An Approach to the Generation of Technologies Appropriate for Rural Development

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One of the basic problems facing the Third World countries today is how to generate technologies adequate for an autonomous and self-sustained process of development. A few decades ago the solution seemed relatively simple: to strengthen the capacity of the small R and D systems of those countries after the model offered by industrialised societies. After an appropriate scientific and technological capability comes into existence the rest - its coupling with the productive system and, consequently, the starting of a true process of development - was taken for granted. Besides, the technologies that could not be produced locally, could be transferred from the developed countries.

As it is now well known this simple scheme did not work, and one of the few things in science policy we have truly learned in the last years is that the relationship between science and society is much deeper and subtler than it was formerly believed. Consequently, the first condition to devise a science policy for the future is to have some idea about how the concept of development has evolved, and how this evolution affects the role that science and technology should play in the process. In what follows we will briefly analyse that area of problems and, on that basis, a methodology for generating technologies for the rural areas of the Third World countries will be suggested.

THE TRADITIONAL APPROACH TO DEVELOPMENT

The process of development was conceived - and is still being conceived by most international organisations engaged in financial and technical aid or assistance - as a linear process. According to this concept, underdevelopment is an early stage of development and, essentially, not very different from the situation of the developed countries before, or at the beginning, of the Industrial Revolution.

In this context the problem of development, at least from a conceptual point of view, is relatively easy; it consists of repeating the path followed in the past by the developed countries. In practice, this rich and complex evolution is reduced to a process of industrialisation. In a certain sense "development is industrialisation" reflects the nineteenth century mechanistic view of human progress. In this conception of development - which amounts to a whole vision of the world - cultural differences were almost completely neglected. The specific characteristics of the poor societies were mainly valued - despite the lip service paid to their cultural achievements - in relation to their relevance to the prevailing conception of progress. To the extent that those cultural specifities posed obstacles to the western-style transformation of those societies, they were considered a sign of backwardness and were destined to be changed. In other words, cultural differences were implicitly assimilated to the stages of economic development.

From the point of view of the market, this industrialisation was based on the demand of the privileged minorities which constitute between 10% and 20% of the total population in most developing countries, and hold most of the economic and political power. These minorities are predominantly urban, have an essentially European education, and follow the cultural habits, values and pattern of consumption of the middle and upper classes of the advanced countries. A modern sector of the economy was then developed in the backward countries, which in some fundamental aspects are closely integrated with the industrialised countries.

The rest of the population, mostly rural, has been hardly touched by this process of modernisation, and remains more or less in the same state of poverty and backwardness that has been its lot for many generations.

The relationship between the modern and the traditional sector is one of dependency that closely resembles that prevailing between developed and underdeveloped countries. The traditional sector produces the raw materials that are exported or required as inputs by the modern sector. Most of the benefits of international trade are invested in the modern sector - a considerable part goes to consumption of luxuries - which, added to the great wage difference between the two sectors, tends to widen, or at least maintain, the economic gap between the two sectors.

SCIENCE AND TECHNOLOGY IN THE CLASSICAL APPROACH TO DEVELOPMENT

What was the role of science and technology in this scheme of development? In the first place, and taking the evolution of the developed countries as a determinant paradigm, it was implicitly assumed that technology evolves in a kind of self-contained process relatively independent of the human will. To use a biological simile, technology evolves as if directed by an internal genetic code little affected by the external environment.

The fact that modern technology originated in a particular group of countries with given cultural and socio-economic conditions and that, consequently, it might not be adequate in a different environment was not taken into account, except for the recognition of the necessity of minor adaptations. This is a logical consequence of considering cultural differences as mere stages in the process of development: the idea was that the "universal" western technology - not the scientific knowledge on which this is based - superimposed on "backward" societies, will finally lead them towards the true road to progress.

As a consequence of this conception, R and D systems were created in the developing countries with the same imitative criteria that were used to induce industrialisation. They have the same structure and follow the same general principles of those in existence in the advanced countries. It was assumed that once a "modern" scientific system - in the sense of subjects of research, quality of personnel, equipment, etc. - came into existence, it would, in due time, naturally connect with the productive system through the classical chain of basic, applied, and development research.

As it is now well known, those expectations were not fulfilled. Despite the advice and material help of international institutions and scientific centres of the advanced countries, the R and D system of the developing countries proved incapable of generating any significant amount of indigenous technology. Even in the field of adaptation, in most cases they were only able to introduce minor modifications to adapt a final product or process to local conditions, or to make better use of the particular combination of factors of the country involved. And for the study and solution of the basic problems of the poor sector - mostly rural - of these societies, their contribution has been negligible.

The reasons for the failure of the R and D systems of the underdeveloped countries are very complex, and include socio-economic and political factors which we cannot analyse here. (1) However, even from the point of view of the technological dimension, the causes of the failure are fairly evident. The explicit objectives of the R and D systems of the developing countries were first to interact with the productive system - mainly the industrial sector - to satisfy the demands of the international market, and second, to generate innovations in order to be able to compete in the international market.

As the internal demand is shaped by the pattern of consumption of the developed countries, and consequently requires the same technology, it is difficult to see how the weak R and D systems in the poor countries could compete with the scientific and technological structure of the industrialised centres. The failure to contribute to solutions of the problems of the rural areas is determined by the fact that the R and D systems are connected with the modern or rich sectors, and have very weak links with the traditional sectors. In addition, the vast masses of the poor rural areas exert very little demand on the economy, and consequently on the scientific system. They have needs, but not the means to transform them into effective demand.

A NEW APPROACH TO DEVELOPMENT

The Theory of Dependency

The concept that development is not a linear process, and that underdevelopment is not simply an early stage of development, had already been stated in the nineteenth century, although the word "development" was not yet incorporated into the socio-political language. The analysis of imperialism by Marx and his followers was a crucial step in that direction.

In the last decade, mainly in Latin America, a stream of ideas developed in which the central theme was the structural character of underdevelopment. According to this position, capitalism in under developed countries, although having the same general characteristics as in the industrialised countries, also has some peculiarities that are largely due to the position of those countries in the international power structure. Underdevelopment is not merely the first stage of development but represents a different structural situation, largely generated and conditioned by the existence and evolution of developed societies. During the process of colonial expansion, and particularly as a result of the industrial revolution, the countries of the Third World were incorporated into the international capitalist system as peripheral, dependent economies, essentially exporters of raw materials and importers of manufactured goods originating from the great industrial centres. The structure was based on the alliance between local beneficiaries (land owners, importers and exporters, financial elite, etc.) and the international centres of world power. (2)

The form of dependency has suffered certain changes in the last few decades. A great part of the goods which were formerly imported are now produced in the developing countries, mainly by multinational corporations or by local enterprises associated with them. Another development in the last few years, but still in its very early stage of implementation, is the transfer to the developing countries of those industries that, due to their low profitability or emission of pollutants, are not compatible with the high standard of living of the industrialised countries. All this development tends to create a new international division of labour, in which the fate of the poor countries is again to be the peripheral

proletariat of the big powers. The instrument of domination is now, more than military and political power, the scientific and technological superiority of the advanced countries.

The theory of dependency represents a great step forward from the classical approach. By recognising the structural character of underdevelopment it showed that, unless radical changes occur in the international as well as in the national relations of power, there is little hope of a true and sustained development of the poor countries. As for the way to induce those changes, there is a wide range of opinion: from the hope that they can be achieved by promoting gradual changes, even with the support, or at least the acquiescence, of the centres of power (the New International Economic Order(NIEO) is a manifestation of this tendency) to the conviction that only through armed struggle can the necessary changes be produced.

There was a point, however, where all these positions coincided until recently: once the structural obstacles were overcome, the objective was to build societies as "advanced" as the modern industrialised countries. The model could be a modified, more "humane" form of capitalism, or a socialist society, but the central objective remained more or less constant: a society in which every person can have the standard of living or the level of consumption which is now the privilege of the developed countries.

In this context the role of science and technology remained basically unchanged: "to catch up" with the advanced countries, and to give the developing countries the same benefits as those given to the rich countries. The model of scientific and technological development of the western societies remained unchallenged; technology was still conceived implicitly as a sort of independent variable, and the backward societies have the duty to adapt themselves in order to be able to incorporate all its benefits.

The Western Model Challenged

In the last years the conception of the western model as being practically the only model of "progressive" societies has undergone radical changes, and an integrated approach to development has started to emerge. The reasons for these changes - as in all social processes - are difficult to trace in detail, but there are some basic elements that can be identified.

One of the most important of the elements of change - if not in the building of the new approach, at least in helping to convert it into an intellectually respectable option - is the fact that for the first time since the industrial revolution the western world has started to have serious doubts about the soundness and rationality of its own way of development. As is well known, doubts about the intrinsic values on which present western culture rests have been expressed from inside in the past. However, those critical analyses were always restricted to individuals or small groups - artists, philosophers, dissident political groups - and never reached any kind of consensus in the society as a whole. What is different now is that these doubts extend even to the material basis of western society, and they have reached wide sectors of the population, including scientists, politicians, intellectuals, and a considerable part of the informed general public. (3)

If one looks at the evolution of ideas in the last few years, it seems apparent that the main cause of the re-evaluation of the western approach to its own development was the sudden revelation that humanity was probably exceeding the carrying capacity of its physical environment. A deeper look, however, reveals that the realisation of the environmental risk only triggered off fears and

doubts that were more deeply rooted than the simple concern for physical survival. A very brief analysis of a few facts will be enough to clarify this point.

In the first place, it is interesting to see the evolution of the content of the "environmental problematique". When it began, a few years ago, its main emphasis was on the limitation of the physical resources ultimately available to mankind, and the main responsibility for the ensuing dangers was placed on the rapid growth of the population, particularly in the underdeveloped countries. Typical literature on this subject was *The Limits to Growth,* (Meadows et al.). (4) Despite its limitations, this approach contained two basic ideas that, although not new in themselves, were new in their global implications. The first was the conception of a single humanity, in the sense of total interdependence of all human societies - "the Spaceship Earth" - and secondly the awareness that the indefinite increase in material consumption is in the long term a physical impossibility, as well as a doubtful social goal.

From those simple ideas, what can be called the "environmental movement" has developed a current of thinking that greatly transcends the original approach. It has incorporated the concept of "human environment" not merely to denote the human material counterpart of the physical environment, but as a proxy to call in question all the basic values and goals of western society. To a certain extent, the environmental movement is substituting for the political parties, who are wholly incorporated into the system, and are unable to express the deep sense of frustration and lack of meaning and purpose that permeates all social strata of the western world.

Another fact that reveals the true nature of the environmental problematique, is that it is difficult to conceive that the revelation of the possibility of physical limits to economic development would have caused so much concern had it taken place in the nineteenth century or even before World War II. Until that time there was a general belief in the basic values of western society and, above all, a seemingly unshakeable conviction on the capacity of science to overcome all possible obstacles to an endless human material progress. In the last few decades this blind confidence in science - or perhaps more exactly in technology - has, to a great extent, vanished: for the first time since the beginning of the Scientific Revolution, western man started to question the aims and role of science in society. Some of the reasons for this attitude can easily be identified, and refer to the awareness of the actual or potential dangers of some recent scientific developments: the atomic bomb, the possibility of manipulation of the human mind through psycho drugs, the possible implications of the manipulation of the genetic code, the visible deterioration of the physical environment, etc. There is another motive, however, that is deeper and subtler: the growing realisation that to consider technology as a sort of independent variable that increasingly shapes the whole social fabric - values, motivations, interpersonal and social relations - has led to a degree of alienation that deprives individual and social life of all real meaning and purpose.

The extent and the content of the process of self-criticism that the western world is undergoing is well known, so we do not need to revise it here. There are some consequences of the process, nevertheless, that we will examine briefly, because they are especially relevant to our purpose.

The main consequence of the debate has been to destroy irreversibly the conviction that the way of development of the western world in the last two centuries is the best possible one or, at least, is the one inexorably and unilinearly predetermined by the "natural" growth of scientific and technological knowledge. This reasoning, although started in a necessarily negative attitude, has an important positive counterpart: the way a society develops is based ultimately on the basic

values of that society, and these values can change, as they have changed throughout history. The direction in which science - or better technology - develops is, to a great extent, also a function of those values; there is nothing predetermined in the type of technology a society creates. It is true that *scientific knowledge* evolves through a certain logical sequence due to its very nature, but a given body of scientific knowledge allows the creation of many possible types of technology, and the one adopted depends ultimately on the goals and values of the society involved. In other words, the predicament of western society is not an irreversible process, as some lines of criticism seem to imply; there are options, and history is still an open-ended process with many degrees of freedom.

One of the main results of the debate going on has been to change the attitude of the western world towards other cultures. Faced with its own limitations, and with the necessity to find new options, the western countries had to begin to re-evaluate the content of other cultures. It is not only a question of trying to assess their approach to development in the traditional material sense, but, above all, it is an effort to try to understand their whole conception of life manifested through values, social and interpersonal relationships, philosophy and religion. It is the growing awareness that other cultures can make fundamental contributions to the construction of a better society.

This realisation of the presence and importance of other cultures has another root, no less important than the one referred to above, but less obvious. Since the consolidation of European dominance in the nineteenth century, the predominant vision of the world of western culture was that of a "civilised" centre, surrounded by a vast hinterland whose only real importance lay in the provision of raw materials and a few luxury goods, and the absorption of western industrial production. The cultural backgrounds of those dimly perceived societies were considered mainly as relics of the past, opposed, or at least irrelevant, to the building up of a really progressive and "modern" society.

During this century the conditions of the world on which that vision was based have greatly changed. The now so-called Third World has left its passive role to become a living, dynamic presence. First, there was the Russian Revolution on the very fringe of the western world, followed by the process of decolonisation; the emergence of China as a big power and a new option of development; the liberation wars: Vietnam, Algeria, Cuba, the Portuguese colonies- and the creation of OPEC, through which, for the first time in modern history, a group of developing countries can influence the very economic foundations of the developed world. These are only the more visible manifestations of a deeper, widespread phenomenon: the will of the masses of the Third World to put an end to misery and oppression and to reassert their own identity.

For the western world one of the results of this complex process has been the realisation that they are no longer the only protagonists of history; the awareness that humanity is really composed of more than four billion people and that everyone has the right and the will to contribute, in some way, to shape the future.

In conclusion, the process of "westernisation", in which the developing countries acted almost entirely as passive recipients of an external culture, is coming to an end, and a more equilibrated relationship is emerging. There is no doubt that western influence in the rest of the world, if liberated from the evils of imperialism, can have many beneficial effects; there is also no doubt that the Third World can make substantial cultural contributions to the benefit of the west. This process of mutual fertilization could be a basis for the construction of a true new world order. It will be, however, a long and difficult task, and one of the preconditions of success is for the Third World countries to find their own approach to development.

Basic Characteristics of the New Approach to Development

The central element in the search for a new approach is the realisation that underdeveloped countries cannot repeat the path followed in the past by the developed countries because the historical conditions are entirely different. During the Industrial Revolution the western countries had no competitors in the world; they were the centre of economic, military, scientific and technological power, and so they could shape international trade, and to a great extent the national economies of the peripheral countries, according to their needs. They could export whatever manufactured goods they produced and, protected when needed by their political and military power, they had easy access to the raw materials of the rest of the world. It is obvious that this situation cannot be recreated today for the benefit of the developing world.

But even leaving aside the type of path to be followed to develop, it is obvious that it will be practically impossible for most developing countries to reach the standard of living of the industrialised countries - in terms of the same pattern of consumption - in the foreseeable future. In 1970 the average GNP per capita of the advanced countries was about $2030 (in 1960 $US); for the developing countries it was about $170 for Africa; $115 for Asia; and $445 for Latin America. The GNP of the developed countries increased during the period 1960-1970 at a rate of 6% per year, which means an annual growth of around 5% for the GNP per capita. In the developing countries, during the same period, the GNP was growing at 4% to 5%, which means 1.5 to 2.5 for the GNP per capita. Even assuming for the poor countries rates of growth of the economy considerably higher than those observed historically, there is practically no chance for the developing countries to catch up with the industrialised world in terms of overall consumption.

The availability of natural resources and the effects on the environment deserve also some consideration. According to the most reliable forecasts, around the beginning of the next century the population of the earth will be approximately 7 billion - with more than 5.5 billion belonging to the developing countries - and will probably stabilise at about 10 billion during the first half of the twenty-first century. If this huge population is going to have the same type and volume of consumption that the average industrialised country has today - not to mention the probable level of consumption thirty years from now - the pressure on natural resources and the environment will be enormous. It is not so much a problem of ultimate physical limits, but that of the generation or the capital required to develop such an amount of conventional resources, or of the technologies needed to create new ones, or to prevent or correct the effects on the environment. It is very difficult to predict the exact form those restrictions will take, but they will surely impose some limitations on the unlimited exploitation of natural raw materials.

The above arguments against the possibility of the developing countries repeating the type of development of the industrialised countries are all on the negative side. There are, however, positive reasons to justify the search for a new ideal of development that stems from the previous discussion on the western model of progress. First, to repeat the western model - despite the many positive aspects it contains - will lead to the same situation of social and international inequality, wasteful use of resources, deterioration of the natural environment, and growing alienation that confronts the western culture today. Secondly, the Third World countries have cultural characteristics that are worth preserving; they are the common heritage of mankind, and using an ecological analogy they constitute the genetic reservoir of future cultural options.

The distinctive element of the new approach to development, as compared with the "traditional" one, is that it is centred in concrete human beings; in other words, the well being of individuals will not be the by-product of general economic

growth, but a specific target whose attainment will condition the whole social and economic organisation of the country.

According to this approach, development will be centred around the concept of "basic needs". There are many definitions of this concept, but it is basically the recognition that each human being, simply because of his existence, has the inalienable right to the satisfaction of certain needs which are essential for a complete and active incorporation into his culture. Some of those basic needs - food, shelter, health and education - are relatively invariant through time and cultures, and easy to identify. Other needs, however, associated with consumption, or of a more spiritual nature, are more difficult to define. Historically they have changed with each society and with time. New needs are generated by the evolution of cultures, by new forms of social organisation, and by technological change. In judging which of those needs are really "basic", and their relative priority, a large dose of subjectivity, or social bias, is inevitable.

The only way out of this dilemma - determining which are the legitimate social needs for the majority of the population, and not only for an economic or intellectual elite - is to establish mechanisms of participation to ensure that all social decisions really represent the will and aspirations of the populace.

Self-reliance

In the new approach to development, the mechanism of change is centred around the concept of "self-reliance". A brief analysis of its origin and content will give some indications as to whether or not it is the appropriate means to achieve the simple objectives we were referring to.

The emergence of the concept of self-reliance was received in many circles of the developed countries with strong feelings of distrust: it was considered at best naive and unrealistic, and at worst a tentative of disruption of the international system. Leaving aside the cases where the motiviation of the distrust was rooted in the defense of vested interests, this attitude was based generally on a misunderstanding of the true meaning of self-reliance.

In a very simple definition, self-reliance

"...is to be understood at the national level of each developing country as the will to build up the capacity for autonomous decision-making and implementation in all aspects of the development process including science and technology. This approach to self-reliance is reflected internationally as opposition to all forms of dependency. It calls for changing the mode of incorporation of the developing countries in the international, political, economic and cultural systems". (5)

Before entering into the consideration of the meaning of the above definition, it is interesting to analyse why the concept of self-reliance emerged, as it is often argued that it is not necessary to achieve the objectives of development. This position is largely based on the old premise that the reservoir of scientific and technological capability, managerial skill, and capital of the developed countries, could be used through transference and foreign aid, to create modern societies in the poor countries.

The long and bitter experience of the post-war period has shown that this conception is, at best, truly naive and unrealistic. Foreign aid has been, besides the economic and political conditions often attached to it, only marginal to the needs of the countries involved; as for the transference of knowledge and skill, it had been all too often a transference of problems rather than of solutions. The developing countries are finally learning what they should have learnt much

earlier: that what they do not do for themselves nobody will do for them. Foreign aid and transference of knowledge could be very useful, but only in the context of a really autonomous development policy.

Consequently, self-reliance is basically the recognition that the main responsibility to solve the problems of underdevelopment lies with the developing countries themselves. If it is accepted, furthermore, that developing countries, for the reasons already given, cannot copy the type of society in the industrialised countries, it is clear that they will have to rely mainly on their own resources, human as well as material. To follow a path to development different from the one followed in the past by the now advanced countries, means that they will have to initiate a process on which there is no previous historical experience. They will have to confront new problems because socio-political conditions have changed, and also because the relationship between knowledge, technology, resources and population had very little resemblance with those prevailing in the past. In these conditions, it is obvious that developing countries will have to look for solutions in the effort, imagination and creative capacity of their own societies.

Finally, development, progress or evolution - whatever we may choose to call it - is not simply a techno-economic phenomenon: it is also, and mainly, a process through which a society continuously creates and reasserts its own identity. The cultural heritage of a society is an obstacle to development only when this is seen as the passive and indiscriminate acceptance of an exogenous conception of the world. However, when development is conceived basically as an endogenous transformation in which external experience is not imposed but voluntarily and selectively incorporated, the specific cultural characteristics of developing countries could be, instead of obstacles, the dynamic nucleus of the process of change.

Collective self-reliance is only the natural extension of the concept of self-reliance. In the first place it is the awareness that, sharing basically the same problems, regional co-operation could be the best way to enlarge the basis of human and natural resources required for development. Second, but no less important, co-operation for a conception of development that it is not centred in economic growth, but on human beings considered in all their dimensions - material, cultural, spiritual - could be the first step in the creation of a more equitable world order.

A criticism that has been frequently raised against self-reliance, and especially against collective self-reliance, is that it represents a tendency towards autarchy or self-sufficiency that will disrupt the present world order, and will be an obstacle to the objective of an unified humanity.

The truth is that self-reliance not only is not against solidarity at the world level, but it is a contribution to that ideal. In the present world order relationships between countries are of competition and dominance, and the whole structure tends to benefit the rich industrialised centres. It is a system with strong interconnections, but with an almost complete lack of solidarity.

The aim of self-reliance is to substitute a system of real solidary co-operation among partners with equal rights and obligations for the present structure of institutionalised injustice. During the transitional period it is highly probable that the developing countries will have to detach themselves partially from the international system - above all in connection with trade - to reorient their productive systems in the new direction. The concentration on the satisfaction of basic needs with the resulting changes in the patterns of consumption; the reliance on local natural resources, and regional co-operation between developing countries, will undoubtedly call for a drastic change in the present

pattern of international trade. This partial detachment - or de-linking - will be, however, only transitory, and will be followed by a recoupling on a new more equitable basis.

In conclusion, self-reliance is not an unrealistic, romantic conception, destined to fade away when confronted with the "hard facts". It is the natural, unavoidable strategy of development stemming precisely from the acceptance, at last, of the hard facts.

GENERATION OF TECHNOLOGY BY THE THIRD WORLD COUNTRIES

It is obvious that the process of transformation of the developing societies on the conditions we have briefly described, requires the generation of its own technological solutions. Besides, technology is, in a wide anthropological sense, possibly the most important component of culture. It determines the relationship of the community with its natural environment, and it is the most concrete expression of its values. Consequently, one of the main objectives of any process of development by the poor countries should be to reinstall technology as one of the central elements of their own cultural creativity.

The experience of the past suggests that a new approach to generate technologies is required. The problem is: how to connect effectively the R and D systems of the developing countries with their own societies, and how to make them able to produce the knowledge and technologies needed for an autonomous and self-sustained development.

To connect the R and D systems with society seemed relatively simple thirty years ago; now the facts have shown that it is extremely difficult. We are aware now that we have only one historical example of the "natural" evolution of that process - the countries that entered the Industrial Revolution in the nineteenth century - and the economic, social and political conditions of that phenomenon were entirely different from the ones prevailing today. Afterwards, only three countries - Japan, the Soviet Union and China - have succeeded in using science effectively for an autonomous development project, and in all three cases this has been one of the results of deep political, social and economic changes. From all those antecedents, the Third World countries can extract some useful teachings, but on the whole they will have to devise their own solutions.

Probably the most relevant teaching on past experiences is that science becomes really linked with society when society exerts an effective demand for technological solutions on the R and D systems. In the western countries this demand was provided by the Industrial Revolution and the emergence of parliamentary democracies; in Japan, the Soviet Union and China, by autonomous national projects devised and implemented by political and economic elites, or by revolutionary parties.

In the Third World countries, it is difficult to predict through what type of mechanism they will generate adequate societal demand on their R and D systems. We know, however, that participation - one of the central elements of the emerging new approach to development - will play a determining role. Consequently, one of the main areas of problems to explore is social participation in the generation of technologies appropriate for an autonomous development project.

In what follows we suggest an approach to develop technologies for the Third World countries. Although the approach, or methodology, could be applied in any social environment, we will refer specifically to the rural sector, because it is the most important one in most developing countries, and its transformation could be the driving force to change the present structural relationship between the two sectors.

One of the main elements of the approach proposed is that the maximum possible participation of the local people should be ensured through the whole process. This might sound rather unusual, but we have to remember that in the developed world common people participate in the creation of the technologies they use. This participation is implemented through complex indirect mechanisms that normally ensure the acceptability of new technologies even before they reach the potential users. Those mechanisms include public opinion expressed through the media, advertising - that although intended to orient demands, is based on the basic motivations that generate it - market surveys, etc. It should also be remembered that as people perceive the growing influence of science in everyday life, even in the advanced countries there is a general feeling that much more direct participation is needed in the generation of the technologies that so deeply affect all aspects of people's life. The recent public demonstrations in several countries against the building of nuclear facilities are an impressive indication of that attitude.

In the rural areas of the developing countries those mechanisms of participation have never existed and should be created. The main specific reasons to induce participation in the generation of technologies - besides the fact that it constitutes a basic human right - are the following:

a) The technologies used by the traditional sector are based greatly on empirical knowledge, which is transmitted mainly by verbal tradition and is the result of centuries of struggle to survive. This knowledge is comprised of a great amount of useful information on the physical environment, and on the ways to use it to provide for the essential needs of life. Coupled with modern science, this empirical knowledge could greatly contribute to the solution of many technological problems of the rural areas.

b) One of the most difficult aspects of the introduction of new technologies in poor rural areas is to induce people to accept them. This is not so much because they are "conservative", as it is commonly assumed, but because people generally tend to reject changes in their way of living, unless they have participated in some way in their generation. As we have already seen, in the economically advanced societies, that participation is ensured through indirect mechanisms. However, historical experience shows that these mechanisms frequently fail, and new technologies are rejected when they reach the market for reasons that are not more "rational" than the ones that induce the rural poor to reject innovations introduced from outside.

c) One of the difficulties the peasants experience to solve, or at least to pose clearly, their problems is their almost complete ignorance of the possibilities and limitations of modern science and technology. Participation in the process of creating technologies will help them to overcome that obstacle, and to incorporate science as a normal element of their lives, as is the case in the richer parts of the world.

d) The resulting technologies should be produced as much as possible by the local people with local resources. The participation of the populace in the process of generation of technologies should contribute to generate the skills necessary for their use and production.

The Assumptions or Paradigms of the R and D Systems

Previous to the description of the suggested approach, we have to consider how the present R and D systems determine the orientation and content of the research connected with social problems from the point of view of the specific technolo-

gies required to solve them. Some developed countries have very well defined institutional structures for establishing the direction and content of the scientific effort in relation to their main objectives of development. In other countries such a formal arrangement is almost completely lacking, and the R and D system works more or less independently of the formal structure of the national planning. In both cases, however, the efficiency of the R and D systems, in terms of their contribution to the general objectives of their countries, is more or less the same. Of course, this statement does not represent a value judgement on the intrinsic desirability of the direction of development: it only expresses the fact that the R and D systems of the developed countries respond efficiently to the implicit demand of their societies.

The explanation of this fact is very simple, and we are going to examine it briefly only because it is often forgotten in the analysis of the problems of the developing countries.

The determination of the adequacy of a technology to a given society is a problem with many variables, only a few of them being strictly technological. Most of these belong to the fields of economics, sociology and social psychology, and form what might be called a set of assumptions or paradigms, which constitute the frame of reference of the R and D system. Some of them for the advanced countries can be stated as follows: the scarce factor of production is labour, so the more capital-intensive technology is the better; it is necessary to stimulate consumption by producing as many varieties of goods to satisfy the same needs as possible; the dynamics of the economy depend to a great measure upon a rapid circulation of goods, so a relatively fast rate of obsolescence is desirable; a considerable part of the population has its basic needs more than fulfilled, so its consumption can only be stimulated by the production of more and more sophisticated goods, irrespective of their real social value; it is a highly competititve economy in which innovations are essential to survival, and they have to be stimulated even when they waste resources, in the sense that they result in the production of more complex and expensive goods that add nothing, or very little, to the rational satisfaction of the needs to which they are directed; natural resources or their substitutes, with a very few exceptions, are available in unlimited amounts.

These are only a few examples of the set of assumptions that direct the effort of the R and D systems of the developed countries of the capitalist world. They are the expression of the most basic characteristics of those societies, and are seldom explicitly stated as they have become assimilated by every member of the R and D systems. This is the reason why any scientist or technologist of the developed world, whatever his personal social position or political ideology, when faced with a technological problem rejects automatically, almost unconsciously, any solution which does not conform with the accepted assumptions. This is the first filter that sorts out any possible technological solution which can be of application to the specific problems of the developing countries. The trivial but important point here is that without that set of assumptions or any other equivalent, no technological problem can be stated in meaningful terms .

In the developing countries, the R and D systems have evolved with the modern sector of the economy, and are closely connected to the R and D system of the advanced countries. Its paradigmatic determinants are very similar to those of the developed societies, and this similarity is continuously enhanced by a well known feed-back process.

In the traditional sector, on the other hand, the problem area is different from that of the modern sector, and consequently the assumptions of the R and D system cannot be applied to the solution of its problem. It is an essentially non-explored area and there is no set of paradigms which could form the basic

framework to direct the efforts of the R and D systems. Without that frame of reference, hunger or illiteracy, for instance, are not problems from a scientific point of view; they are only facts. They become scientific or technological problems only when their social, economic and psycho-social parameters and variables are unambiguously defined. The consequence, which is widely known, is that the traditional sector exerts very little demand on the R and D system of the underdeveloped countries.

This system does not contradict the fact that the R and D system performs some research on the problems of the traditional sector that results in the introduction of a few modern technologies. The important point, however, is that the research is directed towards the implicit assumption that the criteria applied to the modern sector are also valid for the traditional sector. This necessarily results in a piecemeal approach that induces the introduction of some "modern" technologies, without taking into account the overall social effects.

In conclusion, a basic element of the R and D system of the developing countries fails to direct its research in a set of assumptions embodying a whole new concept of development. This would give the *under-developed* countries, and not merely the modern sector, a frame of reference for adequately defining the type and character of the technologies required.

THE ELEMENTS OF THE PROPOSED APPROACH

The methodology starts by assuming that the type of technology a developing country should use cannot be determined in a simple and *a priori* basis (i.e. labour-intensive, soft, small, simple, intermediate, etc.) or that all existing technology has to be rejected, whether modern or traditional. The characteristics that a technology must have, to be the most appropriate for a given problem, should emerge naturally from its very process of creation.

We will describe briefly the main elements of the methodology. (6) It is obvious that these stages do not constitute a strict time sequence, as they will take place simultaneously. The main task, to build up a set of comprehensive, valid assumptions or paradigms, constitutes a dialectic process. A few initial assumptions will form the framework for the definition of technologies, but the experience gained in their building and application will revert to the assumptions to modify, enlarge or complete them. This is the process that now operates in the advanced countries and allows them to generate "spontaneously" technologies adequate for their needs and aspirations and that needs to be induced in the developing countries.

The elements of the methodology are the following:

(a) The general socio-economic characteristics of the selected region should be evaluated.

The scope of the analysis and the methodology to be applied will depend on the information on the region and on the objectives of the research project.

However, in order to obtain an adequate understanding of the more important things that are going on in the selected community, as well as of the historical process that has led to its present situation, a basic knowledge of the following elements will be necessary:

1. Nature of the national and regional socio-economic formation in which the community is immersed

2. Forms and mechanisms of articulation of the community with the socio-economic formation in which it is included

3. Social relationships and forms of production inside the community

4. The economic cycle inside the community, and form of appropriation of the economic surplus.

(b) As the effort is made by the local population and scientists to analyse the current situation in the community ((a) above) technological problem areas will be identified, and some of them will be chosen for research.

(c) This part of the work is concerned with the determination of the functions that the required technology is expected to fulfil. The first step is one required in any scientific research into a new area: to ask the very basic questions referring to the specific technological field selected: What is the purpose of the technology? What need or needs must it satisfy? Who will really benefit from the solution? These are only a few of the many questions to be answered: what we want to emphasise is that it is necessary to start by rejecting, as far as possible, any preconception or prejudice about the nature of the multiple needs (social, economic, psycho-social) it has to satisfy.

It seems obvious that this kind of question is always asked when a technology is being developed. The real point is that in the customary work of the R and D systems the answers are generally obvious, for reasons already examined: the scientist is working on problems that belong to his own economic, social and cultural sector, so he has the tendency to apply the same criteria to a completely different environment. He frequently assumes that he has to satisfy the same needs, but on a lower level, due to limitations posed by the local economic conditions.

A typical example of the mistakes to which this approach can lead is posed by the housing problem. Technologists tend to believe that, given the precarious situation of the peasants, they will be content with any house that offers them a reasonable degree of climatic protection, and a minimum of modern sanitary conditions. The result is that in many cases, to the disappointment of the well-meaning technologists, the peasants prefer to live in their own poor dwellings rather than in the supposedly better new ones. The cause is that a house, besides giving climatic and sanitary protection, has several other roles to fulfil: social, economic, cultural, and psycho-social. If these elements are not taken into consideration, the final product could be unacceptable to the people, even if it were much better from our point of view than the one being currently used.

(d) This part consists of the analysis of the solutions that the local community has traditionally given the problems identified. We must remember that common people have had to solve their problems in their own way much before modern science was born.

This part of the research is a very difficult one, because in most cases it is not the problem of simply adopting the traditional specific technologies being used, but one of extracting the original ideas they might contain, and studying them, applying the resources of modern science. The most important

local contribution would probably be *more than in concrete specific technologies, in new approaches to the solution of old problems that may stimulate scientific research in hitherto unexplored directions*. Besides the methodological difficulties, this approach requires an unprejudiced and open-minded attitude that is not one of the remarkable characteristics of the R and D systems in respect of traditional knowledge.

To give an example of traditional technologies, we can take the preservation of food, an extremely important problem for countries with poor transportation, particularly in the tropical regions. In many rural areas, people preserve meat for long periods of time by exposing it to the solar heat under certain condtions they know through long experience. The central idea in this technology is the utilisation of solar radiation, a cheap and always available source of energy. This idea, coupled with modern science to improve the process from the biological, sanitary, nutritional and economic points of view, could help to solve one of the important problems of the rural areas.

(e) A general survey of the natural resources of the area should be carried out.

A very important point to keep in mind here is the concept that natural resources are generated by the combination of some natural object with science and technology; there are no natural resources in an absolute sense. This elementary concept is frequently ignored in developing countries, and there is the tendency to consider natural resources as those taken as such, by the industrialised countries. So the research must include not only the natural resources already used, but also those that can have potential application for the problem area being studied.

(f) With the information gathered in the previous stages, a set of assumptions or paradigms will be derived, which will be the frame or reference for the final step of developing the required technology. The set of assumptions - which will contain scientific, technological, economic, social, psycho-social and anthropological information - will define a "*technological space*".

In finally building the technology, all possible solutions that fit the technological space should be considered. As is well known from a certain body of scientific knowledge, many technological solutions to a given problem can be devised. The existence of an adequate frame of reference, including all the requirements the technology must fulfil, allows the exploration of a multiplicity of possible paths, and the selection of the one best suited to the particular situation.

It is obvious that once the set of paradigms has been built, in some cases required technology will already exist, and there may simply be the question of introducing it into the area. In other cases, it may be a problem of combining existing technological elements in a different way. Fianlly, in many cases, it may be necessary to devise an entirely new technology. However, in most instances, it will probably be a question of the combination of the three situations.

NOTES

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(4) Universe Books, New York (1972).

(5) Pugwash Symposium (June 1977) The Role of Self-Reliance in Alternative Strategies for Development, Dar es Salaam.

(6) Herrera, Amilcar O. (1977) Modern and Traditional Technologies, An Approach to the Generation of Technologies Appropriate for Rural Development, SPRU, University of Sussex, Brighton, (Mimeo).

DISCUSSION

WORTHINGTON: Herrera is concerned mainly with rural development, and I think that this paper forms something of a watershed in our discussions, most of which to date have been more concerned with built environment than with the rural environment. If the objective of development is for the people, then it is important to recall that a large majority of the people still (fortunately for them) live in the rural environment. In all rural situations we are in contact with nature and this is where "appropriate" technology becomes enormously important. The examples of "inappropriate" technology in agriculture, for example, are not only affecting the people of the region but also the future of the natural resources on which they live. To give one simple example related to the discussion at this seminar, Zahlan made the point that there has been little change in the productivity of cultivation in Middle Eastern countries over the last century and even back to Pharaonic times. Some areas have increased and others have been reduced. In the dry farming areas of the Middle East, which are enormously more extensive than

irrigation, one would find a diminution in the product per unit area. The great increase of population in the rural and urban areas has involved cultivating more marginal land, more brittle land, and nature has bit back in a vigorous way. The Arab nail-plough drawn by a camel is still in use; it disturbs the soil very little. Replace it with the normal European tractor drawn plough, and a deep breaking up of the surface causes erosion; in a few years time, your grain crop has diminished to a point that you have to move on to damage more land. Appropriate technology would make a tractor driven plough affect the soil in the same way as the highly adapted nail-plough. When dealing with nature, the environment will always kick back in response to inappropriate technology.

CHANNABASAPPA: Herrera's paper describes conditions which do not exist today and which will not exist tomorrow. Although it is right to champion the theme of developing indigenous technology, the world population is not standing still. It is growing. It is at present, four billion, is expected to be about six billion at the end of this century and will reach ten billion by the middle of the twenty-first century. Developing indigenous technology is a long process. It is not a near term solution. We will have to import western technology, or at least adapt western technology to meet our near term needs. Only when the necessary skills and institutions are developed locally, can we then seriously consider developing indigenous technology.

We have to adopt a two-fold approach: first, to import western technology to provide food and fibre for the expanding population and, at the same time, develop our own professional skills, financial resources and institutions. We do not, at present, have an institutional structure to develop the technology. One of the problems in the transfer of technology is the education of the population. The transfer of technology has not been possible in many countries not because the technology is not good, not because it cannot be modified to suit the local conditions, but because we have not educated the masses to accept this technology. It seems to me that this education, particularly in the rural areas, is very much lacking.

The local population has no idea why a certain technology is to their benefit, e.g. that it could improve economic standards, health, etc. A good example is population control. In Asia and South America, population control technology has not yet taken hold whereas in industrialized nations, it is in practice. I think we should educate the rural masses, who constitute 95% of the population, to the benefits of modern technology and assure them that modern technology is not going to change radically their social and cultural patterns that have been established through the centuries. In fact, modern technology could advance the institutional and cultural values of their society.

MAKSOUD: I think the main issue in Herrera's paper is that the process of development is being conceived of as a linear process, and the author gives the priority of rural as opposed to urban development as an alternative to this idea. Development, of course, is not a linear process, but I think we have to use both methods, rather than one or the other. I will concentrate on the Arab region where rural and urban populations have always existed side by side. If we resort to both concepts in different degrees and according to the conditions of each country, then we could reach a balanced development. After all, what is it that we really want from technology? I would briefly say that we want an equitable economic and social development as quickly as possible with optimal capital investment, effort and time.

Thus a balanced development could be planned and based on: solar energy, abundant in Arab countries; the desalination of sea water by solar energy, abundant in Arab countries; and flourishing new agricultural areas using desalted sea water for settlements in the new rural areas in the deserts and along the lengthy Arab

sea shores. Modern industries could be established using cheap solar energy, available fresh and sea water, agricultural products (e.g. agro-industrial complexes) and other inputs, thus creating new settlements and new employment opportunities and achieving both the rural and urban development concepts.

PALMER-JONES: What Maksoud was referring to may well be a technology adapted to the environment and may well result in increased production. But after all, the United States could produce enough food to feed all the needy of the world by using existing technology if it wished to put extra resources into it. But this would not solve the problem of distribution, of getting food to the people who really need it. The only way to guarantee that, is if they participate in production and control the resources used in production.

I also want to make a point on what Channabasappa said. The solution is simple. All we have to do to get them to adopt western technology is to turn them into western people. But to do this, we have to adopt western technology. This, of course, tells us nothing about how to induce either western technology or western values.

KUBURSI: George Santyana once said that those who do not learn from history are condemned to repeat it. I would like to share with you the experience of what is more or less a developing country that I know well, i.e. Canada. You might think that its high per capita income is an indication of economic maturity, but it still has several problems endemic to the developing countries, particularly those relating to turn-key operations.

Production is heavily concentrated around an axis between Montreal and Toronto and virtually absent from other areas where the unemployment average is twice that of Ontario. The tremendous transportation costs between the various regions in Canada and the protection of the industrial complexes in Ontario and Quebec exert a very high income cost on the rest of the country. Most of the products are basically produced by branch plants from major U.S. companies and there is not a single variety in the U.S. that does not exist in Canada. They are produced at costs that are 30% to 40% higher than in the U.S. There is also the fact that the local national talents are not utilized. Most of the high technical and managerial positions are staffed by foreigners. Branch plants appear to exact high foreign exchange costs that create balance of payments problems. I could go on and list several other costs of this process. Mind you, there are benefits, but are they worth these costs? I think Herrera has an excellent point and we should take it very seriously: the question of local initiative, goals, structures are just as important, if not more so, than all the questions we have been considering.

We must start to think about what we really want this technology to do. What do we envisage of our society? What are the benefits we are going to get from this technology? What are its costs? Are the costs basically justified? I think Herrera is giving us a viable alternative; it might seem to be Utopian but the dreams of the past are the reality of today, and time should not really matter. Technology has to be transferred in the short-run; in the long-run there is no effective alternative to the development of a technology that fits our factor endowments and future vision of our economy and society.

ADEL SABET: What Herrera really thinks is that we have to look into society in terms of class structure: that the majority of people have very low incomes and the few privileged sectors dictate their own needs on the evolution of society. Herrera emphasizes rural development because the majority of the people live in rural areas, but this does not mean that he is excluding people who live in large cities. He also does not exclude the use of sophisticated technology if it proves to be beneficial to the vast majority of the people, e.g. in projects like the Aswan High Dam, which is valid for all the Egyptian people. But if we look into

some of the very small villages in Egypt, for example, we find some individuals using calculating machines for which they pay relatively highly and which are not locally produced. We may have to import huge numbers of these machines just because they are fashionable, while in countries like the U.S.S.R. they are not even used in the big department stores. We should not have to spend our very limited resources to buy sophisticated technologies which are of no real use. Similarly, we should not continue to import huge numbers of cars and buses, besides establishing assembly plants to manufacture cars, while our cities are almost strangled by traffic and we have not learned how to decongest them.

The other theme in Herrera's paper is that we have to go to the people to discover their needs. This applies for the educational system. One cannot just sit in the capital city, or in one of the provincial capitals, and set up the curricula for schools in rural areas; one should go to the farmers and try to plan a curriculum which suits their needs. Similarly, rather than buying complicated tractors that require a high degree of skill for operation and maintenance, simpler forms could be designed. It is the responsibility of the planning body to derive plans and devices which not only reflect the real interests of the majority of people, but also reflect possible solutions that can be worked out through their active participation. This approach would ultimately build up indigenous technologies, narrow the social and cultural gaps, and prevent many of the disruptive effects of social change.

SALMAN: Many Arab countries have started industrial development and have already imported different technologies. What Herrera is suggesting is difficult to apply now: it is like turning the clock back. It would be difficult to apply his model in many industries, such as petrochemicals, which need sophisticated methodologies; it could, however, be applied in the agricultural sector where limited technology is needed.

ZAHLAN:* It is true that the petrochemical industry is sophisticated, but so are all other modern technologies in agriculture, health and industry. No matter how sophisticated the activity, it should be possible for the Arab states to acquire the know-how in association with five, ten or twenty transfers of capital goods. There is something fundamentally wrong when a society repeatedly acquires identical capital goods without ever learning how to manufacture them.

RACHID: I agree with much of what Herrera said. Today, however, Arab countries are engaged in the development of their petroleum and petrochemical resources. Thus, I think Herrera is suggesting that we turn the clock back.

ZAHLAN: Herrera does not recommend turning the clock back, and I do not think that to put scientists to work in contact with a local population entails that. There are two important aspects in Herrera's approach: first, he pushes history forward by liberating man from collecting goods that are not essential to his happiness or cultural evolution; and second, he wishes to reduce the social injustices prevalent in most developing countries. In his view, a society should develop petrochemicals or any other industry which it finds useful to meet its own needs; he does not reject "modern" technologies, but stresses the importance of selection. He says that you should start with yourself and your problems. In the Herrera scheme, he is not telling you what to do or not to do; he is merely telling you to ask the basic question of what do you want science and technology for.

PALMER-JONES: I have recently come back from living with rural people in a rural part of a less developed country and would like to comment on some of the difficulties people frequently encounter, or are likely to encounter, in trying to do

* Zahlan replied for Herrera whose illness prevented him from being present at the Seminar.

the sort of things that Herrera is suggesting. Educated researchers, including those from less developed countries, who go overseas, or are educated in a developed country, face great difficulty in developing a methodology of participating in development with either rural people or low income people in urban areas. I think, however, that we have a great deal to learn from the work of Paulo Freire's The Pedagogy of the Oppressed, which suggests that we have to go back to the educational process. We have to engage in a process of mutual learning rather than a one-way transfer of knowledge and understanding. He contrasts this with the traditional concept of education which he terms "banking" education, in which we invest in the knowledge of the advanced sector. We store it afterwards and use it subsequently as a capital asset. My experience is very much that when you think about trying to organize rural development, and you wish to avoid the sorts of inequality and inefficiency resulting from development that has occurred all over the world up to, including and succeeding the Green Revolution, you have to engage in mutual learning and a mutual training process that incorporates most of the people in the community. I want to hold out some hope to people who think that this is a methodological dead-end. You are not going to get much out of traditional methodologies anyway.

CARRUTHERS: Let us question the goals of technology transfer. Will it, if achieved, help obtain social objectives? Herrera notes that there appears to be a correlation between technological advance and the various forms of environmental and social pollution. As a participant in the frantic life-style of the West, I wonder if this is really the road that you wish to follow. In this conference, problems and constraints are being identified, and in some cases remedies are being suggested, such as more engineers, more technicians, more data, more conferences. But why not look again at the objectives?

Indeed, I would contend that the speed of technological advance in the West and of the economic gains we obtain from the complementarities that exist within a broad-based modern economy, may make the form of technological advance which we have achieved infeasible as well as undesirable for the Arab world.

Therefore, I would like to hear a clearer statement or discussion of the social objectives of Arab development. Only when this is apparent can criteria be developed to facilitate choice of technological means to execute change.

ZAHLAN: Herrera finds encouragement in the fact that there is growing dissatisfaction in the West with the prevalent life-style. He feels that this mood in the West will influence LDC's. I have a feeling that those responsible for planning and decision making in LDC's are not in intellectual contact with the new Western mood and are rather committed to fairly traditional thinking.

JABER: Herrera's definition of self-reliance is not definite. There is no way that I could measure whether country A is more self-reliant than country B. Also, the same would apply to the final part of the paper on the elements of the proposed approach. In any planning exercise that we carry out explicitly or implicitly these elements are being taken care of.

What we need most in the Arab world is to devote considerable efforts to develop the rural areas. Unfortunately, most developmental projects are at present concentrated in the big cities, on harbours, etc., and the rural areas are being neglected. Regarding the form of technology that should be undertaken there, we tend to apply the same technology for irrigation, housing, education etc., as those being applied in the cities. We have little choice except maybe with certain variations; instead of using modern machines, we are depending more on labour. However, we are becoming progressively short of labour and the private sector is depending more on capital intensive equipment. This is due to the fact

that development itself is a dynamic process. What was true even in the early 1970's is no longer true in terms of relevant and efficient technology. I think of technology as an important input in our development or production functions. Therefore, technology should respond to the priorities of development plans. Of course, development plans differ from one country to another.

ZAHLAN: It appears to me that Jaber's comments exhibit an internal contradiction. On the one hand he implies that planners in Jordan are doing all the correct things and yet he complains that the rural education programmes are mere transplants of those of the city and do not bear on the educational requirements of the rural population.

Jaber asserts that the region is witnessing rapid change. In fact, a small fraction (maybe 5% - 10%) of Arab society is being affected by the transplantation of goods and services into the region. But in most countries 80% - 90% of the population are living at the same - if not lower - standard of living as they did one or two centuries ago.

Herrera realises that it takes time to develop new appropriate technologies. But there is no alternative: importing technologies as LDC's are doing today cannot and will not solve problems. The present pattern of problem solving in LDC's will only make conditions worse.

JABER: My comments were addressed to the region as a whole. However, when I stated that we are following the same approach proposed in the paper, I had our experience in Jordan in mind, particularly the Jordan Valley development plan. We studied the social and economic aspects together with national resources, and drafted a completely integrated development plan for that area.

NADIA SAAD: We should perhaps develop some criteria for the kind of technologies we want to bring in as well as for those we should discard. UNEP has developed the concept of Environmentally Sound and Appropriate Technology. To begin with, it was developed to meet the environmental objective of ecological soundness, i.e. to fit in with all physical, human, cultural and also the socio-economic environment. Technologies that would be polluting, disruptive, and that would lead to more loss than gain over a long period of time should be discarded. The second criterion is that of appropriateness which has two components. Technology should be economically appropriate, i.e. it should contribute to the reduction of economic inequality within and between countries in terms of income distribution, wage differentials, etc. Technologies should also be socially appropriate, i.e. they should aim at satisfying basic human needs and meet the objective of social participation and control. I am perfectly aware of the fact that what I am saying sounds Utopian. I do not see how we can stop anybody from importing a new technology unless we engage in the global effort of establishing what the U.N. refers to as a New Economic International Order.