of priority areas.

We start by examining the existing mechanisms which are intended to play a coordinating role within the UN system. We then review the on-going activities of the different UN organisatione which are engaged in appropriate technology. Better coordination possibilities through joint planning of programmes relating to appropriate technology are also discussed. The concluding section makes some recommendations for improving the performance of existing UN mechanisms. In particular, it examines the role of UNDP in stimulating coordinated action at the country level.

SOME EXISTING COORDINATING MECHANISMS

Advisory Committee on the Application of Science and Technology to Development (ACAST)

ACAST, being an advisory body, could be considered instrumental in coordinating UN activities in the field of science and technology. Created in 1963 following the United Nations Conference on the Application of Science and Technology for the Benefit of the Lees Developed Areas, its major piece of work, the World Plan of Action (WPA) of 1971, only received a lukewarm welcome. Apart from the list of R and D priorities and the special attention given to appropriate industrial technology and product and plant design. the WPA recommended the establishment of a fund, as part of the resources to be made available to UNDP. The fund was never established.

In response to General Assembly resolution 3168 (XXVIII). and to Economic and Social Council (ECOSOC) resolution 1826 (LV) of August 1973, ACAST set up an Ad-Hoc Working Group on Policy for Science and Technology, within the United Nations system. Over the past few years the Group submitted various reports, most recently to the 24th Session of ACAST in August 1978. This report3 does not refer to appropriate technology. It concentrates on the constraints in harmonising policies, on alternative approaches to harmonisation, on existing structures for coordination and on the restructuring exercise for the Economic and Social Sectors of the UN system. It concludes with a number of alternative suggestions to improve institutional arrangements in the field of science and technology. The Advisory Committee felt that the idea of a ... Programme should be emphasised without necessarily ... g this alternative to

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'Advisory Committee on the Application of Science and Technology to Development8 Report of the Ad-Hoc Working Group on Policy for Science and Technology within the U.N. System, E/AC.52/XXIV/CRP.2, 23 June 1978.

the creation of a special fund for science and technology activities. The fate of this report and the very exercise of formulating an overall science and technology policy for the UN system, at this period in time has become doubtful both in view of the current UN restructuring process and the preparations for the UN Conference on Science and Technology for Development (UNCSTD) which is to take place in August 1979.

ACAST, as requested by the Committee on Science and Technology for Development (CSTD), will submit this report to the third session of the Preparatory Committee for the Conference and also to all national focal points for the UNCSTD, and regional commissions for their information. ACAST's role has been important in promoting appropriate technology. ACAST was among the first UN bodies to put it on the policy makers desk by giving it some prominence in the WPA. Later, ACAST advised the Second General Conference of UNIDO (Lima, 1975) to do something about appropriate technology.

More recently ACAST established an Ad-Hoc Working Group on Appropriate Technology to review the work being done by the various UN agencies and consider new developments and discuss possible contributions to the UNCSTD. In view of the importance of the subject, however, one may well ask whether such a temporary arrangement is sufficient.

At its 24th Session (August 1978) it was recommended that ACAET prepare a paper on appropriate technology for policy makers to be presented at UNCSTD and other related symposia to be held in early 1979. The paper should clarify concepts and definitions of appropriate technology, present the state of the art, review the work of the different UN agencies and, to the extent possible, other activities outside the UN system. Although ACAST is an independent and objective body, it was agreed that the UN Office for Science and Technology, in cooperation with interested organisations of the UN system should prepare a first draft of the paper in consultation with the Chairman of the Working Croup.

Committee on Science and Technology for Development (CSTD)

Apart from ACAST the UN has two organs which play an executive role in the field of science and technology within

the UN system. In 1971 the Economic and Social Council (ECOSOC) decided to establish the Committee on Science and Technology for Development (CSTD) "to eliminate any existing institutional gaps among the bodies and organisations of the UN system dealing with specific science and technology problems".[4] Moreover, the CSTD was to provide policy guidance and assist the ECOSOC in coordinating the activities within the UN system in the field of science and technology with a view to ensuring the utmost efficiency and cooperation and avoiding duplication.

The CSTD activities until now fall rather short of expectations. It has not made any proposals for the improvement of coordination within the UN system. With regard to the institutional arrangements for science and technology, the CSTD did not even discuss this item during Its third and fourth sessions although the subject (and a position paper) was on its agenda. This unfortunate development is explained by several factors beyond the control of the CSTD itself. CSTD is a political body set up to provide guidelines to the UN science and technology activities. However, it has no subsidiary body to supply an analytical framework to assess and evaluate the manifold UN science end technology activities. The Office of Science and Technology, which acts as the secretariat of CSTD, has limited staff although its workload has increased; it serves not only CSTD but also ACAST and ACC Sub-Committee on Science and Technology. It is no surprise then that CSTD has become a deliberative organ dealing mainly with procedural, administrative, and budgetary problems, instead of being the most important political and executive UN organ in the field of science and technology.

ACC Sub-Committee on Science and Technology

The Administrative Committee for %-ordination (ACC) Sub-Committee on Science and Technology is another UN organ with a consultative task at the inter-agency level. Most

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[4] ECOSOC Resolution 1621 (LI) of 30 July 1971, "Organisation of the Work of the Council; Part B: Institutional Arrangements for Science and Technology".

collaboration agreements pertaining to more than two agencies are concluded within the ACC and its subsidiary bodies. The task of the Sub-Committee is to avoid duplication and conflicting programmes, to take mutually complementary action and in general to promote cooperation and coordination where necessary. However, as experience shows, consultation mostly takes place when programmes have been adopted. The effectiveness of the Sub-Committee is considerably hampered by the fact that no accepted conceptual framework exists, and each agency has its own list of priorities. Moreover, the Sub-Committee is not equipped to deal with specific projects but instead with general prinoiples and guidelines. Its mandate is very broad. It does not really promote coordination of activities in the field of appropriate technology.

REVIEW OF ONGOING UN ACTIVITIES

Many EN bodies are engaged, in one way or another, in activities in the field of appropriate technology. To be able to examine these activities objectively and critically one needs a neutral and common yardstic; the more so since "in a sense, all technologies may seem appropriate insofar as at the moment of application, their choice may be economically rational".5 Furthermore, the appropriateness of technology has to be restricted to the possible use by developing countries. For although a certain technology may be appropriate for a developed country it is not necessarily at the same time appropriate for a developing country.

Opinions differ among the various UN agencies in respect of the criteria determining the appropriateness of a technology. Some use more comprehensive definitions than others with the danger that the term "appropriate technology" may lose its relevance for a science and technology policy, let alone for its critical review. This in itself is a reflection of the widely differing nomenclature for the term appropriate technology such as: bare-foot technology, soft technology, low-cast technology, village technology, inter-

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5ACAST, Report of Ad-Hoc Working Group on Appropriate Technology, p. 3 (E/AC.J2/XXIII/CRP.2, 10 June 1977).

mediate technology and many others. Each of these different terms indicates the stress one wants to put on certain desirable aspects of the development and use of technology. These terms also indicate that there is more than one concept of appropriate technology and that we have to choose between the various options. It is not surprising, then, to observe that most UN agencies view the appropriateness of a technology as a relative concept, depending on the development goals of the country and the use one wants to make of such a technology. Logically and theoretically, there is of course nothing wrong in taking such a view. However, such an all embracing view of the concept tends to lose relevance of the real development problems of the developing countries. It runs the risk of losing its meaning especially for the poor in those countries who are the real goal of all appropriate technology development.

The development and use of technology therefore should be geared to the satisfaction of the minimum requirements of a family for private consumption such as adequate food, shelter and clothing. Moreover, it should imply the satisfaction of community services such as safe drinking water, sanitation, public transport, health and education. It goes without saying that the satisfaction of basic needs is of special importance to the rural and urban poor who constitute the majority of the population of the developing countries.

An appropriate technology, therefore, should aim at:

(a) providing people with an adequate income through the creation of employment with low-cost per workplace;

(b) providing people with a (higher) income through better use of their resources, thereby raising productivity. This can be achieved by improving their production techniques as well as by providing them with better tools and equipment;

(c) providing people with goods and services commensurate with their needs and low income.

In the light of the above definition we examine below the activities of various (though not all) UN organisations relating to appropriate technology.

1. UNIDO

In 1966 UNIDO was created as an autonomous organisation within the UN to play the central role and "be responsible for reviewing end promoting the coordination of all activities of the UN system in the field of industrial development."[6]

Since its creation UNIDO has considered its main task to be the most effective application of modern industrial methods of production and the strengthening of the industrial infrastructure in the developing countries. This task entails activities such es-the dissemination of industrial knowledge, end assistance to LDCs in solving technological problems, especially in the adaptation and transfer of know-how. etc.

At its Eleventh Session (Kay-June 1977), the Industrial Development Board approved a "Cooperative Programme of Action on Appropriate Industrial Technology"? in response to a resolution which was adopted unanimously at UNIDO II, in Lima (March 1975). UNIDO intended to mobilise the interest of other agencies engaged in the field of appropriate technology. In fact, paragraph 32 of the document entitled "Cooperative Programme on Appropriate Industrial Technology" clearly states that it is a CR system-wide programme in which other agencies will be invited to participate.

The programme is subdivided into four different fields of action, namely:

(a) Promotion of technological research (paras. 42-60);

(b) Collection and dissemination of practical experience (paaras.6161-66);

(c) Application of technology to rural developvent (paraas67-67-M);

(d) Technologies for alternative sources of energy (paras. 81-84).

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[6] UN General Assembly. Res. 2152 (XXI), pare. 27.

[7] UNIDO, Cooperative Programme of Action on Appropriate Industrial Technology, Report by the Executive Director, ID/B/188, April 1977.

The programmes classed under (a) and (b) may not be primarily aimed et satisfying basic needs and alleviating poverty. They do aim, however, at making more efficient use of capital and natural resources. Many of the projects listed under (c), (pares. 67-84) may however be designed to satisfy basic needs. All of them explicitly aim at the provision of food, shelter and agricultural implements. They also aim at making more effective use of capital. It is not clear, however, whether these activities will lead to more 'employment. Moreover, some of these projects are concerned only with the dissemination of information (para. UC).

From the foregoing, it is evident that UNIDO is mainly concerned with the development and dissemination of technology which aims et cost-saving by making use of local natural resources and by improving the performance of industrial processes. Of course, there is nothing wrong in this; some UN body et least should be engaged in such an activity. However, most of these activities are not "appropriate" in the sense defined above.

This bias towards industrial development is also visible in UNIDO's establishment of an industrial and technological information bank which has to promote inter alia 'the proper aelection of advanced technologies."[8] This bank is regarded as an integral part of the implementation of the Cooperative Programme of Action.

One cannot escape the impression that UNIDO's current activities are not mainly centred on "appropriate technology for basic needs'. Most of the activities are aimed at accelerating the transfer of advanced technology et better (and thus in a sense also appropriate) terms for the develop ing countries.

2. UNCTAD

UNCTAD was established in 1964 as en organ of the General Assembly. Its task is, inter elie, to accelerate and

[8] UN General Assembly, Establishment of an Industrial Technological Information Bank, A/32/116, Anne I, P. 2, 21 June 1977.

facilitate the transfer of technology from the developed to the developing countries.

The main thrust of UNCTAD's activities is in the fieid of the transfer of advanced technology. However since UNCTAD IV, stress is also being laid on the appropriateness of transferred technology. Since then, the transfer of technology is considered by UNCTAD es part of an integrated policy aimed at strengthening the technological bargaining power of LDCs.

Resolution 87 (IV) recommended that LDCs should:

(a) formulate a national technology plan to be an integral part of national development policy;

(b) establish national centres for the development and transfer of technology to implement, inter alia. the national policy;

(c) establish regional centres for the development and transfer of technology es a means of improving their negotiating strength vis-à-vis developed countries and of reducing their technological dependence.

UNCTAD has provided institutional arrangements to assist LDCs in bringing about these policy recommendations. Apart from studies regarding the international patent system, an international code of conduct on transfer of technology, and the experiences of several developing countries with the transfer of technology, UNCTAD has edvieed countries to formulate laws and establish institutions which will improve their capability in dealing with issues of technological transfer. In addition, UNCTAD has started training programmes for government officials in the field of technology transfer. UNCTAD is also involved in the establishment of regional and sectoral centres for the development and transfer of technology in collaboration with the UN regional economic commissions end other UN organisations and specialised agencies.

Notwithstanding all these activities, one cannot classify UNCTAD's work as primarily aimed et alleviating poverty and satisfying basic needs. Since most of the technology is transferred from the developed to the developing countries, it is more often than not, inappropriate to the

latters' needs. It is evident that UNCTAD's activities, although necessary and useful, will, only in rare cases, contribute to the satisfaction of basic needs.

3. WORLD BARK

The World Bank was not engaged in promoting appropriate technology until 1971. That does not mean that all its activities prior to that date were inappropriate, but its policy then was primarily aimed et maximising efficiency and the growth of output. It was believed that the poor would also benefit from such a policy, by the indirect "trickle-down" effect. However, since 1971, the Bank he5 financed an increasing number of projects aimed at the alleviation of poverty.

The Bank considers a technology appropriate when it satisfies the following criteria: it is in accordance with the national development policy, the final product or service is useful and affordable by the consumers, the product-on process fits the socio-cultural setting and makes economic use of resources.9

The Bank policy with regard to LDCs is that the project5 it helps to finance should be appropriate and that such projects should develop local capacity to plan for, select, design, implement, manage and, if necessary, adapt and develop appropriate technology.

The Bank's activities range over a wide variety of fields and include institution building, creation of infrastructure to support appropriate technologies, and economic and technical research. Most of these activities are aimed at the rural poor: activities such as the development of small-farm equipment, the introduction of new plant and crop varieties, improved agricultural extension services, credit mechanisms for the small farmer, educational facilities in rural areas, rural transport systems, promotion of rural industry, improvement of village water supply and rural road construction. In the case of the urban sector, the

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9 See World Bank, Appropriate Technology in World Bank Activities, July 1976, p. 5.

Bank promotes the efficient use of labour-intensive techniques in housing, urban water supply and waste disposal projects.

A few years ago, the Bank launched a major research project on lebour-capital substitution in civil construction in developing countries. The initial (first) phase of the study confirmed the technical feasibility of substituting labour for equipment in mad building vith various design standards. In the second phase of this project, field studies were carried out in India and Indonesia on a number of construction sites to gather data on labour and equipment productivity rates obtained in the use of labour-intensive methods. Until recently, the Bank maintained a technology unit in Kenya to undertake research and development work in the construction of rural access roads with an appropriate mix of labour, light equipment and tools. Close collaboration was maintained by the World Bank team with the ILO/UNDP team of civil engineers assisting the Ministry of Works in the implementation of the Rural Access Roads programme. These and other activities by the Bank satisfy the criteria of our concept of appropriate technology on both counts: i.e. these activities lead to the creation of employment and increase of income. They are also capital-saving and aim at satisfying basic needs of the poor.

4. ILO

The activities of the ILO in the field of appropriate technology are mainly executed by the Technology and Employment Branch. ILO's technology policy has always been considered to be an important part of its employment-oriented development policy. The realisetion that development activities had not resulted in solving the employment problem of LDCs led the IL0 to launch the World Employment Programme (WEP) in 1969. During the early period of the WEP special attention was given to research projects in different economic sectors. The commonly accepted platitude that no real choice of techniques or of products existed was proven wrong. A number of studies were published which show the viability of alternative technologies as well as demonstrate the relationship between technological choice and employment generation and (to a lesser extent), income

distribution.[10]

Independent evaluations of WEP research on Technology and Employment have been undertaken by the Swedish Agency for Research Cooperation (SAREC); by Professor Thorbecke of Cornell University, and by the 'WEP Research Evaluation Meeting held at ILO headquarters in December 1976.[11] 'These evaluations assessed the ILO technology research programme in favourable terms and recommended more emphasis on the institutional and socio-poiitical bottlenecks in the application of appropriate technology. Research now underway is increasingly concerned with these questions, in particular, with the implications of government policies for technological development, adaptations and innovations.

Apart from research on institutional and macro - as well as micro -policy aspects of technology choice, development and diffusion, the ILO is increasingly concerned with the implementation of appropriate technologies through technical cooperation projects. The assistance given to the Kenya Rural Access Roads Programme in collaboration with the World Bank, and to the Guatemala Rural Roads Programme, are but two examples of such technical assistance.

The first phase of the World Employment Programme (WEP) culminated in the World Employment Conference (WEC) held in June 1976. The WEC included an agenda item on "Technologies for Productive Employment Generation in Developing Countries",

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[10] See ILO, Technology and Employment in Industry, Geneva, 1975, Employment, Technology and Development, (Oxford University Press on behalf of the ILO), 1975; Technologie et emploi dans le commerce (Librairie Droz, for the ILO, 1976); Employment and Technology Choice in Asian Agriculture (Praeger, New York, for the ILO, 1977); Manual on the Planning of Labour Intensive Road Construction (ILO, 1977); Technologies for Basic Needs (ILO, Geneva 1977); and Men or Machines (ILO, Geneva, 1978).

[11] P. Thandika Mkandawire, WEP Research: A Critical Review, Stockholm, September 1976; and Erik Thorbecke: A Comprehensive Evaluation of the Research Component of the World Employment Programme of the ILC, 1976 (mimeo).

With the adoption of a basic needs strategy at the WEC, the IL0 programme on appropriate technology is now being reoriented to ensure that the technologies that are appropriate for employment generation also assist in the satisfaction of basic needs of the poor.

The Programme of Action adopted at WEC called upon the ILO, in collaboration with other UN agencies to (a) help in the establishment of national and regional centres for the development and transfer of technology; (b) strengthen activities in the field of collection and dissemination of information on appropriate technologies; and (c) establish a Working Group on Appropriate Technology to ensure more concrete ILO action to implement the concept of appropriate technology in developing countries with the active support of its tripartite constituents.

Steps have already been taken to implement the recommendations of the World Employment Conference. The ILO's Programme and Budget for 1978-79 approved by the IL0 Conference in June 1977, makes substantial provision for the dissemination of information on appropriate technologies. This work will be carried out in liaison with the Industrial and Technological Bank of UNIDO and with the proposed Inter-Agency Network on the Exchange of Technological Information. Some work on the preparation of "technical memoranda" which will consolidate technical and economic information relating to alternative technologies in particular branches of economic activity, has already started.

Along with UNCTAD and UNIDO, the IL0 has contributed to the establishment of the regional centres for technology trarsfer and development.. In order to promote inter-agency collaboration at the project formulation stage, the IL0 invites UNCTAD and UNIDO to participate in its Steering Group on Technology and Employment.[12]

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[12]Steering groups are informal and independent bodies which advise on WEP research. They consist of independent consultants drawn from research institutes and international agencies wherever appropriate.

TO conclude, the IL0 activites ax aimed at the satisfaction of basic needs and the alleviation of poverty. They show that an appropriate technology-mix - an optimal combination of labour-intensive and capital-intensive techniques - is the most viable proposition in a basic needs strategy.

5. FAO

FAO was established in 1945 as a specialised agency of the United Nations. Under Article I of its constitution, the FAO's task, in relation to activities on appropriate technology, was to promote and, where appropriate, recommend national and international action with respect to:

(a) scientific, technological, social and economic research relating to nutrition, food and agriculture;

(b) the improvement of education and administration relating to nutrition, food and ag-iculture and the spread of public knowledge of nutritional and agricultural science and practice.

Activities on appropriate technology cover all the three FAO Major Technical and Economic Programme areas. Under the Agriculture Major Programme, FAO's stated objective is to help in the development, transfer and local adaptation of appropriate technology covering three main fields: land and water resources and use, crop production and livestock production. Under the Fisheries Major Programme, proposed work includes the establishment or strengthening of fishing technology services in Asia, Africa and Latin America through programmes jointly undertaken with national institutions.

Finally, the recent initiative taken by FAO to start a post-harvest losses programme is an important contribution to the development and application of appropriate technology for basic needs.

6. UN Economic Commissions

Although evidence may be incomplete, it would appear that the UN Economic Commissions are not really actively concerned with appropriate technology beyond producing the well-meant but familiar and essentially simple statements directed against the application of inappropriate technology.

There are nevertheless signs that this somewhat complacent attitude is now subject to change particularly in the case of the Economic and Social Commission for Asia and the Pacific (ESCAP). A number of projects in the work programme of ESCAP reflect an increased emphasis on creating employment and meeting basic needs of the rural poor[13] and related directly to technological aspects of rural, small-scale industrialisation. ESCAP operates a regional network for agricultural machinery, concerned with design, development and commercialisation of agricultural implements and tools suited to meet the requirements of small farmers.

The Regional Centre for 'Technology Transfer, newly established in Bangalore (India) under ESCAP auspices,[14] should be expected to-devote a major effort to advise member countries on the choice of appropriate technology, even though, oddly, no explicit reference of such a function is made in the project document of the Centre.

Other projects are: a regional network for agro-industry information, a project on bio-gas technology and utilisation

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[13] See report of ESCAP XXXII Session, March/April 1976 as included in ESCAP Annual Report (March 1975-April 1976) presented to sixty-first session of ECOSOC as document E/5785, July 1976.

[14] See Chapter 3.

and another on guidelines for the development oi industrial technology in the region.

Along the lines of the ESCAP Regional Centre, the Economic Commission for Africa (ECA) also organised an inter-agency mission and a ministerial Conference which recommended the establishment of an African Regional Centre for Technology. This Centre is expected to start its operations soon. As in the case of the ESCAP report, the ECA report also avoids an explicit reference to appropriate technology despite the fact that the need for it is implied.

7. UNDP

The UNDP, although essentially an agency to fund development projects executed by specialised agencies, nay exert considerable influence in financing projects with an appropriate technology component. The UNDP philosophy concerning appropriate technology will largely determine the extent to which concrete efforts are made by the UN system as a whole in this area.

It is of interest to note that UNDP sponsored a meeting on Appropriate Technologies in the Industrial Sector in April 1975. Its Global and Interregional Programme for 1977-1981[15] states that "another key area for international action is research and development aimed at strengthening developing country capacities to develop and adapt technologies appropriate to their national objectives and particular economic. social and employment situation". The Programme calls for investigations into "the alternative approaches that will more effectively attack mass poverty, meet basic needs of all sections-of the population and integrate marginal groups into the development process". It designates technology development and adaptation as a "priority area which requires early investigation towards possible UNDP activity during the 1977-1981 cycle".

Somewhat more reassuring is what the former UNDP Deputy Administrator told the 1976 World Employment Conference:

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[15] UNDP Governing Council, 23rd Session, January 1977, The Global and Interregional Programme document DP/216 of-20 September 1976, para. 25.

"looking beyond, we are anxious to play a much more active role in the development and dissemination of appropriate technology".[16] Commenting on the proposed 'Consultative Group on Appropriate Technology' he expressed preparedness on behalf of UNDP 'to get together with the IL0 and our other agency partners as well as government partners to discuss the next step in providing a proper habitat and a home within the UN system for efforts to promote appropriate technology".

8. UNEP

On 15 December 1972, the United Nations General Assembly established UNEP and invited the organisations of the United Nations system to undertake coordinated programmes with regard to international environmental problems. Since UNEP activities cover areas of interest to other UN agencies, formal and informal relationships between UNEP and some of these agencies were established during the last two years.

In the technology field, UNEP has, up to now, been mainly concerned with developing criteria and methodologies for the identification and selection of what is termed by UNEP as 'environmentally sound and socially appropriate technologies". UNEP has mainly produced policy papers dealing with particular sectors (e.g. human settlements) or concepts (e.g. environmentally sound technologies). A few UNEP projeots involved the promotion and dissemination of specific technologies. Some of these projects include the establishment of rural energy centres, the publication of guidelines for the production of handpumps for rural areas, and the provision of financial and technical aid to developing countries in the field of building technology.

This limited involvement in the field of appropriate technology is understandable since UNEP tends generally to concentrate on activities not covered by other UN agencies (e.g. sea water pollution, and depletion of the ozone layer). It is therefore expected that UNEP will provide support to

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[16] See World Employment Conference, 4-17 June 1976, Summary Record No. 10, p. X/5.

activities of other UN agencies in the technology field rather than undertake activities on its own.

9. WHO

Following the consideration of a report on "Health technology relating to primary health care and rural development" in May 1976, the twenty-ninth World Health Assembly established a programme of Appropriate Technology for Health (ATH). During 1977, the foundations were laid for the first medium-term programme of ATH for 1978-1983. A report by the WHO Director-General outlining the general aim and specific objectives of the ATH programme was considered by the thirty-first World Health Assembly in May 1979 which, in a resolution, requested the Director-General to intensify involvement of member States in the further development of a global plan of action for the programme of Appropriate Technology for Health.

The ultimate goal of the ATH programme is to promote national self-reliance on problem-solving in primary health care delivery and to reduce the existing dependence of developing countries on the industrialised countries for technological support. Priority will, therefore, be given to measures concerned with improving the health of underserved populations and to procedures which facilitate the decentralisation of services, production of goods and sharing of information.

The four principal functions of ATH programme are viewed as: direct cooperation with countries, collaboration with appropriate technology groups and with selected national institutions, evaluation of progress, and dissemination of information. It is emphasised that the new programme cannot be restricted to the health sector, but must emerge as a collaborative effort in which other sectors and agencies are involved, and in which the appropriate technology groups will play an important role.

Current WHO activities in appropriate technology include quality improvements in community water supply in Indonesia by research and development of bamboo as a piping material. Special programmes exist for health laboratory technology, basic radiological technology and immunisation technology.

The 1978-1983 medium-term programme for ATH[17] will focus on a wide range cf activities of a promotional nature including the dissemination of information. Already an ATH Directory containing a list of institutions and persons involved or interested in working in the ATH field has been published. An updated and expanded version will be published twice a year. Collaborative programmes of research for the development of new appropriate technologies will also be increased.

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It seems clear from the foregoing, that activities in the field of science and technology by various UN agencies are not necessarily concerned with appropriate technology. We have based our conclusions in the light of the objectives of employment generation and the satisfaction of basic needs. There is no doubt that all UN activities in developing countries are ultimately aimed at improving living conditions of the poor. However, many UN policy statements do not progress beyond that general statement, with which there can be but little dispute.

The poor have become a target group for the agencies concerned; yet only a few UN agencies care to identify certain well-defined target groups with programmes geared to their special needs. It is also very rarely argued why new programmes and policies are more promising than the past policies. It is insufficient to conclude that the policies which were in force until now did not benefit the poor adequately and then decide to focus one's policy primarily on the poor. This begs the question: can one view the poor in isolation from the rest of society?

It is therefore not enough to gear projects specifically to the needs of the poor. Such projects should also be relevant to the development policies adopted by the LDCs. The choice of instruments, targets and technology should, therefore, be consistent with the over-all development policy. It is only then that a certain technology is not only appropriate per se, but also fits appropriately in its larger development context. How difficult it is to implement such a

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[17] "Appropriate Technology for Health"; Report by the Director-General, Document A31/14 of 6 April 1978. See especially Annex III.

policy is shown in this paper by citing the experience of the various UN agencies. Only the World Bank states that results can be very meagre given the existing socio-economic structures in the LDCs. Appropriate technology can only be effective and useful when the satisfaction of basic needs of the poor as a policy is vigorously pursued by the national governments concerned.

It would appear that most of UNIDO's activities are indirectly aimed at providing employment in the long run to the grey mass of the unemployed urban poor. However, part of its activities which are directly aimed at rural development may create additional employment. Yet it is not clear who is to benefit from the extra employment thus generated.

A similar observation can be made with regard to the technology activites of UNEP and UNCTAD. There is no doubt that UNCTAD's activities aim to strengthen the position of the developing countries vis-à-vis the developed countries. But these activities do not necessarily affect the LDC's internal situation. Take for example, the case of the centres for the development and transfer of technology. One does not know who these centres are supposed to serve. Unless the activities of these centres are carefully planned and directed specifically at the poor target groups, it is most likely that these centres will cater largely for upper-income groups in the modern sector.

The few UNEP technology projects which have been started for the benefit of the rural poor appear to have a strong bias in favour of those who are already well-off. An exception may be the UNEP hand-pump projects as these are public utilities. In the long run, of course. UNEP's preoccupation with subjects such as desertification and @co-development may have a positive impact on the position of the poor.

The assault on world poverty announced by the World Bank is less spectacular and serious than one is led to believe. Although the World Bank has identified the 750 million poor in the LDCs as its target group, in reality, its policy is mainly aimed at the upper strata of the poor. It is true that the Bank lending has been increasingly shifted to agriculture and to the poorest countries. Yet most lending activities are aimed at those countries which are less poor than most and, in the poorest countries, to those who belong to the 'haves' among the poor.

The World Bank describes the following categories of the rural poor: the small farmers, the tenants, the share-croppers and the landless labourers. Most of its activities are however aimed at the small farmers. The Bank envisages the promotion of a minimum package to the small farmers which will offer a rate of return at least equal to the opportunity cost of capital. However, the Bank admits that "the social and economic stratification in many South Asian countries would seem to preclude widespread application of the minimum package approach there where the bulk of the rural poor lives".[18]

The same bias towards the problems of the small farmers is to be noted in the Bank's policy paper on agricultural credit, which is now the largest component in the Bank's agricultural Lending. Here the main criterion used is the productive capacity of the borrower's holding which excludes such poor groups as tenants, share-croppers and landless labourers. Those who are reached "constitute at best only 1% of the 100 million small farmers in the developing world".[19]

ILO seems to have avoided the problem of identifying the target groups for its appropriate technology programme. It certainly does not look as if IL0 is oniy aiming at satisfying basic needs of the bottom 40% of the poor. One gets the impression that ILO's position is not very different from that of the World Bank.

WHO is specifically concerned with health, one of the core basic needs. Its programme, though relatively new, is directly addressed to the delivery of cheap health services to the poor.

BETTER COORDINATION WITHIN THE SYSTEM

From the observations above it follows that some effort should be made to coordinate better the modest UN activities

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[18] World Bank: The Assault on World Poverty, Johns Hopkins, 1975, pp. 42,50.

[19] Agricultural Credit, A World Bank Paper, May 1975.

in the field of appropriate technology. Moreover, a common UN strategy to the problem of science and technology in general and of appropriate technology in particular is highly desirable.

The lack of a conceptual framework makes the formulation of coordinated UN programmes impossible. It is therefore surprising to observe the ritual repeated at each session of the ACC Sub-Committee on Science and Technology when the traditional item of the agenda, namely the World Plan of Action (WPA) is discussed. One dutifully promises to deliver this or that supplement to the WPA. The relevance of the WPA for the discussion under another item of the agenda, namely, UN policy in the field of Science and Technology, strangely enough, is not mentioned in any ACC discussion. Hans Singer was quite right when he wrote that the follow-up of the WPA is "a depressing spectacle, only some subdued lip service has been paid, but no real attempt has been made to follow through".[20]

The failure of WPA cannot be laid at the doorstep of ACAST. The WPA was conceived in close cooperation with the agencies. When the WPA was accepted and no funds were made available by the UNDP to implement it, the agencies just ignored its existence.

In 1976 the ACC Sub-Committee on Science and Technology put the subject of joint planning on its agenda. All agencies agreed "that some form of constructive coordination or joint planning could be of positive value to many organisations". The agencies hastened to add, however, that joint management was not desirable. Participation in joint planning was viewed as something voluntary and one was not required to submit a report of activities if one did not wish to do so.

It rather looked as if no one was prepared to agree on common key areas, and indicate possibilities for multi-disciplinary and inter-sectoral cooperation. This impression was strengthened by the lack of appreciation shown by most agencies to an ILO proposal to have "outsiders" appraise the programmes of agencies in a particular field. Such an out-

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[20] Hans Singer, "Five Wasted Years', Focus, No. 1. 1976.

side appraisal could function as a temporary substitute for the absence of a conceptual UN framework. However, the prospect that the autonomy of the agencies would be curtailed proved to be an effective antidote.[21]

Nevertheless, it proved possible for the ACC Sub-Committee, during its 26th Session in November 1977, to agree upon a first subject area for formulation of joint programmes and projects. The Sub-Committee unanimously recommended for this purpose, "technologies for low-cost construction" which would include low-cost housing, storage facilities for food and water, building materials and low-cost road construction. It was decided that a working group consisting of organisations actively working in the above areas should be responsible for undertaking in-depth studies. The Office for Science and Technology would arrange for the first meeting for such a group some time in the middle of 1978.[22]

During the 28th Session (August 1978), of the Sub-Committee this item was however taken off the agenda in order to give the new UN Assistant Secretary-General for Programme Planning and Coordination an opportunity first to examine various efforts at joint planning before the matter is discussed at ACC.

CONCLUDING REMARKS

We have noted that the UN System has three organisations dealing with the coordination of Science and Technology activities: ACAST, an advisory body giving expert advice; CSTD, a political body providing over-all direction, and ACC Sub-Committee on Science and Technology, an inter-agency body aiming at coordination. All these three bodies are

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[21] ACC, Report of the Twenty-Fifth Session of the ACC Sub-Committee on Science and Technology, 20-22 July 1977, doc. COORDINATION/R.1227, pp. 4-6.

[22] ACC, Report of the nty-Sixth Session of the ACC Sub-Committee on Science and Technology, 3-4 November 1977, doc. COORDINATION/R. 1258, pp. 9-12.

serviced by the UN Office of Science and Technology. Since all decisions concerning a UN Policy on Science and Technology are being deferred until after the UN Conference on Science and Technology to be held in August 1979, we hope that this World Conference will be able to formulate and agree on a UN Plan of Action. This will ensure that more harmonious and integrated programmes can be formulated and carried out both within the UN system and at the country and regional levels. If such a Plan of Action is formulated, ACAST could undertake the task of providing expert advice on a continuing basis. Moreover, ACAST should also continue to advise the CSTD on institutional arrangements on science and technology and on programmes of the UN agencies in this area. Such a role by ACAST would no doubt increase the effectiveness of CSTD.

It would be desirable to convert the ACAST Ad-Hoc Croup on Appropriate Technology into a permanent one in order to ensure that appropriate technology becomes an important component of UN programmes on science and technology.

The CSTD itself should play a more active sole in future. Its agenda should be of a practical instead of a deliberative nature. It should also ensure that the combined UN system-wide efforts in the application of science and technology to development are much more effective. Increasing attention has been paid to science and technology activities in the past few years. The magnitude and variety of these activities in the UN system is also on the increase. The performance of CSTD and of the ACC Sub-Committee can therefore improve oniy if a more strengthened secretariat is provided to them. The Office of Science and Technology, their present secretariat, needs more staff and finances to perform its servicing functions effectively. Although discussions within the ACC Sub-Committee on Science and Technology have taken a fortunate turn in respect of joint planning, many problems still remain. In discussions on joint planning of programmes and projects , it would be desirable to seek participation of those developing countries which are interested in hosting (pilot) projects and programmes on appropriate technology. Moreover, potential donors should also be invited to participate in the discussions of the ACC Sub-Committee when external financing is sought for joint

programmes and projects. The donor participation is likely to facilitate arbitration of financial allocations between agencies. To enable this joint inter-agency action, the establishment of a special ACC Sub-Committee on Appropriate Technology would certainly help to ensure that UN agencies focus their attention on this important issue. The effective functioning of this Sub-Committee can be assured by restricting its membership to those UN agencies which are willing to accept the rules of joint planning.

The restructuring of the UN system, currently underway, is likely to affect the future of ACAST, CSTD and ACC. There is some feeling that ACAST, in its present form, will disappear. We believe that redesigning of ACAST may be necessary in the Light especially of the outcome of UNCSTD in August 1979. Yet it would not be desirable to abolish this advisory body which could play an important role. It is our belief that the types of changes proposed above in respect of CSTD, ACC and ACAST, are fully in line with the main objective of the restructuring exercise, namely, to make the UN system more effective.

So far we have discussed only the programme component of UN Science and Technology activities. However, the project component at the country level, which has received much less attention, is also relevant here.

In fact, there seems to be even much less coordination among the agencies at the field level. Fortunately, the UNDP field structure in each country could exert greater pressure to ensure coordination of field activities relating to Science and Technology. Measures need to be taken to enable UNDP to play this role. UNDP should increase its own contribution to appropriate technology projects by devoting the bulk of its budget for global projects for this purpose. Consideration should also be given to raising the size of this budget. UNDP could also play a catalytic role in sensitising the governments to appropriate technology through its country programming. To conclude, we believe UNDP can make a coordinated, meaningful and multi-disciplinary contribution to the development and transfer of technology for socio-economic development.

Chapter 5
INTERNATIONAL MECHANISMS FOR APPROPRIATE TECHNOLOGY

F. Stewart

INTRODUCTION[3]

It is now widely acknowledged that there is a need for appropriate technology to form a significant part of the

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[1] Writing this just two days after the death of E.F. Schumacher, I would like to record the very substantial inspiration he provided to all who work in this field - without him indeed it is quite likely that this and many similar papers would never have been written: I dedicate this paper to his memory.

[2] Senior Research Officer, Institute of Commonwealth Studies (Oxford) and. a Fellow of Somerville College, Oxford.

[3] While working on this paper I benefited greatly from discussions with R. Steinberg and C. Weiss at the World Bank; R. Muscat, B. Harland and J. Berna at UNDP; J. da Costa of WCSTD; A. Bhalla of ILO; E. Owen of the Appropriate Technology International; I. Ritchie of CGIAR; G. McRobie of ITDG; M.E. de Boot of VITA; and V. Rabinowitz and J. Davenport of the Rational Academy of Science. I also benefited from comments from participants at the Expert Meeting on International Action for Appropriate Technology held in Geneva, December 1977. Needless to say none of them are responsible for my conclusions.

investment programmes of poor countries.[4] The use of advanced country technology in LDCs has had some severe distorting effects on both their patterns of production and consumption. The resource requirements of advanced country technology has involved hi@ levels of investment per man, concentrating LDCs' scarce investment resources on a small proportion of the population with the consequence of un- end under-employment and low productivity for the rest of the population. On the consumption side, the transfer of advanced country technology has tended to involve inappropriate high income products, neglecting the ecrt of products required to meet the basic needs of the majority of the population.[5]

While the need for appropriate technology is acknowledged, there are many obstacles which impede its introduction on any significant scale. These may be classified into obstacles arising on the supply side and obstacles arising on the demand side:[6] that is to say. for successful introduction, those who make investment decisions in LDCs must want to choose appropriate techniques (i.e. demand it) and such techniques must be available. This paper is chiefly concerned with the international dimension of the supply side, but it is useful to put this into context by first briefly considering the overall demand and supply conditions necessary to get a successful appropriate technology programme under way.

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[4] Some of the international interest in appropriate technology is catalogued in Cooperative Programme of Action on Appropriate Industrial Technology, Report by the Executive Director of UNIDO (ID/B/188, 17 April 1977).

[5] For a much more detailed analysis of the effects of advanced country technology in poor countries and a discussion of the characteristics of appropriate technology, see F. Stewart, Technology and Underdevelopment, Macmillan 1977, Chapters 3 and 4.

[6] See C. Cooper's contribution tc the International Economic Association Conference on Appropriate Technology, Teheran, September 1976.

If those who make investment decisions in LDCs are to choose appropriate techniques and products, three conditions must be met. First of all, the structure of demand must be such that there is a market for appropriate products. Secondly, the structure of incentives - of labour and capital costs - must be such that the appropriate techniques are also the profitable techniques. Thirdly, decision-makers must have easy access to information about appropriate techniques - at least as easy as access to information about inappropriate techniques. The first two conditions impose requirements for government policy in LDCs, related to income distribution, market structure and product promotion, international trade policy, government expenditure and price/tax policy. There is little that can be achieved by international action on the supply side without national policies to restructure the choice of technique towards appropriate technology. But however appropriate the pattern of demand and the system of prices and incentives, entrepreneurs will not choose appropriate techniques if they do not know about them. Thus appropriate channels of communication are of vital importance to an appropriate technology policy.

This brings us to the supply side of appropriate technology. A critical obstacle to the introduction of appropriate techniques are weaknesses on the supply side in relation to development and to communication of appropriate technology. Historical neglect of research and development into appropriate technology has meant that advanced technology is often the only feasible and efficient technology available. Today it is estimated that only 4 per cent of world R and D takes place in developing countries (including China); this represents a siseable increase over the previous estimates, when only 2 per cent of the world's R and D (excluding China) was in LDCs.[7] Moreover, much (probably most) of the research in developing countries is unrelated to appropriate technology, being basic research or applied research

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'Estimates prepared by J. Annerstedt for the OECD. The figure of 4 per cent for 1973 includes China. Excluding China to make the figure comparable with the OECD 1964 estimates, LDCs accounted for 3.6 per cent of world R and D in 1973.

designed to duplicate and compete with developed country research. Thus an important part of an appropriate technology policy consists in the promotion of appropriate R and D both within LDCs and elsewhere.

In recent years, there has been growing interest in the development and identification of appropriate technology. For example, the IL0 publication entitled Technologies for Basic Needs identified over twenty institutions concerned with appropriate technology for rural and small-scale activities.[8] Economists making empirical studies of the choice of techniques have identified appropriate techniques in a large number of industries.9 Thus, although there is undoubtedly the need for a major research effort, it appears that in some fields appropriate techniques are becoming available. But there remains a very serious communication problem. If they are to be introduced, entrepreneurs in LDCs must have easy access to the techniques - both to knowledge about the techniques and to suppliers of the necessary inputs, especially machinery. The communication problem has both a national and ax. international dimension. At an international level virtually- all channels of communication are concerned with the transfer of advanced country technology, not with appropriate technology. By far the greatest proportion of international technology transfer takes place commercially, via the multinational corporations, technology licensing contracts, machinery supplier8 and engineering consultants. For the most part, these sources of communication and transfer are concerned with modern technology from advanced countries. Governments of developed

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[8] Hans Singer, Technologies for Basic Needs, IL0 Geneva, 1977.

[9] See G.V. Jenkins, Non-Agricultural Choice of Technique: An Annotated Bibliography of Empirical Studies, Oxford Institute of Commonwealth Studies, 1975; A.S. Bhalla (ed.), Technology and Employment in Industry, ILO, Geneva, 1975; 'The Choice of Technology in Developing Countries", World Development, September/October, 1977; B.S. McBain, The Choice of Techniques in Developing Country Footwear Manufacture, London, HMSO, 1977; and M.M. Huq and H. Aragaw, Leather Manufacturing in Developing Countries: A Study in Technical Choice, David Livingstone Institute, University of Strathclyde (forthcoming).

countries - in their aid and training programmes - provide another source of international technology transfer. In the past, these governments have been accused of transferring inappropriate techniques, but recently a number of countries have made serious attempts to transfer appropriate techniques. Notable among these is the US Appropriate Technology Program.[10]

Individual. governments and international institutions are coming to recognise the need to provide better communication channels for appropriate technology and to do something about it within the areas they control directly.[11] But there is no systematic mechanism whereby information about appropriate technology may be collected and transferred internationally. Consequently, individual groups on appropriate technology find themselves working very much in isolation and people in LDCs who wish to gain information on appropriate technology have little idea where to go. In the area of appropriate technology there is a peculiar need for systematic international channels of communication. This is partly because the sources of appropriate techniques are so diverse both in nature and in location. They include, for example, old techniques from the now developed countries: as has often been pointed out the science and technology museums in the developed countries provide a very rich potential source of appropriate technology; many traditional techniques from one part of the world may be appropriate

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[10] USAID, Proposal for a Program on Appropriate Technology, US Government Printing Office, Washington DC, July 1976.

[11] For example, Resolution 2 on appropriate technology adopted by the Second General Conference of UNIDO (Lima, March, 1975); The World Bank, Appropriate Technology in World Bank Activities, Washington, July 1976; USAID Program on Appropriate Technology, Washington, July 1976; Appropriate Technology: Report by the Ministry Of Overseas Development Working Party, Overseas Development Paper No. 8, London, HMSO, May 1977; Progress Report on the Application of Intermediate Technology in the Inter-American Development Bank. May 1977; and Appropriate Technology and its Application in the Activities of the Asian Development Bank, Occasional Paper No. 7, April 1977.

elsewhere; improvements in traditional techniques and newly-designed appropriate techniques provide a third source, emanating from local entrepreneurs, research institutes, universities and appropriate technology groups both in LDCs and DCs. Without effective channels of communication, many of these techniques will be applied only in very limited areas, while elsewhere - sometimes even in a neighbouring country - people are facing similar problems to which similar solutions would be appropriate. Because of the nature of the main sources of appropriate technology few commercial groups are concerned with communicating and transferring the technology. This is the second reason why there is a need for non-commercial international action. Thirdly, the demand for appropriate technology is very often absent, latent or ill-defined. Hence a bigger effort on the communication side is needed to overcome deficient demand. Fourthly, the sort of decision-makers, to whom appropriate technology is especially suited are relatively small-scale, often located in the rural areas and operating their enterprises on a family/self-employment basis. They are in a particularly weak position to seek out information for themselves.

There is as suggested above, a national as well as an international communication problem. International channels of communication are needed because the supply of and knowledge about appropriate technology arises in many different countries, while the need for appropriate technology is similarly internationally dispersed. But there is also a communication problem within nations. As just suggested, appropriate technology is to a large extent designed for the small scale and rural, which presents a major internal communication/dissemination problem. A national communication effort is needed for this. Something like a three- or four-tiered institutional structure may be needed. Some international institutional mechanism is required to collect and transmit information from various national and international sources of appropriate technology to the national or regional institutions. But the regional or national institutions must then transmit the information to the users; this is likely to require institutions below the national level - let us call them local institutions - located in various sub-regions of each country to provide close contacts with users.

It should be emphasised that information must go both ways.

Problems and responses of users have to be communicated to those collecting information about appropriate technology and to those developing appropriate techniques, so as to ensure that the right sort of techniques are developed and transferred. Any sort of rigid institutional structure would be totally inappropriate. Flexibility of structure and of informational network is required, so that local institutions may communicate directly with the international mechanism, or with national or local institutions in other countries, to produce a rapid and efficient communication system.

The aim of this paper is to consider possible new international mechanisms that might be developed to meet the need for improved channels of communication for appropriate technology and to promote the development of appropriate technology. The national counterpart to these channels, briefly sketched above, is considered in detail elsewhere,[12] and will only be touched on below in so far as it affects the working of the international mechanisms. The need to accompany any international mechanism by national policies both in relation to the structure of demand for technology, and in relation to communications within the nation, must be' underlined. Failure to change demand conditions so as to favour appropriate technology, or to introduce appropriate national and local communications, may thwart any international mechanism, rendering it ineffective.

The need for new international mechanisms for the promotion of appropriate technology has been recognised in a number of places and a number of proposals have been put forward. Moreover, in specific fields - particularly related to agriculture and some aspects of rural development - various international mechanisms (in particular Consultative Groups) have been in operation for several years, generating valuable experience which may provide a model in developing mechanisms to cover the much broader field. The workings of some consultative groups has therefore been examined. We also analyse and contrast the objectives and functions that might be met by international mechanisms for appropriate

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[12] See Chapter 3.

technology. Finally, we present some conclusions about requirements for new international mechanisms for the promotion of appropriate technology.

SOME PROPOSALS FOR INTERNATIONAL MECHANISMS[13]

Inter-agency Network for Exchange of Technological Information

The United Nations Inter-Agency Task Force established under paragraph 6 of resolution 3507 (XXX) of the General Assembly, proposed a network for the exchange of technological information, and this was endorsed by the General Assembly. The network was to consist of "a large number of individual nodes and links between them; the nodes should be sources of technological information at the national, regional and international level in the private or public sector; and the links would make possible the exchanging of knowledge of the operations of all participants, compatibility among those operations, practical working arrangements and common aims. Each of the nodes would be an active participant within the network, committed to cooperating with any and all other nodes in seeking out ways of accelerating and increasing the flow of technological information" (Para. 5).[14]

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[13] Numerous other mechanisms not described in this section are directly or indirectly involved with transmitting information on technology. These include, for example, UNISIST (UNESCO's Universal System for Information on Science and Technology); AGRIS (The FAO International Information System for the Agricultural Sciences and Technology); the Control Data Corporation in the USA. The first two are described in A.S. Bhalla and F. Stewart, "International Action for Appropriate Technology" in Tripartite World Conference on Employment, Income Distribution, and Social Progress and the International Division of Labour, Background Papers, Vol. II, ILO, Geneva, 1976.

[14] Report of the Secretary-General to the United Nations Economic and Social Council, Institutional Arrangements in the Field of the Transfer of Technology, Establishment of a Network for the Exchange of Technological Information, E/6002, 2nd June 1977.

"Thus the network should be viewed essentially as an international programme of cooperative act.. ,n designed to support the activities of national and regional information services. Furthermore, it should not replace any of the existing or planned sectoral, national, regional or international networks. Rather it should be viewed as a means of strengthening these and providing, through shared knowledge, of the operations of all participating organisations, the means for their intercommunication" (Para. 6).

The proposed network would n.+ "depend on any specific physical interlinking . . . the participating organisations would themselves decide on the most suitable means of communications" (Para. 7).

"For the continuing day-to-day operation of the network, it would be desirable to have a series of well-designed comprehensive use-oriented sectoral, regional and international directories. These would be designed in such a uay as to help participating organisations to identify the best sources of technological information and to find how to gain access to them and at what cost if any. The operation of the network and its effectiveness would be further enhanced by the development of training manuals, guides, etc. and by the periodic convening of seminars and workshops by the participating organisations" (Para. 8).

The Secretary-General and the Inter-Agency Task Force were asked to ascertain the current availability of information Capabilities at the national, regional and international levels in terms of information sources, means of access to information and information related services, in order to "identify any deficiencies that might inhibit the setting up of the network". They made further recommendations in a report presented to the General Assembly at its 32nd Session which is complementary to the previous reports of the Task Force.

This report[15] concludes that the original concept of the

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[15] UN Draft Report of the Secretary-General on the Establishment of a Network for the Exchange of Technological Information. Document "CO-ORDINATION R.1236 Add. 1" of 23 September 1977.

network remains valid and that its establishment is feasible.

"The effectiveness of such a network depends on a number of actions which have to be taken on a continuous basis for:

(a) The identification by countries and regions of the type of information which is relevant. its appropriateness to their specific needs and overall development objectives, and applicable at the various levels of end-use, namely policy and overall decision-making, use by scientific and other institutions and by industries and ultimately assimilation by the less privileged populations in urban and rural areas;

(b) The adaptation by national and regional institutions of their means of dissemination of information ... to wet the needs at the various levels of end-we mentioned above" (Para. 52).

It is undoubtedly due to the complexity of the matter that everything remains vague. It appears however reasonable to conclude that it is not intended to establish a network of a physical nature but rather a comprehensive programme designed to foster greater cooperation between existing information generators, transmitters and receivers. The explicit identification of urban and rural poor as a main category of end-users of technological information is worth noting in this respect: "One of the reasons why basic needs have not been met so far lies in the use of inappropriate technologies. One of the means to meet the needs of this end-user category is to be found in adequate information delivery, starting from the premise that information should be adapted to the requirements, the capabilities and the means of the user, rather than vice-versa' (Para. 16).

Industrial and Technological Information Bank (INTIB)[16]

The proposed bank would form part of the international net-

[16] UNIDO, Establishment of an Industrial and Technological Information Bank, Report by the Executive Director, ID/B/183, April 1977.

work for the exchange of technological information, just described. The proposal for the Bank was a response to the recommendation of the Lima Declaration and Plan of Action on Industrial Development and Co-operation, that "Appropriate measures, including consideration of the establishment of an industrial and technological information bank, should be taken to make available a greater flow to the developing countries of information permitting the proper selection of advanced technologies".

The Bank would be "concerned primarily with the selective processing of technological information. thereby providing the developing countries with a basis for making decisions" (Para. 16); it would not only collect information but also assess it. "The provision of information might in certain instances have to be followed up by further consultations and advice in the countries concerned with the aim of assisting the recipient in assessing and applying the information" (Para. 18). It is intended therefore that the Bank will not simply be an archive of information but will provide access to information, its analysis and synthesis, with the capability of giving on-site technical advice to assist the recipient in the effective application of information (Para. 19). The Bank would draw on technological information from within UNIDO and outside - e.g. information from reports of technical assistance projects, consultants' reports, reports of staff missions and of expert group meetings, UNIDO research studies and information obtained through the Industrial Inquiry Service, journals, library and documentation. The Bank would not duplicate external sources of information, but would establish a memory/ retrieval system for collecting relevant information when required.

A Pilot project has been initiated, selecting four areas - iron and steel, fertilisers, agro-industries, agricultural machinery and implements. This stage is intended to last from July 1977 to December 1978. Information will be supplied in anticipation of demand when directly solicited by individual requests. The target customers include ministries of industry, planning and industrial development, multipurpose technological institutions. transfer of technology centres and registries. "Our intention is to serve all those who can be identified as having genuine technology selection responsibilities and problems, whether

in an advisory or decision-making capacity".[17]

While it is clear that the Bank would provide information on appropriate technology - indeed its role is mentioned in the documents related to the "Cooperative Programme of Action on Appropriate Industrial Technology" (ID/B/188) - its function is to provide information on all types of technology and it has no special role in relation to the dissemination of information about appropriate technology.

Technology Referral Service (TRS)

This World Bank proposal was put forward in the belief that "International assistance and coordination can perhaps be most useful in broadening the scope and quality of information available to developing countries for rational choice of technologies . . . The Bank would favour a system that is initially modest. well-defined, pragmatic and fast action. It would be a major boon to developing countries to make readily available a mechanism to review the shelf of existing technological processes and associated hardware, and present clearly and quickly the relevant elements permitting informed choice of the technological alternative. Subsequent feedback to monitor the choice to see whether the investment project is successful, beneficial to the investor and to the country should be provided for. The network would then progressively improve the knowledge base on appropriate technology and help identify priority areas for R and D".[18]

The TRS is designed to provide such a network; the TRS proposal lays particular emphasis on the need to improve the quality of technological choice, the need for any information system to be closely linked with decision-makers, and the need to follow up studies to see that the system is

[17] Letter to colleagues within the UN from R.T. de Mautort, Industrial Information Section, July 1977, UNIDO.

[18] World Bank, Technology Transfer and Appropriate Technology, The World Bank Role, 1977, p.5 (mimeo).

working effectively.

Initially, the information provided would be channeled only to private business or public enterprises needing help to make decisions; and only to those where an investment decision is imminent. TRS should initially serve both large and small enterprises "although the character of the service may differ markedly". It is proposed that to start with the service should deal only with industry, which it is felt is particularly poorly serviced.

The TRS would operate with a clearing house, to which LDC enquiries would be funneled through "screening institutions". The screening institutions which should have a direct interest in "appropriate" technology, might consist of a financial intermediary (e.g. regional development banks, and national finance corporations) or a national office for the transfer of technology. The screening institutions would be responsible for seeing that the enquiry is fully specified, and that the TRS replies promptly and usefully.

The clearing house would receive enquiries, refer them to technical sources, evaluate the procedure and recommend improvements: it would have "the prime responsibility for identifying, enlisting, refining, evaluating and where necessary eliminating technical sources". Particular emphasis is placed on the need for top professional talent in the clearing house. It is not proposed that the clearing house functions should be carried cut in the World Bank, but that some other existing institution should be used.

The World Bank proposal emphasises that the TRS could not act as a complete substitute for on-the-ground technical assistance, and the best approach would be to combine the TRS with technical assistance. Emphasis is placed on follow-up procedures to assess the value of the advice. "The service, at least initially, would remain neutral as to what constitutes "appropriate" technology for a particular request. The clearing house role is to broaden the range of information and the clarity and focus of that information.

The proposal contains fairly well worked cut ideas for the nature of the proposed processes of enquiry, response, monitoring formats, data organisation and storage, retrieval and communications technology. It is our understanding that this proposal is currently being reformulated as a research-

cum-pilot project in one country, to test the feasibility of the TRS in a national context.

Socially Appropriate Technology Information System (SATIS)

This is a proposed networking system for the appropriate technology groups: it was initiated by the Groupe de Recherches sur les Techniques Rurales (GRET). The aim is to systematise information storage/retrieval by the appropriate technology groups, so that on receiving enquiries each group could call on the work of other groups. As the proposal stands at present, it appears that SATIS would involve classifying all technologies, recording details of each on fiches, which would then be available to all affiliated organisations. The Intermediate Technology Development Group (ITDG) magazine, Appropriate Technology, and TRANET (see below) already perform some networking function among appropriate technology groups.

Transnational Network for Appropriate Technologies (TRANET)

This is a voluntary organisation whose main purposes include promoting bilateral exchanges between appropriate technology centres throughout the world and promoting the understanding of, development and use of appropriate technology. 'Towards these purposes TRANET may operate a clearing house, publish a regular newsletter, hold seminars..." (TRANET-BY-LAWS).

World Plan of Action (WPA) Fund[19]

In the UN World Plan of Action a special World Plan of Action Fund was proposed to be established within the framework of UNDP. The purpose of such a fund was to enable UNDP to act as a catalyst in implementing research projects which were given high priority in the WPA, in order to build an indigenous science and technology capacity in developing countries. This fund was supposed to absorb 50 per cent of

[19] UN, World Plan of Action for the Application of Science and Technology to Development, New York, 1971, pp. 39-41.

the additional contributions to UNDP projected between 1970 and 1975, to amount to 25 per cent of the total resources of UNDP (in addition to any current UNDP resources allocated to relevant projects under the country programing and global project provisions). Thus the fund was not proposed as a new special. fund. In order to ensure flexibility and to take account of changes in research priorities the Governing Council of UNDP was to take the responsibility for changing the objectives of the fund.

Although the fund was never created, this proposal is relevant since its aim was to provide financial assistance for research activities at "the national or regional levels, for which such support was not otherwise available".

Sir Austin Robinson's Proposals for UNDP[20]

Robinson's report recognised the dual need for up-to-date and comparable information on alternative technologies, and for R and D to modernise traditional techniques and devise new techniques appropriate to developing countries. He proposed that a relatively small number of industries should be selected (say eight to ten) to avoid dissipating energies over a large field. In each of these areas international research institutes should be set up (analogous to the seed institutes), each devoted to R and D in a specific industry or industrial research centre, which had been identified as "outstanding/excellent". "Each such international institute would be focused on the basic problems of recording, analysing and developing technologies appropriate to the developing world in that one specific-area industry, with the twin duties of being a complete source of technical and economic information and experience regarding all existing practices and a centre for the development of the basic techniques". The institute's workshops would have examples of the principal techniques in working order, and regular production, to identify problems of production and maintenance. They would be linked with institutes in the same field in advanced countries, which

[20] Future Tasks for UNDP - Report to the Administrator of UNDP by Austin Robinson. (1976).

would undertake research for them when requested. Each individual LDC or group of LDCs would have an institute in close contact with the world institutes to apply, adapt and disseminate the results of the world institutes and to identify problems of those engaged in the industries concerned.

A provisional, initial list of industries suggested was: textiles, building and construction, farm machinery and equipment, water pumping and distribution, footwear, food processing and foundry work.

World Employment Conference Proposals for New International Mechanisms for Appropriate Technology[21]

One of the proposals at the World Employment Conference was a new International Appropriate Technology Unit to provide a means of coordinating and disseminating work on appropriate technology on a worldwide basis and to foster, encourage and disseminate new R and D to meet the basic needs strategy. It was proposed that the Unit should be relatively small (20-30) professional staff, and its aims would be focused on providing and improving technologies for the poorest people in LDCs: it would collect and disseminate economic and technical information about alternative techniques and products, monitor ongoing R and D, identify R and D gaps, find means of getting the gaps filled and communicate the results to users. The unit would not itself conduct R and D but get R and D carried out in national institutes (in LDCs wherever possible) by identifying gaps and helping raise funds. It would not duplicate information collection of other institutions but catalogue who knows what and where and provide a link between national (and other international) institutes where needed. National institutions would be put directly into contact with each other, bypassing the central

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[21] See A.S. Bhalla and F. Stewart "International Action for Appropriate Technology", op.cit. and ILO, Employment Growth and Basic Needs - A One-World Problem - Report of the Director-General to the World Employment Conference, Geneva, 1976, Chapter 9 on "Technological Choice and Innovation for Developing Countries".

unit wherever possible.

It was proposed that the Unit should select priority areas starting with one or two, and covering at most say six at any time: the priority areas would be selected in accordance with various criteria including significance of industry, geographical coverage, relevance to the poorest sections of LDCs, and in the light of existing knowledge and suspected gaps in knowledge. In the priority areas the Unit would aim to be thorough and effective in collecting and disseminating information, in identifying R and D gaps, in securing appropriate R and D and in communicating between users and researchers. In non-priority areas, the Unit should simply have the function of registering and communicating sources of information. This proposal was discussed at the IL0 World Employment Conference held in Geneva in June 1976. At the Conference the Group of 77 and the Workers Group endorsed the establishment of such a Unit. Most industrialised countries however did not support the proposal on the grounds that new institutions were undesirable.

A related proposal on the establishment of a Consultative Group on Appropriate Technology was also discussed at the World Employment Conference. The main functions of this Group were to "suggest programmes of action taking into account other programmes under way or being planned, and to provide for their financing. The priority problem areas could be identified from among candidates by small task forces. Once a candidate problem area had been given a priority by the Consultative Group, it could be entrusted to an appropriate international or regional institute".[22] The establishment of the Group was earlier recommended by the IL0 Technical Meeting on Adaptation of Technology (organised in collaboration with UNIDO and ESCAP with UNDP financial support).[23]

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[22] See ILO, Employment, Growth and Basic Needs, op.cit., Chapter 9, pp. 150-152.

[23] See ILO, Policies and Programmes of Action to encourage the use of Appropriate Technologies to Asian Conditions and Priority Needs, Bangkok, 3-14 November 1975.

At the Conference the Group of 77 and the Workers Group endorsed the establishment of a Consultative Group to be especially directed to research on the choice of alternative uses of resources allowing a greater use of labour per unit of investment . . . [24] The Workers Group also emphasised that the Group should be tripartite in character including representatives not only of governments but also of employers and workers. Most industrialised countries did not support this proposal. In particular, the US delegate to the Conference felt that the proposal was premature since the institutional capacity in LDCs that was so necessary for the success of such a mechanism was lacking.

As the paper by Amulya Reddy (Chapter 3) shows, there is a growing institutional capability in LDCs for undertaking R and D on appropriate technology. It is often the wrong priorities and lack of funds that prevent success of the LDCs institutions in this area.

More recently, the Group of Non-Aligned Countries at their Fifth Summit Conference held in Colombo in August 1976, included an endorsement of the proposal on the Consultative Group on Appropriate Technology, in their Action Programme for Economic Cooperation.[25]

An International Centre for Appropriate Technology[26]

A. Khan, of the International Rice Research Institute, put forward a proposal for the establishment of an international

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[24] ILO, Declaration of Principles and Programme of Action adopted by the World Employment Conference, (WEC/CW/E.1), para. 62

[25] Action Programme for Economic Cooperation: Fifth Conference of Heads of State of Governments of Eon-Aligned Countries, NAC/CONF.5/S/4, Colombo, 19 August 1976, p. 13.

[26] See International Center for Appropriate Technology, proposal to USAID, 1974 (mimeo).

centre for appropriate technology to bc located in an LDC, whose task "as the development cf products and techniques appropriate to very poor rural areas - particularly arid and semi-erid areas. The Centre would aim to cover "movement of farm products, low cost alternative energy sources, and simple equipment to enhance the quality of rural living, such as for brick. block, rope and mat-making, handicraft tools, simple farm vehicles, equipment for rural road-building and maintenance, solar collectors. windmills, waterwheels, rural home water supplies and implements for insect and rodent control". The proposal was developed in the light of the success of the machinery development project at IRRI. It was argued that "there is currently no international centre for industrial development that could serve as a base for development of appropriate technologies for the rural poor in arid and semi-arid LDCs".

The Centre would conduct research, development, exploratory development and testing and industrial extension. It would need to be located where there was some local capacity for machinery production. Once prototypes were developed they would be sent to other countries for evaluation and testing.

It was argued that "Owing to limitations of organisation, personnel and other resources, industrial research organisations in developing countries have generally not been able to mobilise the innovative inputs required for new product development. The industrial research institutions are mostly engaged in providing routine technical services and information to local industries and research of limited commercial potential". Khan therefore proposed a new international research centre. The Khan proposal fits into the general framework proposed by Austin Robinson, and could be viewed as one of his proposed international institutes.

An Interim Global Project Towards an International Council for Appropriate Industrial Technology[27]

This proposal is for a relatively small interim (or perhaps pilot) project devoted to appropriate technology. The project would have a core staff of about 5 experts, an executive committee and an advisory committee which drew from practitioner institutions. The major functions of the project would be:

(a) To stimulate serious policy studies in individual developing countries looking into the scope and need for government action to facilitate the development and application of appropriate technology: the main focus of the studies would be on the determinants of technological decisions;

(b) To provide technical and financial support of a limited scope for on-going local operational programmes;

(c) To explore and promote "larger" project possibilities of international significance, calling for ad hoc funding - particularly related to new institution building.

This proposal thus differs substantially from earlier proposals in that it is primarily related to social/economic policy determinants, rather than to ths collection, dissemination and development of information on technologies.

World Technological Development Authority

The report of the Club of Rome[28] on Proposals to reshape

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[27] This proposal by M Usui, then at OECD Development Centre (Paris) was presented at a UNDP meeting on Appropriate Industrial Technology held in New York in April 1975. No action was taken on it or on any other proposals.

[28] See J. Tinbergen (coordinator), Reshaping the International Order: A Report of the Club of Rome, E.P. Dutton and Co. Inc., New York, 1976.

the international order proposed that a World Technological Development Authority should be established, to be backed up by an International Bank for Technological Development. These institutes would be concerned with global technological issues, not simply those within the UN system. The Technological Development Authority would be a "planning, programming and training organisation which would carry out feasibility studies, devise detailed programmes of research and development, arrange for their implementation in cooperation with the Bank, by contact with the most appropriate experimental institutions ... supervise the programme of work in each case and act as custodian of such industrial property as might accrue, on behalf of the participating countries".

USAID Proposal for a Program in Appropriate Technology

The objectives of the US Program, which was incorporated in a new section, 107, of the Foreign Assistance Act, are:

"(1) To promote the development and dissemination of technologies appropriate for developing countries, particularly in the areas of agriculture and rural development, small business enterprise and energy;

(2) To identify, design and adapt from existing designs, appropriately scaled, labor-intensive technology, and policies and institutions directly related to their use;

(3) To formulate policies and techniques to facilitate the organisation of new small businesses;

(4) To engage in field testing of intermediate technology;

(5) To establish and maintain an information center for the collection and dissemination of information on intermediate technology;

(6) To support expansion and coordination of developing

country efforts in this field".[29]

The programme included a $20 m. fund. An independent non-profit making institution - the Appropriate Technology International (ATI) was established to administer the fund. The programme areas were defined under five areas:

1. Communication and coordination;
2. National policies for appropriate technology:
3. Appropriate technology projects in LDCs;
4. Education of relevance to appropriate technology;
5. US Business - finding means of involving US business in appropriate technology.

The programme of AT1 is not intended to involve establishing elaborate administrative structures, in any of the areas.[30] The intention rather is to contribute under each head by supporting the initiatives of others (e.g. supporting net-working among appropriate technology groups), by financing projects which contribute to the general aims (e.g. seminars or educational programmes related to communication and education), and by adopting an innovative and flexible approach to the subject - exploring new possibilities, learning by experience and developing new approaches.

The US Program is a national, not an international effort. This, obviously, makes the precise model inapplicable vis-à-vis international mechanisms. In my view, a serious disadvantage of the programme is its national, developed country organisation. The programme may reinforce the views of those in LDCs who lack commitment to appropriate technology - and who, indeed, argue that it is an attempt to sell them an inferior technology, and one which will keep them permanently under-developed. In this way it

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[29] USAID, Proposal for a Program in Appropriate Technology, op. cit., p. 2.

[30] An overview of ATI's objectives and functions is described in AT. International: An Overview, Washington DC, March 1978 (mimeo).

could actually be counter-productive in terms of the overall development and acceptance of appropriate technology. Whether this is the net effect or not will be partially, but only partially, dependent on how it is administered. It will also depend in part on other stances the US takes in relation to the North/South questions - stances which have nothing to do with appropriate technology, or the administration of the ATI. This is one reason why an international mechanism is needed - and one that contains a large LDC element.

Proposals of a Working Party of the UK Ministry of Overseas Development

The Report[31] concluded that "in view of the importance now attached to intermediate technologies by the developing countries, of the role aid donors can play, of the direct relevance of the subject to our aid policy of doing more to help the poor, particularly in the rural areas, and of the possible advantage to British industry, the current modest level of assistance to intermediate technologies within the aid programme should be increased".

Policy recommendations included intensifying existing technical cooperation and capital aid activities in intermediate technologies, encouraging the strengthening of information gathering and dissemination, the establishment of links between British producers and overseas markets, encouraging the testing, monitoring and evaluating of prototypes, and considering providing finance to firms in Britain and developing countries for producing intermediate technology products. Not less than £1/2 million per annum were to be set aside for three years for this purpose. A clearly defined departmental responsibility was to be created within the Ministry of Overseas Development to cover all aspects of intermediate technology; a proportion of the funds were to be allocated to the ITDG to work in cooperation with the Ministry's Special Units. The Report also recommended that the Commonwealth Development Corporation should be asked to extend its intermediate technology activities. Like the US Program, the UK proposals are Primarily national in focus.

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[31] Appropriate Technology: Report by the Ministry of Overseas Development Working Party. HMSO, London, 1977, op. cit.

Consultative Groups

The Consultative Croup form of organisation may provide a model for a new international mechanism for appropriate technology. Around 30 Consultative Groups have been established at various times. These groups are intended to "achieve more effective use of development resources, especially by coordinating flows of external assistance. both with respect to objectives and policies, and also by providing forums in which measures could be discussed for improving the performance of developing countries and of governments and organisations and giving them assistance".[32] While most of the early groups were primarily concerned with individual LDCs, recent groups have been devoted to broad problem areas. that transcend national or regional boundaries. For example, the Consultative Group on Food roduction and Investment in Developing Countries and the Consultative *Group* on International Agricultural Research.

There is considerable variation in the form that Consultative Groups have taken. In general each member of the Group retains the right to independent action; actions taken in the Group are entirely voluntary, and procedures followed by the Group are highly informal. Membership of the Groups is normally self-selected, with countries joining to benefit from information exchange and coordinated action. In some groups members are expected to express financial commitments in support of selected projects sponsored by the Group. In many, assistance remains purely bilateral. Institutional arrangements tend to be minimal, with very simple and broadly defined terms of reference.

Consultative Group or International Agricultural Research (CGIAR)

This Group - which has been directly concerned with questions of agricultural technology - perhaps comes closest to providing a model for a possible appropriate technology group.

CGIAR was founded in 1971 following the success of the Ford and Rockefeller Foundations in financing the international

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[32] Discussion paper for Item (i) from Meeting of the Ad-Hoc Group on Rural Potable Water Supply and Sanitation.

institutes which began the seed revolution. The Group was sponsored by the World Back, FAO and UNDP. The Group has 29 donor members, and five members to represent the five developing country areas. It has a small secretariat of seven, and calls on the expertise of a Technical Advisory Committee consisting of 12 experts in the field. The Group has been notably successful in raising finance. Total financial support is now around $80 m. and growing at about 30% per year. The Group finances 11 International Research Institutes/Centres devoted to agricultural research. Each of the centres is autonomous, and has training as well as research functions. Each centre has close links with the country in which it is located; most centres are situated near an agricultural university or research station, and some carry on joint programmes of research. In addition, the centres have international links with other research centres in other countries. The centres build up library and documentation services for international reference. They also organise seminars and workshops and help finance relevant projects in the countries in which they are located.

Special Programme for Research and Training in Tropical Diseases

This body is still at an early stage. It is a global programme of technical cooperation with and service to governments, developed in response to a demand for coordinated research on the control of tropical diseases. It has two objectives: the development of improved tools needed to control tropical diseases, and the strengthening of biomedical research capability in tropical countries. The sponsoring agencies of the Programme are UNDP, WHO and the World Bank. Like CGIAR. the Programme will have a Scientific and Technical Advisory Committee.33 Two major differences between this programme and CGIAR are that the participating countries (i.e. LDCs affected by the diseases) will be of greater significance in the Joint Coordinating Board; and the intention, it appears, is to finance research in existing institutions, or by particular groups

33 Memorandum of Understanding on the Administrative and Technical Structures of the Special Programme for Research and Training in Tropical Diseases, TDR/CP/78.3.Rev.1, Geneva, 1978 (mimeo).

of scientists, not to establish new international institutes.

Consultative Group on Food Production and Investment in Developing Countries

The main functions of the Group are to encourage larger external resource flows for food production to developing countries, coordinate activities of various donors and ensure more effective use of available resources. Membership is self-selected, including international institutions, donor countries and recipient countries. It has a small staff (of five).

The co-sponsors of this Group are the FAO, the World Bank and UNDP. The Group has been chiefly concerned with looking at world trends in food supply and consumption, and identifying required policies to increase food production and investment. There is some feeling that the Group has not been sufficiently specific in its contributions, and that it is not doing very much that other institutions could not also do. It appears that this Group is now being phased cut.

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The Consultative Group model is thus an extremely flexible one; its structure, organisation and membership is informal and fluid. It can be, but is not always, a powerful agent for raising and allocating funds, and providing for international coordination of activities in the chosen area.

One implicit difference between the various proposals - which has considerable bearing on the relevant mechanisms - is the definition of appropriate technology. Just as everyone is against sin, so all favour appropriate technology; and in an analogous way, interpretation of what is meant determines the relevant action.

At one extreme there is the view that the appropriate technology is the technology a country would choose, given as wide as possible a range of choice to choose from. The task of promoting appropriate technology then is that of widening the available spectrum of technologies of all sorts: the proposed Inter-agency Network for the Exchange of Technological Information and the UNIDO Industrial and Technological Bank are based on this principle, aiming to increase

access to information about all types of technologies in order to extend the basis of choice. Adopting this approach to appropriate technology tends to lead to prime emphasis on information collection and dissemination, little emphasis on R and D or social research and little selectivity in the types of information collected and disseminated. At the other extreme is the view that appropriate technology is labour-intensive, small-scale, designed to meet the basic needs and raise the productivity of the poorest people in poor countries. This is the basis on which most of the Appropriate Technology Groups work; it is broadly the definition adopted by Khan for his proposed institute and by the proposals for the World Employment Conference. Adopting this type of definition tends to lead to emphasis on a particular type of information collection/dissemination, on the need for R and D to develop new appropriate techniques, and for social/economic research into the determinants of choice of technique.

The World Bank takes what it described as a neutral view of definition of appropriate technology. In the description of the Technology Referral Service its initial function is described as "to broaden the range of information and the clarity and focus of that information".[34] However, in its description of World Bank activities in relation to appropriate technology, it is apparent that appropriate technology is used operationally in relation to labour-intensive small-scale technology which uses local resources and meets basic needs. In defining appropriate technology in that report, the World Bank identifies four dimensions of appropriateness: appropriateness to goal, appropriateness of product, appropriateness of process and cultural and environmental appropriateness.

For the purpose of the discussion that follows, it is necessary to be clear on what is meant here by appropriate technology. Precise criteria are impossible to devise.[35]

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[34] World Bank, Appropriate Technology in World Bank Activities, op. cit.

[35] See F. Stewart, Technology and Underdevelopment, op. cit. Chapter 4.

but it is not accepted here that promoting appropriate technology is simply a matter of extending the range of choice, but of extending it in a particular direction. A summary definition was provided in the USAID report.[36]

- "In terms of available resources, appropriate technologies are intensive in the use of the abundant factor, labor, economical in the use of scarce factors, capital and highly trained personnel, and intensive in the use of domestically-produced inputs.

- In terms of small production units, appropriate technologies are small-scale but efficient. replicable in numerous units, readily operated, maintained and repaired, low cost and accessible to low income persons.

- In terms of the people who use or benefit from them, appropriate technologies seek to be compatible with local cultural and social environments."

This definition, broadly, summarises the direction in which choice needs to be extended - though I would wish to make two qualifications to it. First, appropriate technology is a matter of appropriate products as much as appropriate techniques - i.e. products which are appropriate for low income consumers, make use of local resources, and fit the local environment. Secondly, while the emphasis on small-scale production units is correct, many innovations related to large-scale production - innovations both in terms of product characteristics and techniques - would increase the appropriateness of the technology. It would be a mistake, at this stage, to exclude appropriate technology for large scale industry.

Defining the promotion of appropriate technology as being the extension of the choice of technology in a particular direction is of operational significance in terms of mechanisms. It means that information collection and dissemination need to be especially focussed at the appropriate technology end of the technology spectrum; information collection/dissemination of much of very recently

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[36] USAID, Proposal for a Program on Appropriate Technology; op. cit., pp. 11-12.

developed advanced country technology would not form part of the promotion of appropriate technology. It also implies a similar selectivity and focussing of efforts in relation to the promotion of R and D. Finally, it suggests the need for complementary social and economic research to identify the obstacles facing, and conditions conducive to, the successful adoption of appropriate techniques.

The adoption of this type of definition is not intended to suggest that collection of information about advanced country technologies is a useless activity: obviously, it may be very useful and some of these technologies may be the best for LDCs in their particular circumstances, and therefore in one sense the appropriate techniques. Nor is the definition intended to be restrictive in the 'way, for example, that perhaps some of the Appropriate 'Technology Groups' use of the tern may be. It is not intended to focus solely on the very small-scale and rural techniques. Labour-intensive large-scale techniques producing inappropriate products for sale on the international markets may be more appropriate than similar capital-intensive techniques. and their promotion may be part of the promotion of appropriate technology. What is intended by the definition is to focus on a strategy of promoting appropriate technology in a particular direction, so as to give some content to the strategy. and some guide to the requirements for mechanisms.

FUNCTIONS OF INTERNATIONAL MECHANISMS

The description of proposal5 and existing mechanisms makes it clear that there are a number of functions that international mechanisms may fi11 in relation to the promotion of appropriate technology. The proposals and mechanisms differ in the functions for which they are intended. Some of the functions are linked; others are not. It will be helpful therefore to start by distinguishing the various functions of international mechanisms, considering how far they are necessary, how interrelated, and whether a single or a number of mechanisms are required.

The main distinct functions are:

(a) Information

1. Collection of information on technological alternatives.

2. Dissemination of information on technological alternatives.

3. Networking.

(b) Research and Development

1. Identification of R and D needs.

2. Identifying and organising relevant R and D.

3. Funding R and D.

(c) Social/Economic Research

1. Analysing determinants of technological choice.

2. Following up success/failure of efforts under (a) and (b).

3. Analysing relevant government policies and institutional changes.

In general terms there are obviously strong links between many of these functions: for example, R and D needs cannot be identified without first knowing about what is currently available. A comprehensive search for what is available also sometimes involves some research. Then information collection and dissemination needs to be linked with R and D in order to communicate the results of the R and D. Clearly, information dissemination must be associated with information collection, or the latter would be useless. But despite the strong links, the functions are distinct and may be performed by different institutions - as illustrated by the many variation5 contained in the proposals described. The discussion below considers the extent to which such institutional separation is possible and desirable, and how the various proposals complement or duplicate each other.

There are gaps in the fulfilment of all the above functions in relation to appropriate technology. While some work is being done with respect to all the functions in various parts of the world, communication between those doing the work is weak probably leading to some duplication of work

on appropriate technology. Coverage, in terms of industrial and geographical area, is sporadic, and the total effort involved is inadequate. Action therefore is certainly justified in relation to all types of function. However, not all of this action need be international, and much of it, by its nature, must be national.

Information

Collection and dissemination of information about the existing "shelf" of techniques are conceptually distinct functions; different expertise and contacts are needed. Information collection in a particular field is best done by experts familiar with the field and requires contact with the various research institutes and suppliers of technology throughout the world. Information dissemination has an essential **local**, not just national, component, requiring contact (directly or indirectly) with those who make the investment decisions. However, it is also necessary to have strong links between those who collect and those who disseminate information. On the one hand, and most obviously, the disseminators have to have access to what has been collected. On the other, efficient collection of information cannot be carried out in complete isolation from those who are to use the information: what information is useful, and how it should best be presented can only be decided in the light of knowledge about the circumstances of the users. It is therefore necessary to incorporate systematic links between information collection and dissemination, and for this some sort of international linking system is required. But the main thrust of the dissemination effort has to be national; some national institutions are needed to see that the dissemination is properly carried out.[37] Information collection has an international element in that the information about technologies is contained in different countries, but it can efficiently be carried out within a national institution.

Information collection - if it is to be useful - is not simply a matter of recording technical details of various pieces of hardware. The whole process of production needs

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[37] See Chapter 3.

to be described including software aspects, like skill and managerial requirements, marketing and so on. There is other essential information that is needed - for example, the costs of the various types of machine, running costs, likely life, maintenance and repair, and so on, which do not appear in the normal technical manuals. Moreover, even such apparently 'technical' information as rate of output of different machines are related to the conditions under which the machine is operated. Thus to be of help to a decision-maker in an LDC, the information needs to be focussed on his particular needs and problems, taking into account the social and economic circumstances; and needs to contain far more than simply a technical description of the various alternative machines. These requirements have implications for the most efficient mechanisms for information collection/dissemination.

At the collection end, they suggest that the semi-automatic compiling of technical information - as in some proposed data bank proposals are riot likely to be of much use to users. This sort of system is unlikely to give users information in a form that they can use. Users would be likely to be served much better if they were put directly into contact with institutions/individuals who have considerable experience in the relevant fields, and who may then, through personal contact, present the information in a helpful and relevant way. At the local dissemination end, it would seem that individual technology users - those making the investment decisions - need to be assisted in formulating their enquiries and appreciating the replies, by institutions/technical assistance experienced in dealing with the sort of information presented.

Various individuals and institutions throughout the world are already collecting and documenting much relevant information in relation to particular areas - artly in the course of answering queries from LDCs, like VITA[38] and ITDG, partly during the process of formulating appropriate development projects. like the World Bank and some aid agencies, partly during economic/social/scientific research. Centralising all this information in a single data bank would be a mammoth

[38] Volunteers in Technical Assistance.

task, and one of limited value. It would require continuous updating, would, for reasons already stated, probably be of limited use to users, who would lose rather than gain by receiving the information from the centralised source, rather than from the individuals/institutions responsible for its collection in the first place, who should be able to formulate the information in more relevant form.

The conclusion; for international mechanisms are that networking and linking users and sources of information is the appropriate function for an international mechanism, rather than the compilation of technical data. Networking involves establishing a directory of sources of technological knowledge and linking users with the relevant source. Users may be able to address enquiries directly to the central unit of the network, which then hands the enquiries on to the relevant sources, or supplies the users with relevant names and addresses; or the users' enquiries may be filtered through screening institutiono. as in the World Bank proposed Technology Referral System. Any network is only as good as its individual components, at both ends - information source and user application. In the field of appropriate technology both ends are weak. Collection of information on the existing shelf of techniques has been sporadic and unsystematic. This is one reason why some proposals - e.g. the UNIDO Industrial and Technological Information Bank - do include provisions for the collection of information. Any centralised network system should - in the process of its work - help identify gaps in the compilation of information - indeed this should be one of its functions. It might then take responsibility for seeing these gaps are filled - raising funds for it, and organising work. However, the identification of these gaps and filling them will also be one aspect of a systematic R and D effort, as will be discussed below, so that responsibility for this type of gap filling might in part be handled by the system designed to promote R and D.

Research and Development

The dividing line between collection of information about the existing shelf of techniques and research and development into new techniques is a bit arbitrary, possibly unjustified. The use of the term 'shelf' is itself misleading, as if all the alternative techniques were laid out

on a shelf in the larder, waiting to be identified and catalogued. In fact a systematic search for alternative 'known' techniques can be difficult and expensive - it may involve searching among the science museums for old methods of doing things, as well as a geographically extensive search for methods currently in use. As this sort of search proceeds, the dividing line between what is 'known' and what is not tends to disappear, as does therefore that between cataloguing existing information and discovering new. Moreover, small changes in 'known' techniques (e.g. use of different materials) may make the techniques appropriate in particular circumstances; or synthesising processes in a new way - as shown by the research at Strathclyde University - may make a major difference to the appropriateness of the whole productive process, e.g. in terms of employment implications. But even minor adaptations or new syntheses are innovations requiring engineering knowledge and some field testing before they are proven. In many cases, then, efficient search, or collection of information also involves a research and development element. And, of course, efficient R and D requires a preceding search/collection effort in order to identify requirements and gaps and avoid duplication.

This discussion has relevance for institutional forms: it suggests that search and research should be kept together where possible. It supports the conclusions of the previous discussion that a technology referral/networking service is likely to be of greater use than a data bank, because the former can link users directly with researchers, who will have up-to-date information, and will be able to appreciate how small technical innovations may improve or make possible certain approaches; at the same time, the receipt of this sort of enquiry will direct the attention of researchers to current needs and problems. Some technologies are relatively routinised and for these cataloguing of information may be disassociated with research activity. A flexible networking/referral system would allow for this.

Organising R and D for appropriate technology is probably one of the most important aspects of an appropriate technology policy. and one to which Least attention has been paid. As Suggested earlier, there are three aspects to its identifying R and D needs, getting particular organisations/individuals to carry out the research. and funding the research. The identification of R and D involves, as already stated, a

search for existing techniques. It also requires knowledge of the social/economic conditions of the likely users of the technology, as well as of their technical capacity, their resources, managerial capacity, infrastructural services and so on. Hence any successful research must have strong links with likely users and a strong LDC element. There has been some discussion about the relative merits of carrying out the necessary R and D in developed countries as against LDCs, and in international as against national institutes. There are very strong arguments in favour of R and D for appropriate technology being carried out in LDCs: not only does this vastiy ease the communications problem between users and researchers, but it also means that the important learning effects of doing the R and D are gained within the LDCs. The only case for carrying out the research in the developed countries is that their research capacity may be stronger. However, many LDCs have large numbers of very good scientists and engineers. I would conclude that appropriate R and D should take place in the LDCs except in very exceptional circumstances. Of course, international institutes may be located in LDCs - as for example IRRI and Khan's proposed institute. The advantages of international as against national institutes are that they may be easier to fund internationally (along the lines of the international agricultural institutes), and that international use and communication of results may be easier. Disadvantages are that there may be less national commitment to the institutes, and that they are likely to be organised on the lines of international organisations, with high salaries, international bureaucracy and so on. An associated question is whether it would be better to identify suitable existing institutes (national) and get them to reorient their work towards appropriate R and D, rather than set up new institutes. My feeling is that transforming national institutes would be of much greater long-run significance for development, than creating new institutes, particularly new international institutes. The drive for technological independence requires that the R and D should be done in and by national institutes, rather than international. Currently, the national institutes absorb large quantities of well-trained scientific manpower. Yet it is widely believed that much of the work is of little net benefit, consisting of duplication of advanced country research, rather than independent appropriate research. If these institutions could redirect their efforts towards appropriate technology, this might make a major research contribution - far greater than

if the appropriate research were confined to a few international institutes. (It is estimated that 12% of the world's scientific manpower is located in LDCs). Currently, financial rewards and international reputations tend to go to those scientists pursuing 'pure' science; and in the applied field to those who produce teshniques of use to the large-scale 'inappropriate' technology sector. An essential aspect of a policy to promote appropriate technology is to change this.

Lack of major sources of funds for appropriate R and D has been au obstacle. Despite such verbiage and the large number of appropriate technology groups, total expenditure on R . ad D is very small. Whoever does the research, funds will be required. Currently, there is considerable potential interest among donors - see for example the US Program. the UK's recent endowment of ITDG, the Dutch government's concern with the subject, and the documents indicating the interest of the World Bank, ILO, UNIDO, UNDP, OECD and so on. Some international mechanism is required to tap this potential interest - (a) to survey the field fairly systematically to identify potentially useful areas of research and individuals and institutions who would do the research: (b) to get an international commitment to the use of funds so as to avoid duplication of efforts by different donors; (c) to incorporate a strong LDC element in decisions and organisation so as to avoid the 'colonial' taint that has touched some of the work on appropriate technology; and to get the essential national commitment to the development and use of appropriate technology; (d) to make sure that the results of the research are transmitted internationally; (e) to organise follow-up studies to see how effective the process was from identification of noeds through research, development, prototype testing, to introduction of the techniques.

Social/Economic Research

There are strong reasons for believing that socio/economic variables may be of as much significance as technological ones in determining the choice of techniques.[39] Providing

[39] See F. Stewart, **Technology and Underdevelopment**, op.cit.

information about appropriate techniques (old ones or newly developed ones) may be necessary but not sufficient. A vital element of a successful appropriate technology policy may then be the identification of the other elements necessary for successful introduction of appropriate techniques.

PRGPOSED AND EXISTING MECHANISMS: COMPARATIVE ANALYSIS

Information

The Inter-agency Network for the Exchange of Technological Information, the UNIDO Industrial and Technological Information Bank (INTIB). the World bank's proposal for a Technology Referral Service (TRS), SATIS and the proposed International Appropriate Technology Unit are all intended to fulfil an information collection/dissemination function. Of existing mechanisms, VITA[40] and ITDG do a good deal of dissemination, with VITA's work being most systematical1 organised. The UNIDO enquiry service also does, but it is not directed at appropriate technology. The conclusions of the discussion in the previous section were that three functions were required of an international mechanism in relation to information collection/dissemination:(a) networking. rather than centralised cataloguing of Information; (b) systematic dissemination including follow-up to see that the dissemination was effective; and (c) identification of information collection gaps, and getting these gaps filled.

The Network for the Exchange of Technological Information is still at a fairly early stage of development: it is possible that it could provide a framework into which other systems (e.g. TRS and SATIS) could fit. The Network may therefore provide some useful comprehensive framework, but as it stands it does not look as if it can do much for appropriate technology. The UNIDO/ITIB, as outlined, has

[40] VITA (the Volunteers in Technical Assistance) is a voluntary body situated in Washington which organises replies to technical enquiries from LDCs. They have 5,000 experts vho are ready to answer the enquiries free of charge; they deal with between 1200 and 1500 enquiries a year.

a large element of information cataloguing, which, it has been argued, is not the best way of collecting/disseminating information. The UNIDO proposal, like the Network, has no particular emphasis on appropriate technology. The most promising networking proposal is that of the World Bank, which contains carefully worked out proposals for networking, for screening of enquiries, and for follow-up. Although the Bank takes a 'neutral' view of appropriate technology, its own work suggests that the system is likely to emphasise appropriate technology, as understood here. It would seem that the TRS offers the most well-worked out and promising system for networking and dissemination, and should provide the basis for a new international mechanism in this field.

There are three areas in which clarification and possibly supplementation of the World Bank proposal are required. One is to strengthen the appropriate technology side of the service. As it stands it is possible that the service could efficiently promote 'inappropriate' technology. It is proposed, to begin with, to service both small-scale and large-scale enterprises but implicit is the proposal that it may be desirable to phase out one or other of the two in the next stage. It is essential, if the service is to promote appropriate technology, that the small-scale side of the operation is retained. Secondly, it would be helpful to have built into the system some way of identifying information/research gaps and some system to get them filled. Further discussion is also necessary on the proposed screening institutions. However, the TRS provides the basis of a useful international network/enquiry service. SATIS is a network for the appropriate technology groups, and could fit, as a subsystem, into the TRS. One problem with SATIS is that, as it stands, the proposal incorporates an information-cataloguing as well as a networking function.

On the information collection/dissemination side, then, while existing mechanisms are inadequate, proposed mechanisms provide a satisfactory basis for the development of a new international mechanism. However, while the TRS is likely to provide a good formal network, effective information communication also requires a vast array of informal activities - seminars, training sessions, journals, pilot projects, consultancy and so on. No formal networking system can substitute for these. So far this sort of activity has been organised by the Appropriate Technology Groups. Probably it is desirable to keep much of them on an informal ad hoc

basis, but some activities could be organised/financed by some international mechanism - e.g. the institution dealing with the TRS - in the course of its other activities. The USAID proposed Program includes informal dissemination activities, as well as proposals to support more formal networking activities.

Research and Development

The Network/information collection/dissemination proposals discussed do not contain proposals for the promotion of R and D. The proposals directly concerned with research and development are Sir Austin Robinson's Peport, the International Appropriate Technology Unit, the Consultative Group on Appropriate Technology and the Khan proposal. These are fairly different in content. The Khan proposal is for a specific institute for research into appropriate techniques in particular areas. While it obviously has much to be said for it as a direct contribution to R and D, it has little to do with the general problem of organising and funding appropriate R and D. Robinson's proposal is to establish a number of International Institutes in chosen fields (of which Khan's Institute could form one) - with links to national institutes - to collect and record information about existing techniques and to research, develop and test new techniques. The institutes would thus have the dual function of information collection and R and D, and could form part of any networking system adopted. The Bhalla/Stewart proposal is for a small international unit, whose functions would be to select priority areas, raise funds through the Consultative Group mechanism, and commission research in those areas. The research and development would be commissioned in existing national institutions in LDCs; the intention would be for the international unit to act as a sort of catalyst which, while directly financing some R and D, would encourage LDC institutions to redirect a large proportion of their efforts in this direction. As argued above, there is a strong case to be made for carrying out the required research and development in national institutions in LDCs. The analogy with the seed revolution has inspired the idea of international institutes. But the very much more heterogeneous field of appropriate technology may make the model inappropriate. Moreover, some of the problems of the Green Revolution - in particular the failure to take into account social effects - may be due to the strong international

element in its development.

The Consultative Group on agriculture provides a further possible model for international mechanism to promote appropriate R and D. In agriculture in particular, CGIAR has been notably succesful in fund-raising, and in channelling these funds into research. This Group has devoted the funds to international institutes, but others (e.g. the proposed group on tropical diseases) intend to use funds raised to finance research in national institutes. It is clear that irrespective of whether the research is eventually funded in new international, old national or new national institutes, the first priority would be to get donors and LDCs together to commit their funds and interest to appropriate R and D, and to decide on priority areas. For this CGIAR provides an excellent model, being flexible and informal, lacking the bureaucratization which often bedevils international bodies. CGIAR has a small secretariat, and a technical advisory committee consisting of distinguished scientists in the field. CGIAR's membership is also fluid, but until recently it has been dominated by the donors. A similar group for appropriate technology would need a much stronger LDC membership and commitment.

While the TRS provides a good starting point for information networking, proposals for promoting appropriate R and D are still at a much earlier stage, but elements of a fruitful approach to the question are contained in the examples of Consultative Groups. If a similar mechanism were established for appropriate technology, it would draw on the other proposals in determining how to go about organising R and D for appropriate technology.

Social/Economic Research

M. Usui's proposal is the only one directly related to the socio-economic dimensions of appropriate technology. It, or something similar, would play a vital role in complementing any major effort on the technical side, providing an opportunity to follow up and assess the effects of improved information and improved technologies. The Green Revolution story indicates how important such research would be.

CONCLUDING REMARKS

Recently there has been an upsurge of interest in appropriate technology; yet despite widespread approval of the idea, action has been of almost minor significance. The lack of action is not due to lack of finance; more to lack of sufficient specific and well thought out ways of promoting appropriate technology. Much of the necessary action - perhaps most - requires changes at the national level within LDCs. But there is also an urgent need for new international mechanisms to improve information collection and dissemination and to promote appropriate R and D. Despite the view voiced above, that it is difficult to separate the two functions completely, it is possible and desirable to separate the institutional form the new mechanisms take, in order to make the task of manageable proportions.

One need is for improved systematic networking. This paper takes the view that the World Bank proposal for a Technology Referral Service offers a promising model; and should be supported. But the service should perhaps make greater efforts to concentrate on appropriate technology than appears in the proposed outline. It should also aim at identifying information gaps and provide some way in which they could be filled. Any institution responsible for the networking should obviously have links with-other international mechanisms for appropriate technology. But there is no need for them to form part of the same institution. The new networking mechanism would not be a substitute for the many informal information dissemination activities which would continue to be of great importance.

Another major need is for the promotion of R and D into appropriate technology. Very little systematic work has been done here, and it seems likely that the potential returns may be huge. It also seems that funds would be available if suitable opportunities could be identified. But we are not yet at the stage when it makes sense to set up a vast array of new institutes. What is needed at this stage is (a) raising funds; (b) identification of priority

areas; (c) organising finance of R and D in the priority areas - selecting institutions/individuals most likely to be productive; (d) organising prototype testing. A framework of action on each of these is spelled out in the following Chapter.

Part III
Global Action

Chapter 6
A BLUEPRINT FOR ACTION

P. Henry, A. Reddy and F. Stewart

INTRODUCTION

Chapters *3*, *4* and *5* have already established the scope for much more concerted action on appropriate technology than what obtains at present. Yet the existing institutional mechanisms do not faze up to this challenge. Since the writing of the above chapters, we undertook extensive field visits to a number of countries (e.g. India, Bangladesh, Indonesia, Thailand, Philippines, Korea, Kenya, Mexico, Japan, United Kingdom, Netherlands and the United States), to United Nations organisations (e.g. ILO, UNIDO, UNEP, UNCTAD, FAO, UNESCO, UNDP, UNICEF, ESCAP and the World Bank), to appropriate technology groups (e.g. TRANET, ITDG, VITA and TOOL) and to national science and technology institutions in LDCs (e.g. Asian Institute of Technology, El Colegio de Mexico, Technology Development Centre, Bandung, and Indian Institute of Science, Bangalore).

The programme of action outlined here is generally supported by the majority of those who were consulted during the field visits. While some reservations were expressed on details the proposal to establish a new international mechanism for the promotion of appropriate technology (IMAT) received

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[1] Secretary-General, Society for International Development, Rome; Professor, Indian Institute of Science, Bangalore; and Senior Research Officer, Institute of Commonwealth Studies, Oxford.

overwhelming support.[2]

For the global action proposed here, appropriate technology is defined as technology which will raise the productivity and incomes of the poor in rural and urban areas, which generates productive employment, makes full use of local resources, and produces the types of goods and services needed to meet the minimum need of all the people.

The prime emphasis-oi such a definition is towards small-scale capital-saving technologies which are accessible to the poor, and which are essential for the creation of productive employment on a sufficient scale. But the definition also includes large-scale and relatively capital-intensive technologies which may also have a vital role to play in meeting development objectives.

In the light of the isappropriate characteristics of much technology emanating from advanced countries, we found widespread agreement that there is a need to promote appropriate technology designed to correspond to the conditions and needs of third world countries, in two main categories: (a) the adaptation of large-scale technologies to suit the requirements of developing countries; and (b) the development and dissemination of small-scale employment-generating technologies.

There are often serious deficiencies in the availability of appropriate technologies. This in part is due to lack of research and development (R and D) on appropriate technologies, and in part to weak dissemination of information about those appropriate technologies which are in existence. Current emphasis with respect toth to R and D and to dissemination is overwhelmingly concerned with advanced country technologies. Hence there is a need for R and D and for improved dissemination of information regarding the hardware aspects of appropriate technology.

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[2] This Chapter draws heavily on the feasibility study on **IMAT** prepared by the authors. See "A New International Mechanism for Appropriate Technology - Feasibility Study by a Team of Specialists". The Hague, October, 1978.

However, even when the hardware is available, it is well known that the dissemination and application of this hardware does not proceed as rapidly as required by development needs. Many social and economic changes are essential - for example, changes in access to resources and assets, in prices, in the lending policies of banks, in government regulations and expenditure policies, and so on. The socio-economic software aspects of appropriate technologies are not less, and sometimes far more, important than the hardware aspects; both aspects must be emphasised in the promotion of appropriate technologies.

National technological capability is a crucial component of the self-reliance of developing countries. Further, appropriate technologies are largely location-specific, resource-specific, and perhaps even culture-specific. For these reasons, the development and dissemination of appropriate technologies must be unequivocally based on national efforts in the developing countries.

These national efforts can, and do, emerge from established institutions of education, science and technology as well as from "voluntary groups" and "non-governmental organisations". Neither of these two mechanisms must be viewed as any less important than the other; each has its special strengths and weaknesses, and it is the utilisation of both which best serves a national thrust towards appropriate technologies. The effectiveness of this thrust depends upon the level of technological capability in the developing country.

Even when the level of national technological capability is high, the generation and dissemination of appropriate technology is limited by:

(a) an atmosphere in which little prestige is attached to work on appropriate technology in contrast to the active encouragement of work on advanced count-y technologies;

(b) an excessive bias towards R and D on advanced country technologies:

(c) the lack of identified priority areas in appropriate technology;

(d) the paucity of information relevant to priority areas;

(e) the weakness of the development phase of technology generation compared to the research phase;

(f) the absence (or deficiency) of appropriate technology delivery systems involving effective linkages between producers (institutions/groups/organisations) and users of appropriate technology;

(g) the lack of interaction and coordination between different appropriate technology efforts, for example, between the efforts of institutions and voluntary agencies or of national and local organisations in the same country, and between appropriate technology activities in different countries;

(h) the inadequacy of funds, equipment, etc. for critical activities such as pilot plants, field trials, demonstration projects, information exchange, etc.

When the technological capacity of a developing country is low, there are other serious limitations in addition to those listed above:

(a) the absence of appropriately endowed institutions with the potential for developing appropriate technology;

(b) the insufficiency of technical expertise;

(c) the absence of training facilities;

(d) the inadequacy of funds for R and D.

NEED FOR GLOBAL ACTION

It is these limitations on national appropriate technology efforts which define a perspective for global action. The essence of this perspective is that the principal, and perhaps even sole, objective of global action should be to strenghten national appropriate technology efforts where they are weak, and assist in initiating them where they do not exist. In other words, the primary purpose of this action is to help national efforts to overcome their limitations.

As noted in earlier chapters, many existing international institutions are concerned with technology transfer from the developed to the developing countries. At the same time, some international institutions are directing efforts towards the development and/or dissemination of appropriate technologies. Despite this, the fact that the primary responsibility of these institutions does not lie in the field of appropriate technology means that it forms only a peripheral part of their activities. Neither are these international institutions concerned, to any significant extent, with research and development directed towards the generation of appropriate technology. In short, no international institution has the promotion of appropriate technology as its sole objective.

Recently, national institution: for the promotion of appropriate technology have been established in some developed countries - in the UK and USA - but, lacking an accepted international character. they are unable to ensure the full participation and commitments of developing countries. Similarly. many small voluntary bodies in the developed countries, e.g. VITA (USA), ITDG (UK), CRET (France) and TOOL (Netherlands) are devoted to promoting and disseminating appropriate technologies. Although these voluntary efforts are useful, their magnitude is inevitably small in relation to the massiveness of the task. In addition, they often lack the necessary international and developing country component.

The foregoing discussion has led to four major conclusions:

(a) there is an imbalance in globai work on technology with an overwhelming portion of this work not being primarily concerned with technologies appropriate to the needs of developing countries;

(b) whilst being the best guarantee and surest foundation for the successful development and dissemination of appropriate technologies, current national efforts within developing countries suffer from a number of limitations;

(c) there are severe deficiencies in the flow of information about appropriate technologies between nations leading to some duplication of efforts and providing an impediment to the introduction of appropriate technologies where these exist;

(d) a suitable international mechanism for the promotion of appropriate technology is currently absent.

It follows that there is a strong case for an international mechanism for appropriate technology.

A NEW INTERNATIONAL MECHANISM FOR APPROPRIATE TECHNOLOGY

It is proposed that the new international mechanism should be a non-governmental institution. Although outside the main body of the United Nations system, it should be closely associated with it through a sponsorship arrangement. Thus, it would be a consultative group with a category "A" status which would give it the privilege of being consulted by the UN system in all matters related to appropriate technology. It would have the character of an association tc provide the possibility of individuals and institutions becoming members of regional/sub-regional/national/sub-national chapters being formed.

Functions of the Mechanism

The basic objective of the new mechanism will be to help national appropriate technology efforts in overcoming their limitations.

The role of IMAT will therefore be supportive and catalytic: rhus the aim of IMAT, in relation to each of functions, would be to encourage and assist other institutions - national and international - to redirect their efforts effectively towards appropriate technology. The intention should be that IMAT would rarely take an exclusive role in any project; while it might initiate action it would always try to involve others at an early atage and aim to pass total responsibility to other institutions/individuals as soon as feasible. In playing this supportive and catalytic role, IMAT will have various functions which should possibly include:

(a) helping in the identification of priority areas for appropriate technology work;

(b) identifying institutions and groups which require

critical support for the successful development and dissemination of appropriate technologies;

(c) providing suitable assistance by way of information, funds, equipment, training, experts, etc. to these institutions;

(d) assisting the passage from the research to the development phase in the generation of appropriate technologies, e.g. through pilot plant trials, and from the technology generation to the diffusion phase, e.g. through pilot demonstration projects;

(e) strengthening appropriate technology delivery systems by facilitating direct contacts between the producers of appropriate technologies and the users of such technologies;

(f) contributing to the generation of an atmosphere in which the prestige of appropriate technology is enhanced;

(g) facilitating the exchange of experience among appropriate technology institutions/groups in different countries, sub-regions and regions;

(h) disseminating appropriate technology "success stories' as well as insights into causes of failure of hardware and/or software;

(i) assisting the creation of a new national or sub-national institution when circumstances make such an institution crucial to national appropriate technology efforts:

(j) studying ways in which private efforts an generation and transfer of technology might be made more appropriate both with respect to technology generated by advanced countries, and with respect to technology developed by local firms in developing countries;

(k) reviewing developments in the field of appropriate technology including socio-economic aspects;

(l) carrying out all other activities, such as fund-raising and monitoring of the effectiveness of its own efforts to enable it to discharge the above functions.

The precise functions carried out by IMAT, and the balance of work as between different functions, is likely to vary over time as a result of experience gained and changes in conditions. Two functions - monitoring its own activities, and conducting socio-economic research into technological choice - will be of particular significance in helping IMAT to identify priority areas for its own efforts.

Operation

It is suggested that the operation of the new mechanism should be guided by the following principles:

(a) the principal aim of IMAT should be to support and catalyse appropriate technology efforts of institutions and groups in developing countries;

(b) IMAT should not attempt in-house R and D activities;

(c) IMAT should not create new international institutions for the development of appropriate technology hardware and software;

(d) where international action is required, IMAT should initiate an international dimension of existing national institutional activities, e.g. an institution in a particular country may be helped to become a training centre for the sub-region or region;

(e) instead of handling the whole spectrum of possible appropriate technologies, IMAT should concentrate on a few selected priority areas, e.g. appropriate agricultural processing technologies. The selection of these priority areas must reckon with current efforts of countries, institutions and groups active in appropriate technology, not only to respect their autonomy but also to benefit from their field experience. The criteria for selection of priority areas should clearly be consistent with the objectives of appropriate technology - viz. to raise the productivity and income of the poor and, to make use of local resources. to produce appropriate products to meet the needs of the poor and to generate employment; the choice of priority areas must also take account of the existing technological situation, selecting areas where there is a lack

of appropriate technologies, or where known techniques are of low productivity. However, selection of priority areas will vary according to which function IMAT is pursuing; for example, information dissemination activities are best pursued where appropriate technologies have already been identified in some part of the world;

(f) there should be considerable flexibility in approach so that IMAT could interact with governmental and/or non-governmental institutions or agencies in the developing countries and vith national, sub-national or local institutions. IMAT should not attempt to centralise appropriate technology efforts within a country. Considerable flexibility is essential in view of the competition and even conflict which sometimes exists between drfferent groups and institutions;

(g) many of the active appropriate technology groups and institutions have achieved their present level of efforts through a strong spirit of self-reliance. Since such a self-reliant activity is a major objective of IMAT, its linkages with these groups and institutions must be designed to strengthen this self-reliance. This implies that IMAT support to these institutions must in no way lead to the imposition of priority areas, programmes, experts, etc. In some ways, the collaboration between the Development Technology Centre - Institution of Technology, Bandung and the TOOL Foundation in the Netherlands is a model which ensures the self-reliance of the DTC-ITB whilst enabling TOOL to be of considerable assistance ;

(h) in facilitating the collaboration of different groups and institutions, IMAT should aim at the establishment of self-reliant networks of the type established in the United Nations University Programme on Traditional Technologies:

(i) IMAT should not aim to start operation in all developing countries; the approach should be based primarily on organic growth relying on institutions already involved in appropriate technology activity or where it is believed such work can be promoted;

(j) since, however. such growth poles may not be well distributed over and within the various regions, it is

important to identify regions or sub-regions in which appropriate! technology activities are conspicuously absent and to help to establish in these regions institutions dedicated to appropriate technology. Of course, any new institutions which are created must have characteristics which facilitate the development and dissemination of appropriate technology, e.g. proximity of target groups;

(k) insofar as the thrust of appropriate technology must change with time and vary with location, IMAT should not be preoccupied with constancy and uniformity of approach. It should be dynamic and adaptable. Thus, IMAT should be flexible in the definition and development of its own functions:

(l) it will not be the function of IMAT to coordinate the appropriate technology activities of the UN and other international agencies; but IMAT will seek to coordinate its efforts with these agencies when their work is related to the same priority areas. In particular, when these agencies, e.g. the United Nations University or the Regional Commissions, already have programmes which are in tune with IMAT's own objectives, IMAT should support and work through such programmes provided that they involve actual field activities at the grass roots level.

IMAT may assist international institutions and national developed countries' efforts to support appropriate technology by identifying suitable projects and activities.

Organisational Structure

Secretariat. The secretariat should be small since its principal role is to support, catalyse and activate national appropriate technology efforts in the developing countries. In the first few years of operation, it may perhaps consist of about 3-6 senior professionals with about one for each priority area and the requisite support staff. To compensate for this restriction in size, the secretariat may convene ad hoc panels of experts to assist in special areas and/or establish networks of groups active in those areas.

The members of the secretariat will spend a considerable proportion of their time (e.g. half) avay from the headquarters of IMAT, visiting national institutions, appropriate technology projects and so on. The staff members should be technologists and social scientists. It is important that the secretariat consist of people vho are experienced, innovative and entrepreneurial.

The Director sad senior staff should be appointed by the Governing Body vhich in turn will be selected according to procedures instituted by the founding members (see belov).

Location. The location of IMAT's secretariat is bound to be an important factor vhich will help determine its acceptability and performance.

It is clear from the thrust of the previous discussion that IMAT must be located in a developing country; it should be situated in a country vhich villvelcome the institution, and preferably, one that already has a serious commitment to appropr. ate technology. It will be an advantage to IMAT if the particular developing country has a rich experience in appropriate technology so that IMAT's secretariat can benefit *from* locally available intellectual inputs and awareness of field conditions and problems. Of course, IMAT should be located in a place vith good transport and communication facilities.

It is not necessary that the location decided upon initially should be a pe-ent one; the location for IMAT's initial *gestation* or take-off period can be temporary. During the course of consultations, many of the UN organisations seemed to vish to host IMAT, locating IMAT either physically and/or *de jure* within their auspices. However, the team receive4 very strong intimations that it vould be preferable to have IMAT outside the UN system, both formally and physically: locating IMAT vithin any single existing UN organisation vould lead to counter-productive inter-agency rivalries. This feeling vas shared by many people consulted in *the* developing and developed country research institutions and government departments.

Notwithstanding the possible cost advantages of locating IMAT in an existing international institution, such a move

would bring in its wake the disadvantages associated vith the image, procedures and influence of the host institution. It appears therefore that IMAT should not be housed in any UN agency, organ or organisation.

Whichever the initial location of IMAT, there say be a tendency for it to concentrate its activities in the region in which it is located. This tendency can be corrected by IMAT having regional offices or perhaps using one of its associated institutions to take on, vith IMAT's assistance, IMAT's supportive and catalytic functions for the region.

Governing. The Governing Body should consist of betveen 20 and 30 eminent persons who have made distinguished contributions to the field of appropriate technology. They should not be representatives of either governments or agencies, but vould be selected as a result of recommendations from relevant institutions such as (a) donor governments/agencies, (b) the governments of developing countries, (c) appropriate technology institutions and (d) non-governmental bodies active in appropriate technology. An attempt must be made to ensure that the governing body achieves a reasonable geographical representation, and a balance in favour of the developing countries.

The Governing Body will select the Director of IMAT, and, with the assistance of the Directo-, appoint senior staff. The Governing Body and Director will define the constitution of IMAT, in the light of discussions at the Founding Conference. The main role of the Governing Body will be to provide general directions for IMAT's vork in its priorities and programmes, and provide a critical review as the vork of the mechanism proceeds. The Governing Body will meet once every year or two.

Executive Council. The Governing Body will provide overall direction, but because of its size and the (relative) infrequency of meetings it may be desirable to have an executive council vhich meets sore frequently to provide a sore regular overview of the vork of IMAT. The Executive Council vould consist of about six persons, two-three from the secretariat of IMAT and three-four from the Governing Body. The Executive Council, vhich is ultimately responsible to the Governing Body, should meet about every six months.

Level of Finance

To finance the secretariat, a minimum sum of US$ 0.5 - 1.0 million will be required. This sum will be used mainly for secretariat salaries and various administrative expenses including travel of secretariat staff to field projects and the organisation of governing body, executive council, expert panel and other meetings necessary for the secretariat to discharge its functions.

In addition, IMAT must have fund- for the support and initiation of projects and programmes in the field. It is envisaged that the bulk of IMAT's funds will be devoted to these field activities. Administrative expenses should not exceed some fairly low fraction of the overall expenditure of IMAT. A figure of 10% was suggested. However, it is difficult to be precise about any such figure partly because what is desirable and feasible is likely to change over time as IMAT gains experience and the administrative machine is established. Kore significantly, because of the catalytic role of IMAT, IMAT may often initiate appropriate technology activities but not finance them, or only finance a very small proportion of the total activities. In such cases, IMAT's administrative costs nay appear to be a high proportion of its total expenditure, although they are a low proportion of the total expenditure on appropriate technology generated by its work. Thus any target figure for the ratio of administration to other expenditure vould be misleading and might even distort the activities of IMAT.

It is suggested that at a Founders' Conference, vhicb will bring IMAT into being, a number of governments and agencies will contract to place at the disposal of IMAT a block grant of around US$ 10 million for an initial take-off period of three years. IMAT will prepare a three-year budget vith annual components to be approved by a small Finance Committee. This Finance Committee which will include representatives of donor governments and agencies, is intended to assist IMAT's Governing Body in matters of finance. The approval of the three-year and annual budgets will be in terms of the directions, priorities and programmes.

Such an arrangement will ensure that IMAT's secretariat can concentrate during the take-off period upon substantive

matters and programming work, rather than on public relations and fund-raising on a project-to-project basis.

It is envisaged that towards the end of this initial take-off period, IMAT's performance will elicit regular contributions from governments and agencies so that its activities can be expanded.

CONCLUSION

We recommend that the nev international mechanism should be established as soon as possible. For this purpose, a special Founders' Conference should be organisea. preferably to be financed by a number of participants including donor governments from developed and developing countries, and non-go-rernmental appropriate technology bodies. The Founders' Conference should determine the functions, location and funding of the new mechanism. It should also establish and institute procedures for the appcintment of the Governing Body of the mechanism.

The early establishment of the new mechanism would be very timely in relation to thr forthcoming UN Conference on Science and Technology for Development to be held in August 1979, which should enable the nev mechanism to elicit wider participation and support.