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UNITED NATIONS ENVIRONMENT PROGRAMME

THEMATIC JOINT PROGRAMMING ON ENVIRONMENTALLY
SOUND AND APPROPRIATE TECHNOLOGY

BACKGROUND PAPER
DRAFT REPORT ON APPROPRIATE TECHNOLOGY WITHIN
THE UNITED NATIONS SYSTEM

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REPORT ON APPROPRIATE TECHNOLOGY
WITHIN THE UNITED NATIONS SYSTEM

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P R E F A C E

Thematic Joint Programming is conceived as a mechanism for the development of a system-wide medium term environment programme, to commence in January 1984. It is concerned with subjects or areas of activities in which several UN agencies have specific interest and programmes. Technology is one of these areas. This exercise is intended to identify actions required by each of the organizations concerned and particularly initiatives UNEP should take in order to achieve the objectives of the Environment Programme, it therefore seeks to ensure that any action undertaken complements the actions of the other concerned organizations and to identify the resources needed and their sources.

This exercise has been endorsed by the UNEP Governing Council, and is in line with General Assembly resolutions on the restructuring of the economic and social sectors of the U.N. system, which has called for an increasing measure of joint planning in areas of mutual concern.

The thematic joint programming exercises should provide the basis elements for the preparation of the system-wide programme. The thematic joint programming attempts to set out the objectives to be achieved and to identify the expected outputs, to examine the total resources needed for regular budget, from the environment fund or from other extra budgetary sources. More specifically, the thematic joint programming should; identify actions which each organization by virtue of its current and planned activities, is prepared to take as part of an implementation plan for environmentally sound and appropriate technology, and therefore should produce those elements for programme which includes the activities to be undertaken, the agents of implementations, the resources required and the time frame.

This paper has been prepared by UNEP as a background document for the thematic joint programming. It draws upon information available in UNEP and obtained by direct contact and discussion with the different agencies. The document is only a first draft and its objective is to present a picture of the activities of the UN system for the purposes of the meeting.

I. INTRODUCTION

The purpose of this report is to present an overview of the activities of the UN system in the field of appropriate technology, so as to identify gaps in knowledge and in the mechanisms of inter-agency coordination to ensure a regular exchange of information and to design joint supportive action.

In order to fulfil this objective, whilst taking into account the lack of a single understanding of appropriate technology as well as other methodological and technical difficulties that are mentioned below, the scope and approach of the report is somewhat different to the previous surveys in this areas⁽¹⁾.

Since there is no overall consensus within the UN system as to the definition and content of the concept of appropriate technology, the report departs from the conventional approach which consists of selecting activities for review according to a pre-determined definition. Many of the activities mentioned here do not correspond in fact to what is considered by UNEP as environmentally-sound and economically and socially appropriate technologies. These activities are nevertheless referred to since other quarters, within and outside the UN system, consider that they fall into the range of appropriate technology.

(1) Preparatory Committee for the United Nations Conference on Science and Technology for Development, Overview of Activities of Organs Organizations and Programmes of the United Nations Systems, Report prepared jointly by the Secretary-General of the United Nations Conference on Science and Technology for Development and the Administrative Committee on Coordination, A/CONF/81/PC/19 (Part I 31 July 1978. Advisory Committee on the Application of Science and Technology to Development, Report of the Ad Hoc Working Group on Appropriate Technology, E/AC.52/XXIII/CRP.2, 10 June 1977. W.M. Floor, A Critical Review of the Activities of the UN System on Appropriate Technology, prepared for an ILO meeting on International Action for Appropriate Technology, Geneva, 5-9 December 197

The scope of the report encompasses, therefore, more than a commentary on activities, although the survey is far from exhaustive from the point of view of listing programmes and projects. It reviews the conceptual framework of policies in the UN system for promoting appropriate technology, gives some indications on their theoretical background, and provides selected examples of the resulting operational activities. It is believed that this presentation gives a better overall picture than a listing of activities, which would be incomplete in any case for lack of adequate reporting by most of the organisations.

The attention paid to the conceptual and theoretical basis of policies does not stem from some scholarly and speculative preoccupation but from the fact that the very concept of appropriateness implies a value judgement and, therefore, any consideration made about appropriateness of technology will inevitably reflect a given set of ideas and assumptions about development and the benefits and drawbacks of actions oriented to development. The nature of the activities promoted in the field of appropriate technology illustrates the kind of similarities and divergences that arise from different conceptualisations of the meaning of appropriateness, when applied to technology.

Overview of policies and strategies.

Whereas none of the organisations of the UN system excludes to be doing some work on appropriate technology (either practically in the field, or as a result of a conceptualized strategy, or both), only a few of them have attempted at investigating the conceptual content of this notion. ILO, UNEP, UNIDO, the ~~the~~ Office for Science and Technology, and the World Bank are basically the organisations that are engaged in the elaboration of a conceptual framework on the notion of appropriate technology and its relation to the development process and policies.

The policies and strategies found in the organisations of the UN system show that UNEP's approach to environmentally-sound and appropriate technology is in part implicit in several activities of these organisations. Emphasis is placed, in some way or other, on the need to develop and use technologies that permit savings of raw materials and energy, that reduce wastes and that allow the reproductive capacity of the environment to be maintained and enhanced. However, the choice of the means to achieve these objectives, as well as the economic and social goals of appropriate technology, varies significantly: some organisations give priority to the technical means, as for instance a more adequate use of natural resources and a more scientific knowledge of natural biological processes, through scientific and technological research, others give more weight to institutional arrangements such as a socially and environmentally-oriented strategy of development and a new international economic order.

Within the UN system, the elaboration of the conceptual framework for the notion of appropriate technology stems from two sources. In some cases, this work is the logical continuation of the organisation's involvement with conceptual thinking on technology, in relation to specific aspects of development and policies. In other instances, the theoretical work is derived from practical involvement at the operational level. Many organisations, among this latter group, have expressed interest in furthering the development of appropriate technology at the field level, but have not made any concise definition of what they mean by appropriate technology, thus causing a reaction to this term which is often characterized as being vague and impractical for policy guidance.

As a result of these different backgrounds, the propositions and viewpoints found within the UN system with respect to appropriate technology reflect quite adequately the trends on this notion by other organisations outside of the UN system.

With respect to technology, two views are upheld in general terms. On the one hand, there is the idea that all known and presently applied technology is appropriate to some use or another, to some or other circumstance. The argument is that, if it were otherwise, the technology would be automatically discarded and fall into disuse. Much of the reasoning is based on common sense and involves the belief in the existence of a sort of "invisible hand" which apparently would mediate at the technical, economic, social and political levels to make sure that man uses, for his welfare and comfort, the best means at his disposal.

In opposition to this view, others hold that technology could and should be used for solving immediately the pressing developmental problems of humanity, but that such is not the case at present. Some divergency may be found, however, as to the causes for technology not being properly used. Whatever the answer, solutions generally stress the need to evolve new institutional arrangements to make possible the application of technology to presently identified needs. Much thinking has been devoted to the question of criteria for evaluating the usefulness of technology. This problem is treated both from the point of view of technological choice and planning, and of technological assessment. Both view points are based on the premise that the criteria for evaluating technology do not reflect the priorities and needs of our times, and thus must be changed. There has been however several drawbacks in evolving a proper methodology for evaluation.

With respect to appropriate technology, the survey shows that viewpoints and propositions are quite varied within the UN system.

On the whole, there is a strong tendency towards considering appropriate any activity which is small-scale, low-cost in monetary terms, and which uses natural resources (raw and energy materials) that can be supplied with less capital outlays and more labour inputs relative to current advanced processes of obtaining the same natural products. It is often implicitly believed that such activities are in any case adequate for the rural areas and for the urban low-income populations, where the severe conditions of unemployment and under-employment both cheapens the cost of labour and the cost of obtaining raw materials and products.

It is also generally considered, within this framework of thinking, that the creation of employment is socially adequate whichever the conditions of employment may be, whether employment is ensured through labour-intensive methods of production, the intensification of physical human efforts, or any other means of increasing the use of human energies for productive purposes.

Employment is furthermore regarded by this trend of thought, as the panacea of income distribution, although it is sometimes made clear that employment in labour-intensive operations can only be achieved in a low-wage economy, which is not exactly the most conducive to massive social and economic improvements of the living and working conditions of rural and urban low-income populations.

As for environmental issues, this school of thought takes it for granted that small-scale operations and labour-intensive processes are less disruptive on the biological processes of nature.

A second viewpoint considers appropriate any kind of equipments, designs, methods and know-how which reduce the negative impact on the environment (through avoiding or reducing the output of wastes, for instance), and on the availability of raw and energy materials (through savings, substitution, recycling, longer life period and extended obsolescence, etc.). The environmental soundness of these technologies, a product of the application of scientific principles of efficiency, does not automatically imply, however, that the generalized adoption of these technologies would make them economically and socially adequate in the absence of other institutional and strategic developmental changes.

These two interpretations of appropriate technology both lead to give considerable stress on adapting machinery, implements, tools, equipments, designs, formulas and methods of work organisation. This means, for the developing countries, to increase their capabilities in technological research and development, and their institutional capacities to handle a great many activities that are small-scale and dispersed.

Policy proposals that refer to the search and development of appropriate technology often make no distinction of two sorts of adaptations that are quite different.

One kind of adaptation seeks answers to technical specifications such as scaling down of processes and plants, the search for a different product mix, changes according to quality and quantity of inputs, etc. The other sort is linked to economic specifications. These are determined as a rule, by the prevailing current prices of resources (basically capital finance, technology, labour, raw materials and energy) and they are based not on physical principles but on economic assumptions, in particular that the price ratio of these inputs will remain constant (or in any case that labour will always be less costly than all other inputs), and that the shortage of finance capital and the accumulation of debts is to remain a permanent feature of developing countries. Thus the overall tendency is to adapt technology in such a way as to allow the increased use of manpower for productive purposes.

Overview of activities and gaps.

Due to the fact that there are a range of different and sometimes conflicting criteria for defining appropriateness of technology, the selection of activities which are environmentally sound and economical and socially appropriate is a task made all the more difficult by the absence of material that summarizes the technological content of the programmes and projects or the UN organisations and their plans for the medium-term. There is a need for greater precision in reporting on activities in the general field of appropriate technology.

The problem of choosing activities that are relevant to the search for environmentally-sound and appropriate technologies is compounded by the sheer lack of information on expenditures made in this field within the UN system. There is even a lack of financial figures for science and technology as a whole, as it has been pointed out recently by the preparatory committee for the United Nations Conference on Science and Technology for Development⁽¹⁾. This problem should also be viewed by the inter-agency coordination.

Although the method selected here for the classification of activities is not perfect by any means, it does take into account the UN strategy towards meeting the basic needs of the majority of the developing countries' populations, and the range of activities in the productive sectors that are a requisite for obtaining the goods to fulfil basic needs and for obtaining a viable and sustained environment in the long term. In addition, consideration has been given to the present trend towards institutional building in developing countries, and increased efforts towards dissemination activities. The joint problems of definition and classification of environmentally sound and appropriate technology should be given priority by the inter-agency coordination, particularly because of the great amount of overlapping in this field.

It is also felt that there is a need for catalytic research to complement the in-built programmes and projects evaluations, so as to identify for the whole of the UN system the new research and action needed to ensure environmentally-sound and appropriate technologies do meet basic needs and improve resource utilisation, and the quality of the environment to sustain development.

(1) Overview of activities of Organs, Organizations and Programmes of the United Nations System, op. cit., p. 4.

UNEP's goal, objective and strategy

Goal The Governing Council of UNEP in decision (32(iv)) approved a goal for Environmentally Sound and Appropriate Technology: "A global network of institutions to test, apply and publish advice on appropriate and environmentally sound technology, including human settlements technology and technologies for harnessing renewable sources of energy, particularly for use in isolated areas".

Objective and Strategies.

UNEP's objectives and strategies in the area of Environmentally Sound and Appropriate Technologies were presented at the third and fourth Governing Council of UNEP.⁽¹⁾ However, it should be pointed out that in the meantime different developments in UNEP and in the UN system occurred. Therefore it is possible that a reformulation of both objectives and strategies should be done. Agencies are invited to comment on this aspect.

The Objectives and Strategies can be summarized as follows:

Objectives 50/

- To develop and promote environmentally sound technologies and techniques for using them, and to contribute to devising research and development policies designed to achieve this objective;
- To evaluate the guidelines, reasoning and interests that have governed the process of research and development and to consider in the evaluation the effects of the use of the resulting technologies on the environment;
- To examine the problem of technological dependence and the need for adaptation to the environment in the overall process of transfer of technology;
- To define the role that environmental factors have played and should play in the selection and transfer of technology;
- To promote transfer of technologies in accordance with the requirements and the specific characteristics of recipient countries and to help developing countries adapt these technologies;

(1) UNEP/GC/31. para.109
UNEP/GC/61. para.170

- To contribute to developing new international rules and practices for the transfer of environmentally sound technologies;
- To identify specific areas in which the developing countries can make an effort to create their own technologies oriented towards rational exploitation of natural resources with due consideration of environmental factors;
- To contribute to defining the concept of social responsibility in research and development.

Summary of strategy 51/

- The promotion of research activities on technical and economic aspects of low polluting and non-waste technology;
- The definition and identification of new patterns of research and development and the transfer of technology;
- The identification of environmental factors in the process of research and development and transfer of technology;
- Advice to Governments, investors, industrial enterprises and trade unions on the selection of technologies for new investment projects;
- The strengthening of research and development capacity in developing countries in accordance with their specific needs and characteristics;
- Continuing consultations with Governments, international organizations and the international legal community to facilitate the development of international rules and practices for the transfer of technology.

The main mechanism for the direct implementation of UNEP goal is the establishment of a global network of institutions-based projects on environmentally-sound and appropriate technologies (see section II).

However it is clear that the achievement of the goal rests among other elements in the adequate co-ordination between the U.N. system and the dissemination of the concept among governments, scientific, national and international institutions, so support of activities oriented to these purposes will be developed simultaneously.

Catalytic role of UNEP in the UN system. In the area of the technology this function attempts to be a sort of environmental and developmental conscience for the UN system by analysing whether and to what extent the technologies implicitly or explicitly referred in its various actions and resolutions are consistent with objectives of environmentally soundness and socio-economic appropriateness. This activity should be of a permanent character and imply an adequate co-ordination with activities developed by other bodies of the system. Two types of action should be considered:

To study and evaluate those activities carried out by UN bodies and agencies to which UNEP can contribute substantively and that at the same time can be used as a support for other UNEP activities.

To identify activities where UNEP involvement is more in line with catalysing and deployment of ESAT in the achievement of the global objective of harmony with the environment and of development and International Economic Co-operation.

In relation to information and dissemination, several activities have been undertaken:

- a) a preliminary edition of a Directory of Institutions and Individuals Active in ESAT was prepared in collaboration with IRS. A final version will be issued early 1979.
- b) Two conceptual reports: "A Conceptual framework for Environmentally Sound and Appropriate Technologies" and "Methodologies for Selection of Environmentally Sound and Appropriate Technology" will be published early 1979.
- c) Preparation of a Compendium on Environmentally Sound and Appropriate Technology.
- d) Joint publication of technical paper with UN agencies. The first publication will be prepared with ILO.

II. REVIEW OF CONCEPTUAL FRAMEWORK AND POLICIES

The following chapter gives information on the approaches, scope and strategies, as regard appropriate technology, of the various organisations of the United Nations system. It seeks to provide a background information for future cooperation and for the coordinating activities of UNEP.

1. ECA

The Economic Commission for Africa is among the four regional commissions that have dissemination activities in the field of environmentally-sound and appropriate technology⁽¹⁾. In addition to the activities promoted by the Secretariat of the ECA, most of the work carried out through ECA is in collaboration with other UN bodies, and non-UN organisations, such as governments and regional development banks. Through the influence of these organisations, appropriate technology is generally understood at ECA as labour-intensive and economic resource-saving techniques⁽²⁾.

Among the activities of the Secretariat of the ECA, science and technology, and energy are the two main fields where applications of appropriate technology are sought. From the point of view of institution-building, the ECA has an established Intergovernmental Committee of Experts for Science and Technology Development; it has recently set up a Regional African Centre for the Development, Adaptation and Technology Transfers: in collaboration with OAU, UNIDO, UNCTAD, WIPO, ILO, UNESCO and FAO; and has collaborated to a great many meetings, conferences and seminars particularly in the field of energy, small-scale industries, and labour-intensive building and construction techniques. Under its programme on small-industries, the ECA gives consultancy services in the field of labour-intensive technology⁽²⁾ and publishes jointly with UNIDO a Bulletin of small-scale Industries in Africa.

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- (1) ECA Annual Report (4 March 1977 - 3 March 1978). ECOSOC Official Document Supplement 10 and Asupplement 10, Addenda, United Nations 1978, E/1978/50 and E/1978/50/Add.1.
- (2) ECA, Appropriate Technology for small-scale Industries, Possible roles for development finance institutions in Africa, E/CN.14/INR/219, 16 May 1977.

ECA Fourth Conference of African Ministers of Industry, Report of the Fourth Meeting of the Follow-up Committee on Industrialization in Africa, Kaduna, Nigeria, 23-26 November 1977 E/CN.14/INR/220, 21 November 1977.

ECA Meeting of African Experts on Building Materials, Components of the Policy and Strategy for the Development of Construction and Building Materials Industries, Addis Ababa, Ethiopia, 17-21 July 1978, E/CN.14/HUS/23, 9 June 1978. Ibid., Construction and Building Materials Industries in Africa, E/CN.14/HUS/22, 26 June 1978.

2. ECE

The Economic Commission for Europe is the only regional commission that has evolved a specific policy for environmentally-sound and appropriate technology, through the concept of low- and non-waste technology.

The ECE has elaborated upon this concept since 1971, when Senior Advisors to ECE governments on environmental problems drew attention of the commission to the problem of low- and non-waste technology, stating that production processes making less waste should be encouraged⁽¹⁾. Non-waste technologies have become a feature of the ECE programme of work and priorities since 1973⁽²⁾, leading to numerous activities at the conceptual and policy-making levels.

The concept of non- and low-waste technology has developed out of the ECE governments' concern over the environmental consequences of the established patterns of material and energy consumption. The problem stated by ECE, is that "although highly efficient in terms of physical output of commodities and energy services, these patterns are characterized by great squandering of natural resources and by high rates of waste generation per unit of output"⁽³⁾. In order to avoid such negative side-effects, two types of technological innovations have been searched in the industrialised countries: one has been developed to treat waste at the end of the production line; the other is to minimize the creation of waste all along the production line, from the process of extraction of raw materials, to the end of life of the final consumer goods.

Therefore, according to ECE, the "concept of non-waste technology can be considered as a comprehensive approach towards the solution of the environmental problems of industry". The concept is regarded as "a long-term strategy or a philosophy of the evaluation of the environmental complex". The definition of such technology is as follows: "In essence, non-waste technology is the practical application of knowledge, methods and means, so as, within the needs of man, to provide the most rational use of natural resources and energy and to protect the environment. Expressed differently (but equivalently), non-waste

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- (1) ECE, Senior Advisors to ECE Governments on Environmental Problems, Environmental Issues of Critical Importance, ENV/W.P.7, September 1971.
 - (2) ECE, Senior Advisors to ECE Governments on Environmental Problems, Programme of Work and Priorities for 1973-1974, ENV/2 Annex I and II, 16 April 1973.
 - (3) ECE, Senior Advisors to ECE Governments on Environmental Problems, Problems of Non-Waste Technology, ENV/R.27, 3 December 1974.

technology should promote the reduction to a minimum of losses of natural resources during their extraction, conversion and processing, and should ensure the elimination of undesirable effects on the environment arising from the conversion or use of intermediate or final products. In this respect, wastes should be treated not only as potential pollutants but also as potential resources"⁽¹⁾. It should be emphasized that the essential aspect of the concept of low and non-waste technology is to design processes, equipment and machinery, production facilities, and products in order to avoid creating waste throughout the process, rather than handling and using, re-using or re-cycling waste after it has been produced⁽²⁾. However, the approach to low-waste technology from the point of view of thermodynamic energy expense, also known as energy accounting system, does not make such a clear-cut distinction between these two types of waste-eliminating or waste-avoiding technology⁽³⁾.

In all cases, the research, development and production of new or adapted and improved non-waste technology should be guided, according to ECE, by criteria in which the environmental factors play an important role, as well as the requisite for possible restrictions and limitations on, and improvements in, present technology. This control over technology should be applied to several activities, including among others ⁽⁴⁾:

- product design
- technology assessment and control of products and processes,
- promotion of elementary non-waste processing methods,
- development of anti-pollution industry, including recycling and re-use of wastes,
- vertical and/or horizontal integration of industries (constitution of sectoral multi-level complexes, concentration, etc.).

Since there is scope for policy-action (to restrict, limit or promote scientific, technical and economic activities related to technological innovation), the ECE has given some emphasis on the policy implications of the development of non-waste technology in the fields of education and training; technical experimentation and testing;

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- (1) Problems of Non-Waste Technology, op. cit., p.1
 - (2) ECE Senior Advisers to ECE Governments on Environmental Problems, Non-Waste Technology, prepared by Dr. K.V. Ananichev for the Ad Hoc meeting of experts on the principles, concepts and practices of non-waste technology and production systems, ENV/AC.4/R.3, 15 November 1974.
 - (3) ECE Senior Advisers to ECE governments on environmental problems, Some suggested principles and policy implications of non-waste technology, prepared by Mr. G. Royston for the Ad Hoc Meeting of experts on the principles, concepts and practices of non-waste technology and production systems, ENV/AC.4/R.2, 19 November 1974.
 - (4) ECE Senior Advisers to ECE Governments on environmental problems, Summary of the consultation on basic principles and policy implications of non-waste technology, Geneva, 14-15 October 1974, ENV/AC.4/R.1, 24 October 1974.

and fiscal, monetary and regulatory planning instruments⁽¹⁾.

The major projects that have been designed within ECE on technology, as part of the ECE role in helping to apply scientific advances to the development of new methods and techniques, and to implement a broad transfer of technology⁽²⁾, have been recommended to consider the concept of non-waste as a criterion in their work⁽³⁾.

The concept of non-waste was given a somewhat different content since the inception in 1973, of the research and dissemination project on low and non-waste technology,⁽⁴⁾ which has a significant conceptual importance. The new conceptual approach attempts to distinguish the concepts of energy and natural resources from the concept of environment (of which the first are actually a part), and to attribute a different rationality to the use of energy and natural resources, on the one hand, and to the use of the environment, on the other hand (which is a theoretical framework that may bring negative policy implications, particularly in developing countries).

Furthermore, the concept has acquired, within the non- and low-waste technology project, a two-fold character with respect to the objectives of non- and low-waste technology: it is to reduce pollution to a minimum, and to preserve natural resources, including energy⁽⁵⁾. The integrated approach towards the concept of non-waste technology, which entails moving from non-waste technology at the enterprise or project level, to a non-waste economy and pattern of development, has been somewhat lost by the emphasis placed lately on technology for the use at firm level, both to reduce materials inputs and unused material outputs (non-waste technology) and to recover and reprocess waste (anti-pollution technology). Consequently, as a result of this orientation, the project attributes a particular importance to co-operation with industry in market economies⁽⁶⁾.

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- (1) Problems of Non-Waste Technology, op.cit., p.3, and Some Suggested Principles and Policy Implications of Non-Waste Technology, op.cit., p.4-5.
 - (2) ECE, Annual Report (1 May 1977 - 22 April 1978), ECOSOC Official Records, Supplement 7, Vol.I and II, United Nations 1978, E/1978/47.
 - (3) ECE Senior Advisers to ECE Governments on environmental problems, Report of the Ad Hoc Meeting of Experts on the Principles, Concepts and Practices of non-waste Technology and Production Systems, Geneva, 11 January 1975, ENV/AC.4/2, 15 January 1975, p.4.
 - (4) Ibid., p.2
 - (5) Ibid., p.3
 - (6) ECE Annual Report, 1978, op.cit., p.65

Conceptual, theoretical and policy-oriented research has been carried out within the low- and non-waste technology project on technological problems, economic problems, problems of governmental planning, and the theory of non-waste technology from the point of view outlined above (1). These issues involved, in particular:

- knowledge on the state of the art of non-waste technology, including international and national experiences, and channels of information exchange;
- case-studies of cost-benefit of non-waste technology in the iron and steel, pulp and paper, packaging and tyres industries,
- economic, social, legal and fiscal policy instruments for implementing the search and diffusion of non-waste technology,
- attempts to mathematical and semi-qualified modeling to identify, specify and quantify the states and relationships involving the economy, society and ecology.

In carrying out research on non- and low-waste technology, the ECE project has drawn upon the studies and activities that are being made by other ECE projects, in particular in the following fields (2):

- inventory of air pollution emissions from stationary sources;
- toxic chemicals and toxic substances, including, among other items, available technologies for disposal, technical-economic comparisons of recycling and recovering processes, and non-toxic technology;
- waste heat from thermal power plants, and its possible impact and economic uses;
- technologies for the use of low calorific coal and high sulphur content, techniques for the restoration of surfaces impaired by coal mining, new uses of coal especially for gasification and liquefaction, technologies for the utilisation of coal and wastes during extraction and processing;

(1) Report of the Ad Hoc Meeting of Experts on the Principles, Concepts, and Practices of Non-waste Technology and Production Systems, op. cit. Non-Waste Technology and Production, A Seminar of the United Nations Economic Commission for Europe, Pergamon Press 1978.

(2) ECE Senior Advisers to ECE Governments on Environmental Problems, Review of Work Accomplished or in Progress, Geneva, 27 February - 3 March 1978, ENV/R.70, 21 November 1977.

ECE Annual Report 1978, op. cit.

ECE Senior Advisers to ECE Governments on Environmental Problems, Summary Reports for Activities in the Programme of Work and Priorities for 1974/1975 Geneva, 24-28 February 1975, ENV/R.28, 29 November 1974.

ECE Senior Advisers for ECE Governments on Environmental Problems, Activities undertaken by ECE principle subsidiary bodies in the fields related to non-waste technology, Preparatory Meeting for a Seminar on the Principles and Creation of Non-Waste Technology and Production, Geneva 24-25 November 1975, ENV/SEM.6/PM/R.1, 24 October 1975.

- probable evolution of production and use of energy, new technologies for energy production and use, climatic and socio-economic restrictions to energy consumption;
- environmental policies and strategies, policies on low and non-waste technology and reutilization and recycling of wastes,
- production of engineering equipment for the prevention of pollution and its technical-economic effectiveness;
- measures for saving raw materials in engineering industries;
- technical-economic aspects and results of anti-corrosion measures in engineering industries;
- equipment and techniques for manure treatment;
- raw materials and energy requirements in the chemical industry;
- utilization of wastes in and by the chemical industry
- legal obligations in the design, construction and operations of thermal power stations of conventional types, of nuclear power stations, and of high voltage transmission lines and operations;
- rational use of gas and methods of determining the efficiency of equipment in various industries;
- technological trends in use and recycling of basic resources and materials;
- use of steel in Motor-vehicle manufacturing, interrelation between the iron and steel industry and the steel consuming industries;
- non-waste technology in the iron and steel industry;
- treatment and disposal of organic waste: sewage, sludge, industrial effluents and agricultural wastes;
- recycling of high-polymer wastes
- water supply and effluent disposal

The ECE intends to further expand activities in the search and dissemination of non- and low-waste technology. Apart from the investigations done by the ECE chemical industry committee, the steel committee, and the committee on water problems - some of which are of direct relevance to low- and non-waste technology, the commission is to pursue work in the following fields⁽¹⁾:

(1) Review of Work Accomplished or in Progress, op. cit. ECE Senior Advisers to ECE Governments on Environmental Problems, Report of Special Group on Low- and Non-Waste Technology and Re-utilization and Recycling of Wastes, Geneva 5-7 July 1978, ENV/AC.10/2, 11 July 1978.
ECE Annual Report 1978, op.cit.

- organisation of a high-level meeting for the European policy-makers in 1979, in which one of the two topics under discussion will be the low- and non-waste technology;
- compilation and dissemination of a compendium of all available knowledge, or reference to knowledge, on low- and non-waste technologies available within the ECE region;
- activities to stimulate the exchange of information among ECE countries on policy instruments that incentive the development and adoption of non-waste technology;
- conceptual research on quantitative, semi-quantitative and qualitative methods of comparing and evaluating various technologies;
- study of using recycled paper within the UN system;
- policies and strategies to encourage the effective recycling, re-use, and recovery of municipal and industrial solid wastes;
- policy measures for handling, control, and discharge of toxic chemicals and toxic wastes, including the listing of priority chemicals and methods of controlling the flow of dangerous substances;
- medium and long term planning of energy savings and conservation;
- environmental aspects of new technologies for energy production and use.

3. ECLA

The question of environmentally-sound and appropriate technology has been marginally touched upon within ECLA⁽¹⁾. The issue has been recently brought up in the context of the Commission's activities in the general field of promoting and planning the development of science and technology, including the preparation of the UN Conference on Science and Technology for Development. However, there are a few specific projects concerned with it, in particular in the field of geothermal energy; the prospects and economics of non-conventional sources of energy; human settlement technology; eco-design (climatic influence on urbanistic and architectural design in tropical systems); development of water resources; and the economics of technological adaptation (technical innovations and improvement of locally existing equipment vs. imports of innovations and replacement of equipment).

(1) ECLA, Annual Report (7 May 1977 - 6 May 1978), ECOSOC Official Records, Supplement 11, United Nations 1978, E/1978/51.

4. ECWA

Most of the activities of the Economic Commission for Western Asia in appropriate technology belong to the field of dissemination (1). A series of meetings organized in conjunction with UN bodies and Arab financial institutions, have stressed the importance of the transfer of technology and technological development and change. It is within the context of these discussions that the issue of appropriate technology has been raised.

The meetings have tended to consider the appropriateness of technology, both from the labor-intensiveness point of view and as a means to solve specific problem-areas such as desert development; rural development and agricultural productivity; water, energy and natural resource savings; etc. (2).

The ECWA's science and technology programme has been engaged in the preparation of a Centre for the Transfer and Development of Technology, together with FAO, ILO, UNCTAD, UNESCO, UNIDO and WIPO, as well as several Arab organizations and banks. It was decided at the last interagency meeting that the development of appropriate technology should be the fourth priority of the Centre, following the objectives of policy design; regulating the inflow of tools, techniques and technology; and coordinating and integrating regional efforts and actions in science and technology (3).

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- (1) ECWA, Interim Report (1 May 1977 - 1 May 1978), ECOSOC Official Records, 1978, Supplement 9, United Nations 1978.
 - (2) ECWA, Seminar on Technology Transfer and Change in the Arab Middle East, Beirut, 10-14 October 1977, E/ECWA/NR/SEM.1
 - (3) ECWA, Report of the preparatory Interagency Meeting on the Arab Centre for the Transfer and Development of Technology, Beirut 24-28 October 1977, E/ECWA/NR/9, October 1977.

Through collaboration with UN bodies and other regional organizations, the Economic and Social Commission for Asia and the Pacific has carried out in recent years several activities in the field of technology. However the issue of appropriate technology is just being considered within ESCAP policy. ESCAP objective is to develop technologies in the field of industry, technology, housing and environment that are suited to small- and medium scale industries; to strengthen the linkages of these industries with modern and basic industries, including agro- and allied industries; and to disperse and relocate industries away from metropolitan areas⁽¹⁾.

Whereas in the past the main actions were towards increasing information exchange and the transfer of technology, some emphasis is now given also to build up national capacities and capabilities in technology development. This diversification is to materialize in the establishment of the Regional Centre for Technology Transfer⁽²⁾. However, the transfer of technology remains one of the six priority areas listed in ESCAP medium-term plan⁽³⁾, although the revised plan of action prepared for the forthcoming Conference on Science and Technology for development inserts the problem of developing science and technology in a wider developmental context⁽⁴⁾.

The future programme of work of the Regional Centre for Technology Transfer includes the search and development of technologies that either use waste products, are small-scale, or employ more labour, in the fields of food, agriculture and agro-industries; machine tools for the textile industry; energy (mini-hydro plants, solar energy, biogas); and building industry (agro-wastes for cement-like materials)⁽⁵⁾. Future activities, financially supported by UNIDO and UNCTAD, also involve the improvement of information on appropriate technologies in selected sectors. UNIDO has also promoted regional consultations on small-scale iron and steel industry, and on agro- and allied industries⁽⁶⁾. At this last meeting, consideration was given to new developments in post-harvest technology, the improvement of the design and efficiency of animal-drawn carts, low-cost rice-barn stabilization units, the recycling of agro-industrial wastes and by-products, the establishment of bare-foot technologists, and the possibility of creating a network of agro-industrial technological institutes.

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- (1) ESCAP, Annual Report (1 May 1977 - 17 March 1978), ECOSOC Official Records, 1978, Supplement 8, United Nations 1978, E/1978/48. p.41
 - (2) Ibid.
 - (3) Ibid., p.36
 - (4) ESCAP Committee on Industry, Housing and Technology, Report of the Second Regional Preparatory Meeting for United Nations Conference on Science and Technology for Development E/ESCAP/IHT.3/16, 7 August 1978.
 - (5) ESCAP Committee on Industry, Housing and Technology, Review of Activities and Consideration of Issues in the Field of Technology, E/ESCAP/IHT.3/11, 9 August 1978.
 - (6) Ibid., and ESCAP Annual Report, op.cit.

6. ILO

6.1. GENERAL POLICY ON APPROPRIATE TECHNOLOGY

ILO's general policy on appropriate technology has been elaborated within the World Employment Programme that ILO initiated in 1969. The Programme is to assist LDC's decision-makers and planners to reduce unemployment and underemployment through the accelerated creation of productive income-earning opportunities. ILO has held that "the core of the problem is poverty-income returns to labor: situations where people work all day, but earn such a low income from their labor that they can still be classified among the absolute poor" (1). ILO suggests that three target groups should be selected for special attention when thinking of expanding productive employment. First are the people already employed, whose wages or incomes put them at poverty level whether they are self-employed, family or wage-employed. There follows people whose labor is used inefficiently, either because of under-utilization, low productivity, or inadequate input mix. Thirdly are the people whose qualifications, expectations, and aspirations are not matched by their employment opportunities. In short, ILO's work in the field of appropriate technology is heavily biased by its concern with augmenting productive employment.

The Employment and Technology Branch of the World Employment Programme has launched since 1972 a systematic investigation on the application of technology in the development process of developing countries, and has researched many aspects of the relationship of technology to development. It has provided ILO with the conceptual framework and policy guidance both in the inter-related field of technology and employment, and in appropriate technology in particular.

(1) ILO World Employment Programme, Research in Retrospect and Prospects, ILO, Geneva 1976.

ILO's conceptual contribution to appropriate technology stands on the thesis that there is no such thing as "technological determinism", by which it understands an absence of real technological choice. It argues that the idea of lack of scope for choosing technology is a "gross simplification" and an "unfortunate myth" (1). ILO believes, on the contrary, that "economically and technologically viable alternatives do exist in various economic sectors. Often the problem has been found to be not so much the lack of available labour-intensive and efficient technologies but imperfect knowledge about them which leads to wrong technical choices" (2). It has further argued that "at least in certain sectors, technical choice is possible even without changing the composition of output" (3).

ILO's thesis is laid on two fundamental premises. The first is that large-scale, capital-intensive plants, factories, infrastructural projects, and productive undertakings in general cannot solve unemployment and poverty in the foreseeable future. The analysis runs as follows: "The benefits of modern sector growth tend to accrue to the modern sector alone, and in many developing countries industrialisation remains largely irrelevant to the really pressing problems of our times. Hence the need for a redefinition of the place of industrialisation and industrial technology in the development process, and for a careful examination of alternative technology policies" (4).

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- (1) This thesis is upheld in the numerous publications issued by the Employment and Technology Branch since ILO presented a paper on Appropriate Technology, Employment and Income Growth, at the 1971 ACAST meeting. For a recent exposition, see ILO, Programme of Industrial Activities, Appropriate Technology for Employment Creation in Food Processing and Drink Industries in Developing Countries, Second Tripartite Technical Meeting for the Food Products and Drink Industries, ILO, Geneva 1978.
 - (2) Research in Retrospect and Prospects, op. cit., p. 22. See also A.K. Sen, Employment, Technology and Development, ILO/Oxford University Press, March 1975.
 - (3) A.S. Bhalla, Technologies Appropriate for a Basic Needs Strategy, World Employment Programme Research Working Paper, ILO, Geneva August 1978.
 - (4) ILO World Employment Programme, Technology for Development, Some Related ILO Views and Activities, ILO, Geneva May 1978

ILO has also reckoned that the fulfilment of basic needs entails providing the underprivileged and poor groups with low cost goods and services, and that the cost of these products depends on the technology used to produce them. But ILO does not look at advanced technology for reducing costs, as UNIDO sometimes has done (1). It rather suggests lowering costs by diminishing the standards of the products, or else changing the type of output so that the product retains its essential qualities while it is free of superfluous characteristics (2). This point of view - which is rather similar to the World Bank's (3) - is likely to meet criticisms. As far as the first type of technological change is concerned, the production of unsophisticated goods and services for low-income groups may easily establish a system of double standards which is bound to be incompatible with a participatory strategy of development. In the second case whilst the direct production costs may be lower per unit of output, the costs of the new product research and development may outbalance in the short term the savings of materials, energy, labor, and other inputs spent in the superfluous component parts of the product. There is however a significant scope for research to be made in this field, in connection with the search for environmentally sound technologies.

The second premise implied within ILO's conceptual framework on appropriate technology is that the developing countries need in any case a technological policy so as to choose appropriate techniques. These policies for the choice of appropriate technology eventually lead to the need of choosing appropriate products, in accordance with the country's development strategy (which should ideally be directed to fulfil the basic needs of the poorest layers of the population)

Appropriate technology is thus defined as the one which is "more suitable to actual local conditions and national social and economic objective than any other technology resulting in a similar good or service" (4). This definition implies that the output, or product mix is given, or else that it has been selected before hand. In ILO's perception, appropriate technology would thus be the most technically and economically efficient technology (i.e. the cheapest technology) which is selected as a function of a given or chosen output.

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- (1) See section 13. UNIDO pp.
- (2) Technologies appropriate for Basic Needs Strategy, op. cit., p. 17-19
- (3) See section 20. WORLD BANK pp.
- (4) Technology for Development, Some Related ILO Views and Activities, p. 2-3

This theoretical approach to what appropriate technology is poses some problems. On the one hand, whilst it is obviously possible to predetermine in a planned manner the output of production for covering the needs of a society - and thereby choose accordingly the most appropriate technology out of the shelf of known techniques, a process which would in turn make varying demands on the available inputs (skilled labor, energy, quantity and quality of raw materials, etc) - in the actual production processes the scope for substituting inputs is not a given mathematical relation. In the process of production, there is generally a rather fixed relationship between the quantity and quality of inputs, the technology which may be used with these inputs, and the quantity and quality of output begotten. It is thus generally considered that there is little scope for the substitution of inputs, and therefore for choosing an alternative technique when a product with similar essential characteristic is wanted. If, on the other hand, it is believed that it is possible to substitute techniques without changing the type of output (i.e., if it were possible to produce goods of the same quality with different techniques), the problem of technological choice would easily become a mere question of deciding what should be produced, with the focus diverting from the problems of production, including problems of technological innovation, trade and transfer, to those of consumption and product acceptability.

Furthermore, although ILO's definition of appropriate technology could in theory be applied indifferently to labor-intensive and capital-intensive technology - because it centers mainly on the relationship between technology and output, in practice the action-oriented research and operational activities of ILO in the last 5 years have been directed towards the search for, the analysis and the diffusion of less capital-intensive and generally speaking of more labour-intensive techniques that are sound on both technical and economic grounds.

As a result of this conceptual approach, ILO has put a great emphasis on the need to select appropriate technology through institutional mechanisms such as a technological policy, to implement labor-intensive technological change and to develop local R and D accordingly. The initial objectives of the technology and employment research effort have the following (1):

- to identify alternative labor-intensive technologies which are economically competitive;
- to assess the scope for adapting technologies imported from the developed countries;
- to envestigat government policies needed for the promotion of domestic research, development and adaptation of technologies, and for the ascertainment that economically competitive labor-

(1) Research in Retrospect and Prospects, op. cit., p. 21.

intensive production methods are utilized to the maximum extent possible.

The last of these three objective implied two sets of actions: first, policy recommendations to governments to make sure that they will influence the prices of labor and capital in favour of labor-intensive techniques, and secondly the establishment of mechanisms to disseminate information to entrepreneurs about technological alternatives. Indeed ILO has stated that the main effect must now be towards disseminating existing techniques rather than initiating a massive research and development effort to create new producti methods (1).

This general approach to the problem of employment and technology has been further enhanced by the guidelines laid down at the 1976 World Employme Conference which adopted the new ILO basic needs strategy (2). The organisation main conceptual and practical work has thus turned to the policy implications of the development and transfer of technologies that are appropriate to the socio-economic objectives of the developing countries. At present it aims at the following objectives (3):

- to demonstrate how a basic needs strategy (and indeed any other development strategy) implies a certain choice of goods to be locally produced or purchase abroad, and a certain choice of services to be delivered to the population;
- to demonstrate, after it has been decided what will be poduced in what quantity and where, how an appropriate technology may be selected among various alternatives;
- to identify these alternative technologies and to assess the scope for adapting technologies imported from the developed world;
- to assist in the formulation of technology policies;
- to assist through technical cooperation projects and information dissemination activities in the implementation of the appropriate technology concept.

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- (1) ILO World Employment Programme, Programme on the Dissemination of an Appropriate Technologies, ILO, Geneva, February 1978
 - (2) ILO Declaration of Principles and Programme of Action, adopted by the Tripartite World Conference on Employment Income Distribution and Social Progress and the International Division of Labor (The World Employment Conference), June 1976, Geneva, see Chapter III of the Programme of Actio "Technologies for productive employment creation in developing countries"
 - (3) Technology for Development, Some Related ILO Views and Activities, op. cit.

A further objective is to investigate a range of social effects of technological change, in particular on the quality of work, and thus on the quality of life. ILO has noted that "modern technology is frequently transferred to developing countries without the necessary safety and health rules at the same time" (1). It intends therefore to promote the design of new production systems, tools and equipment that are less physically harmful and enduring to the workers, and which would reduce inhuman working conditions and the unnecessarily high incidence of accidents and disease. The work in the field of the working environment is mainly pursued in the field of agricultural production and small urban enterprises. It includes the need to adapt imported technology and work organisation to the socio-cultural, institutional and climatic context of developing countries. New research is sought on the effects on workers and on working environment of various types of technology with a view to establish a typology policies and technology options with their related social implications. (2)

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- (1) Technology for Development Some Related ILO Views and Activities op. cit.
 - (2) ILO, Overview of the ILO programme for the improvement of the working environment, Consultative Inter-agency Meeting on the Follow-up of UNEP Governing Council Decision 87 (V) B, Geneva, 13-14 March 1978. See also the working documents and discussions of the International Programme for the Improvement of Working Conditions and Environment (PIACT), in particular the papers presented at the Philippine National Tripartite Conference on Improving Working Conditions and Environment, organised by ILO in Manila, 12-14 December 1977.

6.2. SECTORAL POLICY

The ILO World Employment Programme is directed to all the productive sectors (agriculture industry construction and services) as the focus for the application of its general policy on technology and employment. However, within these large sectors a particular emphasis is given to small scale productive activities both of the self- and family-employment type, and of the artisan and wage-employment one.

ILO believes that "for appropriate technology choice to be an effective instrument of employment policy, it has to be related to the relevant modes of production. For example, the non-wage modes of production and employment lend themselves to the utilisation of labor-intensive techniques, particularly in small-scale agriculture and services, more than the wage modes of employment" (1). There are rather crucial policy implications to this statement. The most obvious is that the introduction or fostering of old modes of production (self- and family-employment, for instance), for the purpose of disseminating the use of labor-intensive techniques, would have the probable effect of increasing the productivity of labor through the extension of the working time, in contradiction with the legitimate aspiration of the working population to shorter working hours.

(1) Research in Retrospect and Prospects, op. cit., p. 22

7.1 GENERAL POLICY ON APPROPRIATE TECHNOLOGY

Appropriate technology is among the recurrent themes found in FAO's programme of work, and it is viewed as one of the means of removing the constraints for the increase of food and agricultural production, along with other limiting factors such as investment, marketing, research and production of new inputs, etc. (1). All the major action programmes of FAO (for instance the current one on post-harvest and food losses) include reference to reducing the problems identified through a new sort of technology. This should be simple, practical and based on locally available materials, and would involve increasing research and development, as well as the application of new techniques and methods of production. Therefore, generally speaking, all of FAO's sectoral field and research works in agriculture, forestry and fisheries bear a relationship with the search for environmentally-sound and appropriate technology.

However, despite the existence of a few statements on the importance attached to appropriate technology (2), the general feeling at FAO is that, conceptually speaking, there is not much to be said about appropriate technology. It is likely that this attitude will be strengthened as FAO is to shift resources from theoretical and long-term studies towards more practical and short-term actions (3). The general frame of mine, or implicit conceptual framework, is that technical solutions always exist to meet the problems identified. Whether the technical solution is adopted or rejected is a matter of policy option, which is granted a value in itself, regardless of the social and environmental costs it entails. The underlying statement is that the appropriateness of technology is a matter of technical policy choice and is to be tested in field work. The whole approach tends to imply that policy-makers know better in any circumstance. Because of scant work on conceptual aspects of policy implications, there appears to be little thinking on ways of monitoring the side-effects when testing a newly developed technology on a large-scale, except on a technical-economic basis. The reluctance to approach conceptually the relationship between technology and development (which includes the environment) is somewhat compensated by the fact that many of FAO's field activities are oriented towards an environmentally-sound application of technology, as it is shown further (4).

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- (1) FAO, Report of the Conference of FAO, Nineteenth Session, Rome, 12 November - 1 December 1977, C 77/REP.
 - (2) See for instance, contributions to ACAST, and particularly, ACAST Report of the Ad Hoc Working Group on Appropriate Technology, E/AC.52/XXIII/CRP.2, 10 June 1977, p.8.
 - (3) Report of the Conference of FAO, 1977, op. cit., p.37
 - (4) FAO, The State of Natural Resources and the Human Environment for Food

FAO's concern towards appropriate technology stems from the importance it attaches to the development of a new strategy towards rural development, which aims are to increase and sustain food and agricultural development, to make the transfer of technology more effective, and to identify a series of technical constraints for the most efficient use of natural resources. Some of the most important premises on which this analysis is based are the following (1)

FAO believed in the need to maintain the ecological balance for enabling the productive capacity of natural resources to continue. Therefore, natural resources should be conserved but only within the limits required by agricultural production and the maintenance of the cultural and social-economic setting in which farmers evolve. According to FAO, the major world problems of today are the pressure of population on natural resources, the trend towards increasing shortage of fossil fuels and the high cost of inputs for modern, commercial agriculture. Since these costs will remain high, they must be "used parcimoniously, at minimal level and maximum efficiency", in combination with new productive systems (2)

Together with other aid agencies, FAO agrees that the rural poor, small farmers and landless peasants, and agricultural workers should be the focus of aid programmes, with the aim of detaining rural migration. As a result, the technical assistance and research programmes are to be basically aimed at incentivating people to stay in the country side and direct the re-structuring and improvement of rural life. This kind of development is expected to come about when peasants will rely on their own means. FAO also maintains that, although the rural sector needs capital inputs, "money is not the main element to mobilize peasants in the first and crucial phase of rural development in many developing countries"(3).

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- (1) Report of the Conference of FAO, 1977, op. cit. The State of Natural Resources and the Human Environment for Food and Agriculture, op. cit. Natural Resources Management for Food and Agriculture Production, through self-sustaining Agriculture in Developing Countries, Statement by F.J. Mouttapa, at the 69th meeting of the IDWG on Natural Resources and the Human Environment, 16 June 1978.
 - (2) Natural Resources Management for Food and Agricultural Production, op.cit.
 - (3) Report of the Conference of FAO, 1977, op. cit.

What is needed, as FAO sees it, is to help the rural people to understand what they can do by themselves so as to fulfill their needs. In this respect, traditional agricultural systems are considered to be worth of particular attention for the development of these new productive systems. They are expected to be better suited to local ecological, cultural and socio-economic conditions.

Furthermore, modern or high input agriculture, cannot reach poor farmers (partly because they cannot afford the whole package needed to carry out production effectively). Modern agriculture also causes the dislocation of traditional farming. Thus the need is argued for agricultural practices and productive systems that maintain the existing socio-economic and cultural setting. It is also stated that traditional systems could be rapidly and extensively improved (or modernized) with little investment.

Finally, it is thought that there are inherent benefits to self-reliance at the local and national levels, and to collective self-reliance at the regional level. TCDC is actually regarded as a reaction to the technology developed in the industrialized countries and to the realization that this technology is not necessarily suited to the shared LDC's needs and ecological conditions, socio-economic structures and rural situations(1

On the basis of this analysis, FAO considers that the objectives of the rural development strategy, which includes the use of appropriate technology, must be to use local resources and local skills; to increase rural employment and check rural migration to the cities, and to develop new systems of production or improve traditional ones. This last objective gives a particular importance to ways of recycling waste for agriculture, agro-industry and domestic uses; to the design of alternative systems that are adapted to socio-economic conditions and needs; and to the research and development of less resource wasting methods and techniques (using less energy, utilizing more waste and by-products, reducing losses, utilizing a maximum of locally available materials, etc.).

The technical means for the promotion of such integrated self-relying systems of production are: the research for traditional agricultural systems and their improvement, if necessary, in the light of modern scientific knowledge; the integral use of forest resources (agrisilviculture, or agro-forestry), the further development of aquatic resources (aquaculture in particular), and the appropriate way of holding crops (including integrated or ecological pest control, reduction of food losses, etc.). From a socio-economic point of view, small-scale production is promoted, both at farm and village level, including small-scale forest industries.

(1) Report of the Conference of FAO, 1977, op. cit., p.40

Therefore the criteria of appropriateness found in FAO's understanding of technology include the following: "the technologies should be as far as possible scientifically up-to-date, economically-sound, culturally compatible, employment generating, capital saving, energy conserving, waste reducing, environment protection, capable of manufacturing products of the desired quality in required quantity, and capable of further development to meet the changing social needs, and be of benefit to the large majority of people" (1)

7.2

SECTORAL PRIORITIES

Since FAO is specialized in all the technical fields related to agriculture, forestry and fisheries, there is no particular emphasis on one or other aspect of food and agricultural production. However, special programmes are promoted according to crucial problem areas identified at the world level. For instance, staple food was given priority at the last general conference (2), while perishable food is taken care of under another major programme effort for reducing post-harvest and food losses.

The areas of development of appropriate technology are related to specific objectives: increased incomes and jobs, improvement of the quality of life, education and institution building. (3).

- increased incomes and jobs: among other things, aquaculture is viewed as an additional source of food as well as a source of jobs in ricefields, ponds, streams and other fresh waters; agrosilviculture is also regarded as a source of non-agricultural jobs, as well as an activity that helps soil conservation, improving environmental conditions, supply burning fuel, wood and materials for preparing organic composts; small and domestic industries is another source of non-jobs; solar and wind energy and soil and water conservation techniques, adapted to agro-ecological areas, are also considered as priority sectors for development of jobs and improvement of the quality of life.
- the improvement of the quality of life: these improvements are basically in the field of health care and water and waste sanitation; they include better domestic and community sanitary systems (that enable the recycling of domestic and organic refuse for pisciculture, the construction of biogas structures and the preparation of organic fertilizers, etc.), as well as all other productive uses of waste; the excavation and upkeep of wells and other sources of clean water;

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- (1) Report of the Ad Hoc Working Group on Appropriate Technology, op. cit.,
 - (2) Report of the FAO Conference, 1977, op. cit.
 - (3) Report of the FAO Conference, 1977, op. cit.

the improvement of training of local sanitary workers and communal health centres where basic modern medicine and surgery are to be combined with autoctonous medicines and natural remedies of proven efficiency.

- Education: according to FAO, the main problem in this field is the restructuring of rural teaching and training; training programmes should be delivered directly to small-scale farmers and landless peasants, who would be trained into simple cultivation practices and stock-breeding techniques; the overall aim would be to reach the least advanced rural communities, to give them access to the techniques that are already common in the developing countries, and to raise thereby their productive knowledge; FAO believes that it is of particular importance to introduce and train these rural groups - and particularly the youth - into productive activities related to environmental silviculture, forestry repopulation, small forest industries, and aquaculture; training programmes should be formulated globally as to bring out the inter-relations of various connected processes of land and water-based production, such as agricultural systems, agro-silviculture, aquaculture, organic recycling, etc.
- Institution building: this is an implicit requisite for the development of the above-outlined action programme. On the one hand, FAO has recently emphasized the importance of incrementing the efficiency of the transfer of appropriate technologies between the developed and the developing countries, as well as among the developing countries themselves. Bilateral and multi-lateral aid programmes are crucial for the financial and technical support of the development and transfer of technology. FAO sees its contribution to the dissemination of adequate technology mainly through defining of priority food sectors, implementing concrete and applied research, and establishing appropriate mechanisms to transmit the results of research and to attract investments. At the grass-root level, the strengthening of communal organizations is seen as a basic instrument to get the rural people to fulfill their needs by themselves in a spirit of self-reliance. The introduction of simple and practical improvements at village-level should be done particularly through women.

FAO sees that these objectives are generally not easy to reach because of, among other things, "there lacks a clear conception of what is vaguely described as 'appropriate technology' in various fields. The problem resides not only in the costs or in

the availability of funds for the generalized introduction of such technology. It is also a problem of its adequacy to the needs of small farmers and poor peasants in general, and a problem of the capacity of these to maintain such technology constantly. There is much experience accumulated in the world in general, especially in the developing countries themselves, which should be compiled and evaluated so as to be then extended to other countries that may adapt it to their needs."(1)

(1) Report of FAO Conference, 1977, op. cit., p.59 (Spanish version).

8. UNCHS (HABITAT)

The UN Centre for Housing Building and Planning, the predecessor of the UN Centre for Human Settlements (Habitat), has included the choice of appropriate technology in its work programme for 1978-1979. A key feature of this work is that it identifies appropriate technology to labour-intensive techniques that use indigenous resources. From this perspective, appropriate technologies are encouraged because they help to reduce foreign exchange expenditures on machinery and equipment and tend to maximize employment. (1)

A major project has initiated for a compilation of the state of the art of the selection of appropriate building technologies. The focus is on the selection of appropriate technologies for materials production and for building operations, the improvement of existing institutions and administrative procedures for the adoption of appropriate technologies, and the possibilities for international and regional co-operation in the selection of appropriate technologies. As a follow-up, UNIDO, ILO and UNESCO are expected to co-operate in the implementation of an action plan for selecting appropriate building technique.

(1) Work of the Centre for Housing, Building and Planning in the Field of Appropriate Technologies, paper presented at ACAST Ad-Hoc Working Group on Appropriate Technology, Vienna, 16-20 May 1977.

The UN Centre for Natural Resources, Energy and Transport of the UN Department of Economic and Social Affairs, has not produced any policy guidelines on issues related to environmentally sound and appropriate technology. However, it has promoted activities connected to the concept of appropriate technology, in the fields of energy, resource-saving techniques, and water resource development.

Some background material on labour-intensive techniques for water development was prepared for the United Nations Water Conference (Mar del Plata, Argentina, 1977)⁽¹⁾. Although the issue of appropriate technology was implicit in one of the four major items discussed by the Conference (Item on the promise of technology: potential and limitations), no specific recommendation was made on the issue. The Centre's general focus on appropriate technology for water resources is from the point of view of increasing the technical efficiency of supplying water. There is, however, a tendency to equate appropriate technology with labour-intensive technology⁽²⁾, through technical efficiency remains the main criterium adopted when dealing with choice and assessment of technology.

Technical efficiency is a major parameter also in the research on recycling and substitution of mineral raw materials which is presently being prepared by the Centre⁽³⁾. The report investigates the role of recycling in the supply of mineral raw materials, the types of scrap (or metallic residues) used by metal recycling industry, the trends and potentials of expansion of this industrial branch, as well as features of substitution of metals, and policies issues related to recycling and substitution.

The Centre is also involved in the preparation of feasibility studies on the possibility of holding an international conference on new and renewable sources of energy that could be convened in 1981. It has been proposed that the envisioned conference would examine in depth the prospects for solar and geothermal energy, wind power, biomass conversion including charcoal and wood; oil shale, tar and sands; micro-hydropower; tidal and wave power⁽⁴⁾.

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- (1) United Nations Water conference, The Promise of Technology: Potential and Limitations, Parts 1 and 2, Mar del Plata Argentina, 14-15 March 1977.
E/CONF.70/CBP/2, 30 November 1976. United Nations Water Conference, Water for the Thousand Million, report prepared by Intermediate Technology Development Group Limited for the Conference, E/CONF. 70/A.5, 23 February 1977
 - (2) See papers prepared for a symposium on labour-intensive technologies in water resources development, held in New Delhi in 1976, by the Centre.
 - (3) The report is to be presented at the forthcoming meeting of the UN committee on Natural Resources.
 - (4) ECOSOC, Feasibility of Holding an International Conference on New and Renewable Sources of Energy, E/1978/68, 19 May 1978.

10. UNCSTD

The provisional agenda of the United Nations Conference on Science and Technology for Development to be held in Vienna in 1979, deals with "the application of new technologies appropriate to the needs of developing countries", as part of the activities related to the choice of technology and transfer of technology.

As a result, the treatment given to the concept of appropriate technology is necessarily biased to relate it to the two issues in focus. The Preparatory Committee for the Conference thus considers that "the effective application of technology to development depends mainly on the existence of a national capacity to choose the technology that is appropriate to national development goals and socio-economic conditions"⁽¹⁾. In other words, the two implicit criteria used for defining the appropriateness of technology are, according to this approach, the goals established by governments and the existing socio-economic conditions.

However, the preparatory committee for the Conference recognizes that "the effect of technology on the environment and the promotion of the sustainable use of resources" are among the criteria that some UN programmes identify for the choice and the development of technology⁽²⁾.

There are surveys and specific studies undertaken within the UN system, that partly involve discussions on appropriate technology and may feed the Conference with background material. These are, in particular⁽³⁾:

- exploratory studies on trends and developments in research for non-conventional and non-polluting energy sources, appropriate technology, waste-recycling technology, and non-food agricultural materials
- a report on non-conventional sources of energy to identify gaps in current activities of energy research within and outside the UN system;
- a study on technology assessment as a methodological and practical tool of action;
- a study to develop criteria and guidelines for appropriate technology.

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- (1) Preparatory Committee for the United Nations Conference on Science and Technology for Development, Overview of Activities of Organs, Organizations and Programmes of the United Nations System, Report prepared jointly with the Secretary-General of the UN Conference on Science and Technology for Development and the ACC, A/CONF.81/PC/19 (Part I), 31 July 1978.
- (2) Ibid. p.9
- (3) See sections 8, Habitat; 9. UN Centre for Natural Resources, Energy and Transport; 12. UNDP; and 16 UN Office for Science and Technology.

The main emphasis of UNCTAD's programme of transfer of technology is in strengthening the institutional and legal capacity of developing countries to acquire technology on favourable terms and conditions, as well as to use it and adapt it, and finally to generate such technology as required by their needs.

UNCTAD holds the view that appropriateness of technology depends on the economic and social development goals of governments (which are expected to reflect the needs of the country), and on the particular circumstances in which a technology is applied. According to these criteria, which UNCTAD has not elaborated upon, at least as much as the World Bank for instance, the concept of appropriateness appears as a very relative notion. UNCTAD has also suggested, however, that cost could also be used as a criterium, in which case the prevailing prices of capital and labour factors would determine three categories of technology: modern and large-scale (or capital intensive), intermediate (or low-cost), and traditional (or primitive).⁽¹⁾

This approach entails that UNCTAD has no particular explicit policy towards appropriate technology. The problem of appropriateness is rather viewed as a policy matter, and the solution would be in building-up the developing countries ability to choose and purchase existing technologies, as well as to develop new technologies. According to UNCTAD programme, this is to be achieved through the establishment of national technology policies and plans, the creation of national institutions, the setting up of regional centres for transfer and development of technology, and cooperation among developing countries. The developing countries themselves are to play a decisive role in the progress of strengthening national technological and scientific capabilities⁽²⁾.

As a result, UNCTAD's work on appropriate technology has been somewhat marginal, as a side-product of other investigations, in particular in its current research on pharmaceuticals (in collaboration with WHO),

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- (1) Transfer and Development of Technology, note prepared by UNCTAD for ACAST Ad Hoc Working Group on Appropriate Technology, Vienna, 16-20 May 1977.
 - (2) UNCTAD, Report of the Trade and Development Board, Vol. I, General Assembly Official Records : thirty-third Session, Supplement 15, (A/33/15), United Nations, New York 1978, p.163.

and on energy. Recent interest in environmental related issues has led to a joint UNEP/UNCTAD research project on transfer of technology and environmental problems, which includes conceptual work on technological dependence and environmental impact, as well as seven case studies in the plantation, mining and process industries sectors.

UNCTAD plans for the medium-term include an active participation in the regional centers for science and technology, which establishment has been promoted by UNCTAD and other UN organisations for the past two years⁽¹⁾. UNCTAD is also to help the transfer of technology on a sectoral basis⁽²⁾. A programme is being designed with FAO for the transfer of technology in the food processing industry, and advisory services will continue to be provided for the establishment of sectoral regional centres for transfer and development of technology.

(1) See sections 1. ECA, 4. ECWA, and 5. ESCAP.

(2) Report of the Trade and Development Board, op.cit., pp.159-163.

12. UNDP

The role of the United Nations Development Programme is to assist the use of technology, through the financement of projects, rather than to develop an in-house capacity for creating technology.

As a result, UNDP's work in the field of appropriate technology is spread through out the activities it supports in collaboration with executing agencies such as FAO, ILO, UNESCO, UNIDO, and so on, and through international research institutes coordinated by the CGAIR, and the recently established regional centres for transfer and development of technology.

However, some thinking has been done lately on the role UNDP should have in promoting appropriate technology⁽¹⁾. For instance, the UNDP also intends to enter new areas of technological and scientific research and development in the medium-term, as well to support the adaptation of imported technology, in the field of small-scale farming, labour-intensive methods of production, recovery and use of wastes and basic health care.

(1) Overview of Activities of Organs, Organizations and Programmes of the United Nations System, op.cit.

As a specialized agency for education, science and culture, UNESCO has given particular attention to renewing educational systems, and shaping long-term educational, scientific and technological policies and plans, for the purpose of: furthering the world's socio-economic evolution; introducing the foreseeable and advances in science and technology; raising the social productivity of labour and the preparation for working life through education and the introduction of productive work into the educational process; and making possible the best utilisation of all educational and cultural resources. Another object has been the promotion of international co-operation in science and technology towards the economic, social and cultural development of all peoples ⁽¹⁾.

UNESCO has been given specific directives by the UN and its own governing bodies to promote the use of scientific and technological developments in the interests of peace and social development, as well as further the role of modern science and technology in the development of nations, to strengthen economic, technical and scientific co-operation among states. Its concern towards appropriate technology is linked to two problem areas which UNESCO has recently analysed as a basis for medium-term planning ⁽²⁾: the development of man and society, and the balance and harmony between man and nature.

Accordingly, UNESCO is to step up action in the fields of interactions between science and society, and science and technology policies. One of the major concerns of these programmes is the problem of transferring and adapting technology in such a way as to promote endogenous development of a kind consonant with the aspirations of each society, and in keeping with its values. Also prominence has been and continues to be given to studies on the rational use of natural resources, and to the management, and protection of the environment.

(1) UNESCO, Draft Programme and Budget for 1979-1980, UNESCO General Conference. Twentieth Session, Paris 1978. 20 C/5.

(2) UNESCO, Analysis of problems and table of objectives to be used as a basis for medium-term planning (1977-1982), UNESCO General Conference, Eighteenth Session, Paris 1974, 18C/4.

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As a consequence, although UNESCO has produced no major contribution to conceptual, theoretical and policy-orientation research on appropriate technology, it seems to take into account the problems dealt with environmentally sound and appropriate technology at the action-level.

Research programmes and projects that have a component in appropriate technology include the following⁽¹⁾:

- interactions between science, technology and society: this is an interdisciplinary study of the historical development of science and technology and the conditions which appear to foster this development in certain cultures and at certain periods; the study is to clarify the way in which science and technology are introduced and developed in different societies, and to identify the effects of the progress in science and technology on society and on the transformation of the sciences themselves.
- science and technology policies: activities are directed towards developing national capacities in planning, programming, budgeting and management in order to harness science and technology for the endogenous social, economic and cultural development;
- scientific and technological research and training: this includes, among other activities, the research and development of technology geared to specific needs, in particular in the fields of housing construction, unconventional energy sources (including solar energy), and uses of conventional sources that are more rational and less pollution-generating;
- integrated rural development: the programme contributes to the training of engineers whose task is to disseminate appropriate technologies and information on the ecological implications of rural development plans among planners, decision-makers and administrators;
- mineral and energy resources : the programme is to improve understanding of the processes governing the evolution of the earth's crust, and dissemination of knowledge on mineral and energy resources for the purpose of their rational use and mitigation of natural hazards;

(1) Draft Programme and Budget for 1979-1980, op.cit., pp.23-33.

- man and the biosphere: this is a large-scale programme which purpose is to solve concrete problems raised by the rational use of the earth's biological resources; it includes provision for innovatory research and training programmes to promote methods of integrated land development through the transfer or establishment of appropriate technologies specific to the different ecological and developmental conditions;
- participation in cultural life: the activities involve four major concerns, one of which is to understand the relations between cultural innovation and change, and technological and economic innovation and change.

UNEP has began its activities in the field of environmentally-sound and appropriate technology with studies that attempt at clarifying the meaning of appropriateness and, consequently, the methodology for selecting such technology.

The rationale of UNEP's conceptual work is that any programme or activity in the field of technological research, development and dissemination largely depends on the understanding of the substantive issues underlying these activities. Therefore, an effort has been initiated to evolve a conceptual and methodological framework, addressing the attention to three basic issues:

- a conceptual elaboration on the notion of environmentally-sound and appropriate technology;
- a study of the problems and methodology for the generation of environmentally-sound and appropriate technology;
- a discussion on the criteria and methodology for the selection of such technologies.

Experts meetings discussed the preparation of the conceptual framework and the methodology for the selection of environmentally sound and appropriate technologies, and the resulting reports are in the process of being disseminated⁽¹⁾.

These initial works conclude that environmentally sound and appropriate technologies are those consistent with an ecologically balanced growth and with economic and social justice. In order to be compatible with environmental, economic and social goals, the design and choice of technologies must be guided by the environmental principle of ecological soundness, the economic principle of reducing inequalities between countries, and within countries, and the social principle of participation to and control over decision-making. The adoption and application of these environmental, economic and social principles would ensure the appropriateness and soundness of technology on all the environmental, economic and social grounds.

(1) UNEP, Conceptual Framework for Environmentally Sound and Appropriate Technologies, and UNEP, Methodology for Selection of Environmentally Sound and Appropriate Technology, in process of publication by Pergamon Press

According to UNEP, the importance of the concept of environmentally-sound and appropriate technology lies in the fact that, in taking insufficient cognizance of the ecological and socio-economic impact of technology, there is a tantamount risk of running into environmental degradation beyond the reproductive capacity of the environment, and to jeopardize future development in general, and the expected achievements of a new international economic order. Thus, concern for society, and for the environment in which this society exists, must find expression in the choice of technologies. This means that discussion on the choice of technology must be an inseparable part of any plan that involves either the environment or socio-economic objectives. The UNEP sees its role as that of strengthening and amplifying such awareness where it exists, and of initiating and generating awareness where it is absent.

UNEP intends to carry forward this catalytic role through the establishment of a network of institutionally-based pilot projects. The network is based on the premise that a multidisciplinary and multi-institutional approach is necessary, both for the development and for the selection of environmentally-sound and appropriate technologies, and that an efficient flow of information is a condition for its development.

The network is envisaged as a global interaction of institutions that execute projects on environmentally-sound and appropriate technologies, relevant to a variety of environments and basic needs, with the object of promoting, designing and testing environmentally sound and appropriate technology, as well as demonstrating through practical projects the need, feasibility and consequences of selecting and developing environmentally-sound and appropriate technologies.

UNEP is to catalyse, in these institutions, the capability to choose and develop technologies and, through this activity, to strengthen the technological capabilities of developing countries. At the same time, this activity is to increase UNEP's information and referral base for environmentally-sound and appropriate technologies. However, since no conceptual work is finite and networks are not to be regarded as static entities, there is a permanent revision of institutions and projects, that UNEP is to catalytically support. The support to specific activities has begun partially with joint projects initiated with UNIDO, UNCTAD, and lately ILO.

UNICEF has recently began to give emphasis to appropriate technology, which it understands as ideas, methods, equipment, tools and practices that help the improvement of the nutrition, health and well-being of children and families. These devices should be simple and compatible with the environment (1).

A major effort has been undertaken to produce and test equipment and tools that improve the design of traditional implements and methods, and/or use new materials. Emphasis is placed on the low cost of the equipment, the use of locally available materials, the simplicity of skills required both for construction or manufacturing, and for maintenance(2). Activities include the dissemination of knowledge on these simple, village and community level techniques.

The UNICEF future programme stresses the following areas:

- improving the availability and quality of local food supplied through better methods of cultivation and improved food conservation;
- improving health care, home hygiene and home environment;
- improving the use of existing fuel sources and developing others for cooking and household use;
- reducing the physical workload of mothers.

(1) UNICEF, Report of the Executive Board (15-26 May 1978), ECOSOC Official Records, 1978, Supplement 14, United Nations, E/1978/54.

(2) Village Technology in Eastern Africa, A report of UNICEF sponsored regional seminar on "Simple Technology for the Rural Family", edited by Jim McDowell, UNICEF African Regional Office, Nairobi (no date).

16.1 GENERAL POLICY ON APPROPRIATE TECHNOLOGY

UNIDO's increased involvement in the field of appropriate industrial technology dates from its Second General Conference (Lima, 1975) where the organization was given additional mandate to investigate and promote the choice and application of appropriate technology for the benefit of the industrialization of the developing countries. The implementation of this mandate has begun through the establishment at UNIDO of a Co-operative Programme of Action on Appropriate Industrial Technology (1).

UNIDO's policy on appropriate technology is mainly the resultant of the Consultative Group on Appropriate Industrial Technology which advises UNIDO Executive Director and UNIDO Industrial Development Board on policy and substantive matters related to appropriate industrial technology. The Consultative Group has met twice since 1977, and has recommended the organization of the International Forum for Appropriate Industrial Technology that is to meet in India in November 1978. UNIDO hopes that the International Forum will elaborate a programme of action on appropriate industrial technology which would then be included in the future UNCTAD Programme of Action. With the creation of the United Nations Industrial Development Fund (UNIDF), UNIDO further hopes that projects in appropriate industrial technology could be promoted, by channeling the voluntary contributions that finance the Fund towards projects that interest the donors (2).

UNIDO has adopted, so far, a very broad definition of appropriate technology as "technology that contributes the most to the economic and social objectives of development" (3). In this sense, the application of appropriate technology is not limited to the LDC's, nor does it necessarily entail a labor-intensive process of production.

Since the UNIDO's general definition allows for multiple interpretations of what appropriate technology may be, three parameters - or sets of factors - are suggested for determining whether a technology is appropriate or inappropriate:

- a technology is appropriate when it furthers development goals

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- (1) UNIDO, Annual Report of the Executive Director 1976, Industrial Development Board, Vienna, May-June 1977. UNIDO, Annual Report of the Executive Director 1977, Industrial Development Board, Vienna, May 1978.
 - (2) UNIDO, United Nations Medium Term Plan for the Period 1980-1983, Major Programme XI: Industrial Development, Draft Submitted by the Executive Director of UNIDO. Industrial Development Board, ID/B/C.67/Add.1, 6 April 1978. Cf. also to UNIDO exposition of activities to the 24th session of ACAST Geneva, 31 July-11 August 1978.
 - (3) UNIDO, Co-operative Programme of Action on Appropriate Industrial Technology, Report by the Executive Director, Industrial Development Board, ID/B 133, April 14, 1977.

including the growth of employment and output through the more effective use of local resources; the formation of skills; the reduction of inequalities in income distribution; when it meets the basic needs of the poor, improve the quality of life in general, and promotes self-reliance:

- a technology is appropriate when it is adapted to the country's resource endowments, including local manpower and skills, local management capabilities, availability of water, energy and natural resources in general;
- a technology is appropriate when it complies with the prevailing specific circumstances of its application, including economic and non-economic factors such as the size of the foreign exchange situation, the level of infrastructure, climate, environment, the social structure of the population, traditions and cultural background.

UNIDO is aware, however, that not all these criteria may be met when selecting an appropriate industrial technology: some priority may have to be assigned in each specific case. At any rate, there exist other criteria that need to be taken into account when choosing a technology, for instance the profitability of the industrial undertaking, which depends on technology as much as on direct and indirect government intervention through industrial, trade, fiscal and monetary policies. Notwithstanding the fact that it is impossible to discriminate, a priori, which criteria must be applied to each specific circumstance, UNIDO believes that "some attributes of a technology selected for developing countries could include: high employment potential, linkage with local industry to satisfy the actual market needs, low investment required as compared with the level of local income, potential in utilizing domestic resources, higher productivity in a given field, easy maintenance, and compatibility. The present world setting, characterized by the dominance of multinational firms that concentrate finance and technology (and by an international economic recession (2), restricts the scope of action towards the desired objective of spreading industrialization to the developing countries, under such conditions that first avoided the growth of the LDC's debts, their dependence on imported technology, the possible world depletion of non-renewable natural resources, and the eventual shortage of energy and materials, and that second allowed at the same time, the survival of enterprises and a continuity in the flow of finance (3). In other words, the international situation now prevailing hardly permits the redevelopment of industries on a world scale without recreating the very economic, social and political conditions that are unwanted.

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- (1) UNIDO, Reorientation of Industrial Strategy in Developing Countries and Selection and Application of Appropriate Industrial Technology, prepared by the UNIDO Secretariat for the Second Consultative Group on Appropriate Industrial Technology, Vienna, Austria, 26-30 June 1978, ID/WG.279/4, 20 June 1978, p. 4.
 - (2) UNIDO, United Nations Medium-term Plan for the Period 1980-1983, Major Programme XI, Industrial Development, op. cit., pp. iii-vii.
 - (3) United Nations Medium-term Plan for the Period 1980-1983, Major Programme XI, Industrial Development, op. cit., pp. iv-v; and UNIDO, Report of the Consultative Group on Appropriate Industrial Technology, Vienna, 14-16 November 1977, ID/WG.264/4, 27 February 1978.

On the other hand, UNIDO regards industrialization as a means of producing a wide and diversified range of goods and services (4). The increased output of industrial goods should allow to cover efficiently and rapidly all the basic socio-economic needs of the LDC's most needed population, and to improve their conditions of life, including higher incomes and purchasing power, employment, better quality of life, etc. The experience of the developed countries shows that the production of such a large variety of products requires of advanced, large-scale industries which not only save man-power (in an apparent conflict with the objective of increasing employment levels), but also reproduces, at the national and international with prevailing sociological conditions" (1). UNIDO further adds that, although the choice of technology is a relevant problem to all countries, the possibility of an erroneous choice is greater in LDC's because most technology is created in developed countries and suit the conditions thereof.

UNIDO has clearly attempted at taking into account all the various and inter-related factors that enter in the process of choosing an appropriate technology in a given circumstance. However, no list of factors can replace an analysis of them, (and incidentally some of the factors listed by UNIDO are causes and consequences of development rather than criteria for planning development). UNIDO has thus worked out a pragmatic and flexible definition of appropriate technology for industry which shares many a similarity with the World Bank's policy orientation. But UNIDO has not reached the World Bank's level of concised elaboration of policy guidelines for the application of appropriate technology which combine a flexible approach to varying objectives and circumstances with the upholding of banking principles with respect to investment efficiency and monetary returns to financing ventures (2). On the contrary, UNIDO's policy on appropriate industrial technology has remained, so far, at a rather high level of generality and its policy statements are, as a rule, plagued with a number of contradictions. These become evident when an attempt is made to circumscribe the practical application of the concept of appropriate technology, or even when trying to deepen and detail the objectives searched through the search and implementation of an appropriate technology policy, i.e. through the choice of technology. It is believed that UNIDO's lack of clear stand on appropriate technology is mainly due to its attempt at reconciling conflicting objectives.

On the one hand, UNIDO promotes the creation of additional industrial capacity in the LDC's and a world-wide redeployment of industries which should benefit the LDC's share of industrial output (3) levels, the features of a pattern of industrial growth and distribution which is considered inadequate, obsolete and in want of change.

- (4) Report of the Consultative Group on Appropriate Industrial Technology, op. cit., p. 6.
- (1) Co-operative Programme of Action on Appropriate Industrial Technology, op. cit., p.4
- (2) See chapter on World Bank, pp.
- (3) The Second UNIDO General Conference set a quantitative target of industrial production for developing countries (known as the Lima target, or Lima Declaration) whereby the LDC's share should reach at least 25% of the world industrial production by the year 2000.

It is possible that UNIDO's statements on what appropriate technology should be, and what it should serve, reflect two sets of contradictions: first a contradiction between different objectives (the legitimate aspirations of the developing countries to develop their own industries, against the interests of private enterprise, led by the multinationals, that wish to retain the grip and leadership over industrial development); and secondly a contradiction that stems from the means envisaged for implementing the necessary relocation of industries on a world scale (i.e. a contradiction between the need of developing industry on the basis of world resources, and the restrictions posed to this need by the circumstances that prevail at present in the world). It is in the context of this double set of contradictions that UNIDO's policy statements on appropriate technology may be understood and acquire a meaning.

First of all, "in order to avoid partial or conflicting views and ideas about appropriate technology", UNIDO has turned from technology to technological policy and thus restricted the operational meaning of the concept of appropriate technology as to apply to "technological choice and the adoption of criteria for selection (of technology) which, in turn, depend on policy and development goals" (1). The next step was "to be clear first about the industrial development strategy, before an appropriate technology strategy could be defined" (2)

According to recent statements (3), appropriate industrial technology must be part of a general development strategy of rapid and broad-based industrial growth which includes, amongst other elements, a greater decentralization of industries towards the rural areas, and a re-orientation of the design and structure of production. .

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- (1) UNIDO, Towards a Strategy for Industrial Growth and Appropriate Technology, presented by UNIDO Secretariat to the Consultative Group on Appropriate Industrial Technology, Vienna, Austria, 14-16 November 1977, ID/WG. 264/1, 23 November 1977.
 - (2) Report of the Consultative Group on Appropriate Industrial Technology, op. cit., p. 3
 - (3) UNIDO, Statement delivered by the Executive Director of UNIDO, Dr. Abd-el Rahman Khane, Second Consultative Group on Appropriate Industrial Technology, Vienna, 26-30 June 1978. See also UNIDO, Reorientation of Industrial Strategy in Developing Countries and Selection and Application of Appropriate Industrial Technology, paper prepared by UNIDO secretariat for the Second Consultative Group on Appropriate Industrial Technology, Vienna, Austria 26-30 June 1978, ID/WG.279/4, 20 June 1978.

With respect to the design of products that may be appropriate to local conditions, UNIDO has not yet produced any policy statement, nor worked out any concrete mechanism, except stressing the need to disseminate alternative product design and to prepare new plans for changing the pattern of consumption.

At present UNIDO policy approach is very much influenced by the dualistic vision implied in the separation of any industrial structure in two sectors: the modern and the "decentralized" or rural-based sector (1).

(1), Reorientation of Industrial Strategy in Developing Countries and Selection and Application of Appropriate Industrial Technology
op. cit.

16.2 APPROACHES TO SECTORAL POLICY ON APPROPRIATE TECHNOLOGY

UNIDO has lately developed the idea that, within individual countries, a decentralized sector should be helped to mature side-by-side with a rapidly growing modern industrial sector. There should be a division of labor of some sort between the two sectors, though UNIDO sees it as a non-mutually excluding one.

The modern sector is viewed as large scale. It would receive the major allocation of resources, provide basic production inputs for the internal market and products for exports. The decentralized sector would meet the basic socio-economic needs of the rural and semi-urban populations. In a way, the decentralized sector is implicitly viewed as a complement of the modern sector for the provision of goods demanded by the rural people. The linkage between the modern and decentralized sectors could take several forms, including the location of ancillary units, final assembly units and finishing operations in the proximity of the areas of rural consumption.

In order to enable exports to compete on an equal foot in the international market, this sector should necessarily have access to the latest achievements in technology. Thus, "it should be recognized that the developing countries would continue to rely on the import of technologies from the developed countries for some period of time in several production sectors" (1).

Considering that the decentralized sector is referred to as small-scale, while the modern sector is to be large-scale, the difference between the two sectors would concern the scale of production in the first place. As a result, the unit of investment outlay should be considerably reduced in the decentralized sector compared to the modern one, and it would require also greater technological adjustment or applied research and development to local factors of production, mainly human skills

Differential scale of production obviously brings up the question of the efficiency of the small-scale sector, since the competitiveness of the decentralized sector would be limited by products from the large-scale enterprises. In addition, the purchasing power of rural inhabitants and the quality of the products of the decentralized sector may well need to be subsidized by a "comprehensive programme of incentives, including financial assistance, provision of infrastructure facilities, supply of raw materials, equipment and expert guidance" (2). Additional support may also be essential to cover the training needs of this sector. It is not clear

- (1) Report of the Consultative Group on Appropriate Industrial Technology, op. cit., p. 11. See also UNIDO, Aide Memore, International Forum on Appropriate Industrial Technology, 20-30 November 1978, New Delhi and Anana, India.
- (2) Report of the Consultative Group on Appropriate Industrial Technology, op. cit., p. 9

how this programme of "infant-industry" promotion is to be carried out by the developing countries, most of which are seriously immersed in a deep recession. There is however a definite tendency towards supporting greater governmental regulatory controls in respect of industrial activities which by themselves are most unlikely to help enforcing a technological choice which serves the basic needs of the majority of the population.

With respect to technology for both modern and decentralized sectors, UNIDO has once more adopted a rather confusing stand. It considers that "appropriate industrial technology should not necessarily be conceived as labor-intensive, or related only to small-scale production. Depending on conditions, it could well be capital-intensive, sophisticated and used for large-scale production" (2).

On the other hand, UNIDO holds the belief that "the reservation of certain sector for the small-scale sector would automatically ensure that more or less appropriate technology would be adopted in these (industrial) sectors" (3).

The only possible conclusions out of such statements are, first, that UNIDO sees all technologies as appropriate, with the exception of those that are selected a priori as "not always relevant to the situation in developing countries, such as (technologies that lead to) high consumption potential military application, etc." (4). Secondly, given a plurality of technologies in all countries, and given that all of them are appropriate to a given circumstance, such plurality should be maintained and furthered.

Whilst conceptual and policy clarifications for a sectoral strategy have been going on, UNIDO has begun implementing a series of activities (research, pilot projects, information, training and institution building, pre-investment and feasibility studies, etc.) in some 12 industrial branches that it considers of first priority both for accelerating industrialization and for redistributing industries on a world-wide scale. The main investigations have been done in the following branches: industries based on land resources (for example, vegetal oil and fats, building materials, woodworking), industries related to land resources (leather, fertilizers), metal-engineering (iron and steel, metalworking) and chemicals. The International Forum on Appropriate Industrial Technology will discuss the work done up to now in the 12 sectors of productive activity which include:

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- (1) Reorientation of Industrial Strategy in Developing Countries and Selection and Application of Appropriate Industrial Technology, op. cit., pp 26-28.
 - (2) Report of the Consultative Group on Appropriate Industrial Technology, op. cit., p. 5.
 - (3) Ibid., p. 13.
 - (4) Report of the Consultative Group on Appropriate Industrial Technology op. cit.

- basic industries such as steel metal transformation including capital goods, fertilizers, and chemicals and the like;
- drugs and pharmaceuticals
- textiles
- sugar
- cement and building materials
- food storage and processing
- agricultural machinery and implements
- light engineering and rural workshops
- oil and fats
- paper products and small pulp mills
- energy for rural requirements
- low cost transport for rural areas

The specific production techniques that will be thus elaborated upon and discussed at the International Forum relate to the basic industries in developing countries, inputs for agricultural production, and outputs from the rural sector.

UNITAR has supported, in recent years, a series of dissemination activities on new technologies within its programme of the future. The essence of the techniques publicized by UNITAR is that they might lead to saving natural resources, through non-waste processes, for instance, and to substitute some of the presently used natural resources with un-conventional ones. The processes and methods involved in the development of these new technologies generally require a very intensive scientific research effort and a very well developed system of applied research and development.

Scientific gatherings and publications coordinated by UNITAR have been devoted to the following problem-areas⁽¹⁾:

- ways of mining and using types of natural oil and gas deposits and elements that are under-researched;
- advances in chemistry, bio-chemistry and biology for the recovery, recycling and use of wastes and residues (microbial energy conversion);
- ways of making economic use of the resources and ecological peculiarities of desert ecosystems.

Future activities are expected in the following fields⁽²⁾:

- economic feasibility and technological advances for the exploitation of small-scale mineral deposits;
- scientific advances and practical agronomic applications of cells, tissues and organs transplanted from plants and animals (tissue culture);
- petroleum microbiology;
- utilization of platforms and off-shore structures;
- new energy resources.

(1) The Future Supply of Nature-made Petroleum and Gas, International Conference sponsored by UNITAR and IIASA, Schloss Laxenburg, 1976, (published by Pergamon Press). Seminar on Microbial Energy Conversion, Gottingen, 1976. Conference on Alternative Strategies for Desert Development and Management, sponsored by UNITAR and California State Department of Water Resources, Sacramento, 1977.

(2) UNITAR, Important for the Future, Vol.III, N.3, June 1978.

18. UNRISD

UNRISD new strategy and programme, as a priority, research on ways in which the poorer segments of the population maintain their livelihood. This investigation, which has only recently started, is expected to include new findings on traditional and possibly declining ways of self-subsistence agriculture, rural crafts, food preparation and conservation techniques, and alternative ways and methods of supporting life⁽¹⁾.

The aim is to investigate how specific population groups can feed themselves adequately throughout given seasons and years, i.e. how food security can be achieved now and for the foreseeable future for all social groups.

(1) UNRISD, Strategy and Programme Proposals, Board Special Session, 1977/W.P.2/Rev.1, 4 November 1977. UNRISD, Food Systems and Society, Board 1978/W.P.4, 27 June 1978.

19. UNOST

The UN Office for Science and Technology has been increasingly involved with the issue of appropriate technology, through its activities as the Secretariat of the Advisory Committee on the Application of Science and Technology to Development (ACAST).

As early conceptual work noted that the technology developed in the advanced countries might not be suitable to a particular developing country without modification and adaptation to specific conditions such as climate, raw material resources, labour supply, and the level of economic and social development. Research, development and general industrial services were thus required to help developing and/or modifying and adapting imported technology⁽¹⁾.

Further research led ACAST to adopt the view that appropriateness had to refer to the availability and combination of factor proportions in terms of labour, natural resources, and capital, given a stated task or selected output⁽²⁾.

With the reconstitution of the ACAST Ad Hoc Working Group on Appropriate Technology in 1976, the Office of Science and Technology has carried on work on the concept of appropriate technology from the same policy-action point of view. In a review of the conceptual development of appropriate technology, the ad hoc Working Group has pointed out five major criteria of definition of appropriateness⁽³⁾. These criteria, selected according to objectives that are searched through the use of technology, are the following:

- to help small communities to achieve better utilisation of human and natural resources in a context of self-reliance;
- to avoid environmental damage and improve the quality of life;

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- (1) United Nations, Appropriate Technology and Research for Industrial Development, Report of the Advisory Committee on the Application of Science and Technology to Development on two aspects of industrial growth, New York
 - (2) United Nations, Appropriate Technologies in Civil Engineering Works in Developing Countries, An Exploratory Appraisal of the State of the Art, New York 1976.
 - (3) Advisory Committee on the Application of Science and Technology to Development, Report of the Ad Hoc Working Group on Appropriate Technology, E/AC.52/XXIII/CRP.2, 10 June 1977.

- to avoid excessive consumption of energy;
- to create employment;
- to economise on investments (domestic savings) and foreign exchange.

The Ad Hoc Working Group has strongly emphasized that not all these criteria are of equal value and that the measure of appropriateness is given by its contribution to fulfil the basic needs of the mass population, to generate employment and to save capital investment. It would then be up to the individual countries to select and apply other criteria, according to its development objectives⁽¹⁾.

Whereas the issue is regarded in many sectors as a choice between labour-intensive and capital-intensive technology (for instance in small-scale farming, road construction, etc), the ACAST has put forward the idea that in the production of manufacturing technology "actual experiences could demonstrate that labour-intensive and capital-saving/strategies can in numerous cases incorporate management methods, equipment and control systems that the most modern and sophisticated technology now has to offer"⁽²⁾. Therefore ACAST has suggested that research should be made on "how much and what kinds of R and D activities now conducted in the industrialized countries could be directed to the pursuit of innovations in terms of technological needs of the developing countries"⁽³⁾.

To conclude, it might be said that the policy-oriented definition of appropriate technology, such as the one proposed by ACAST, has not led to any substantially new action proposal to alter the basic world pattern of technology generation, transfer and use. The present stress

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- (1) Report of the Ad Hoc Working Group on Appropriate Technology, op.cit., p.12-
 - (2) Advisory Committee on the Application of Science and Technology to Development, New Developments in research Relevant to Appropriate Technology Note by the Secretariat, Ad Hoc Working Group on Appropriate Technology, Vienna 16-20 May 1977, ESA/ST/AC.7/CRP.4, 5 April 1977.
 - (3) Advisory Committee on the Application of Science and Technology to Development, The Design of Equipment and Production Processes Appropriate for Developing Countries, Note by the Secretariat, Expert Group on Appropriate Technology, 25 April 1977.

is on increasing local technological capabilities of developing countries to research and design technologies as well as to increment cooperation among developing countries on problem-oriented projects and in selected priority-areas. However, in essence, this proposal is only a sophisticated variant of the idea of helping countries to establish research and industrial services to effect a massive transfer of technology.

The same can be said of the present efforts to implement a network for exchange of information and transfer of technology, a task in which UNCTAD, UNIDO, UNESCO, WIPO and other organizations are involved (1). The network, as it is presently thought of, would basically accelerate the transfer of the technology required by the developing countries' industrialisation without a major change in the costs and conditions under which this transfer is presently made.

On the other hand, it would permit the advanced research institutions, and the international private sector that controls the bulk of the world scientific and technological research and development, to have access to the scientific and technical achievements reached in the developing world.

Furthermore, the characterisation of technology according to policy-objectives is somewhat lacking of scientific soundness because policy-objectives are not immutable (they do vary over time) and also because the technical solutions needed to meet the problems identified do not necessarily produce effects that are desirable from the economic, social and environmental point of view.

In view of the last consideration, ACAST has recently stated that appropriate technology should not be viewed merely as a technological solution, but also as part of the prevailing cultural and social framework (2). Also it has shown concern with the connotation that appropriate technology is second-rate technology and is therefore to undertake a study that should clarify concepts and definitions, as well as given a global picture of the state of the art, including a review of work done within the UN system (3).

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- (1) Advisory Committee on the Application of Science and Technology to Development, Information exchange and the Transfer of Technology, Note by the Secretariat, E/AC.52/XXIV/CRP.10, June 1978.
 - (2) Advisory Committee on the Application of Science and Technology to Development, Special Report, E/AC.52/XXIV/CRP.13, 11 August 1978.
 - (3) Ibid.

Since 1976, the United Nations University selected three areas of priority for the University work : world hunger, human and social development and the use and management of natural resources. These topics are being investigated by networks of institutions selected by the UNU.

Post-harvest technology has been given particular attention in the World hunger programme that is carried out by a network composed of the INCAP (Institute of Nutrition of Central America and Panama, in Guatemala), the CFTRI (Central Food Technological Research Institute of Mysore, India), and the NCP (Nutrition Centre of the Philippines). FAO has been closely associated to this programme.

The human and social development programme initiated a research on traditional technology, for which the Marga Institute (Sri Lanka Centre for Development Studies) was selected as the first member of the network. One of the main concern of this programme is to research the existing traditional or pre-industrial technology as a means to overcoming hunger, poverty and disease in developing countries.

The human and social development programme initiated a project on technology transfer, transformation and development, which includes action and research on sharing traditional technology. The Marga Institute (Sri Lanka Centre for Development Studies) is the first institution to participate in this network. One of the main concern of this research is to investigate the existing traditional or pre-industrial technology, as a means to overcoming hunger, poverty and disease in developing countries; to probe on the possible linkage between traditional technology and modern technology in the process of rural transformation; and to contribute to an understanding of the nature of changes required within poor communities for the generation of the capacity and ability to effect innovative technological change (1).

The project is to supplement efforts of other institutions that are engaged in the scientific improvement of traditional technologies; the generation of indigenous research and development capabilities; and the controlled transfer of technology from the industrially developed countries.

To this end, the project is to search the key elements for achieving a technological awareness among the rural poor so that they may contribute to a new formulation of the current transfer of technology from industrial to pre-industrial communities. One of the basic premise in setting down this objective is that the newly available technology will be more readily acceptable if it is traditional and only slightly more sophisticated than the one present

(1) Marga Institute, Project Proposal on Sharing of Traditional Technology, submitted to the United Nations University Task Force Meeting held in Tokyo, Japan, 26-30 September 1977.

in use. From the point of view of scientific and technological research and development, the project hopes that knowledge of traditional rural technology will help to expand the frontiers of scientific and technological knowledge of methods, techniques and resources as well as to create new goods and services that are acceptable to the rural people without being cruder and cheaper versions of mass-manufactured goods.

21. WFP

The World Food Programme is not directly involved in implementing any kind of project but, through its food for work aid programme, it has given a considerable support to field activities executed by other UN agencies (mainly ILO, UNIDO, and FAO⁽¹⁾).

Projects that involve labour-intensive methods of slum clearance, road construction, forestry work, water and land conservation, have thus received support from WFP in the form of food rations that are distributed to the casual workers as a wage in kind that it usually but not always supplemented by a cash wage payment. Food is also used in self-help schemes as an incentive instead of money wages or as a partial compensation for lost earnings. At present, around 40% of the value of food distributed by WFP goes to labour-intensive projects.

(1) World Food Programme, Employment through Food Aid, Rome 1978.

The World Intellectual Property Organization has been marginally involved in the field of appropriate technology, as a result of work on the generation and protection of technological knowledge, and of its participation in networks for the dissemination of the technological information contained in patents.

WIPO is collaborating to the setting up of the ACAST sponsored network for exchange of information and transfer of technology, as well as the regional centres for transfer and development of technology.

It is WIPO's view that, by putting information at the disposal of governments and the public in general, and by helping countries and firms to negotiate the purchase of technical know-how, the users of technology are enabled to identify which is the most appropriate to their needs.

23.1 GENERAL POLICY ON APPROPRIATE TECHNOLOGY

WHO established during 1977 a programme of health technology to promote the use of available appropriate technology and develop new technology which answers the need for better health and is at the same time low-cost, effective and acceptable.

Appropriate technology for health has been defined at WHO as "a wide-ranging set of activities, - applying skills, knowledge and creativity for inventing or discovering, testing, improving, adapting applying or using methodologies and techniques with methods of management for solving health problems" (1). That is "technology means not just a device but any association of techniques, methods and equipment which together can contribute towards solving a health care problem" (2).

Thus the concept of appropriate technology for health falls within a basically standard definition of technical change. It is however linked to a precise approach to the question of appropriateness. According to WHO, "appropriate means that the technology is not only scientifically sound but acceptable to users, providers and decision-makers alike; that it fits within local cultures, that it is capable of being adapted, further developed and manufactured locally whenever possible at low costs; and that it is sufficiently simple in design and in execution for local use" (3).

WHO gives much stress to the fact that "the ultimate goal of the development of appropriate technology will be to promote national self-reliance in problem-solving in primary health care delivery and to reduce the existing dependence on the industrialised countries for technological support" (4). The basic problems, to be solved through appropriate technology for health, are two-fold. First, it is a matter of increasing scientific and technological knowledge and innovation on how to meet health problems. Secondly, there is the question of reducing the cost of wide-spread primary health care and basic sanitary services, which are the main sectoral components of the programme on appropriate technology for health.

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- (1) WHO, The WHO's Role in Promoting Appropriate Technology for Health, document presented at the Consultation on Appropriate Technology for Health, New Delhi 5-8 December 1977, ATH/77.1.
 - (2) WHO, Report of the Consultation on Appropriate Technology for Health, New Delhi, 5-8 December 1977, ATH/77.3
 - (3) Ibid.
 - (4) WHO, Appropriate Technology for Health, Report by the Director General to the 31st World Health Assembly, A31/14, Annex I (EB61/26), p. 1-2.

It has been repeatedly stated that "what is needed is appropriate technology at a level and price that can be assimilated by the bulk of the population. Sophisticated technologies cannot provide the solutions to the multifarious problems facing the developing countries" (1). Stated in another way, the problem is to build and manage health services under conditions of limited financial and manpower resources, a basic problem being that of "the difference between cost of services and the ability to pay for them and the lack of people with the necessary skills to design, construct, operate and manage the (health) systems" (2).

It is widely recognized that more than one half of the total expenditure on health is channelled as a rule into curative medicine which is tied to high costs, requires imported equipment and drugs, all of which reaches a very small minority among the urban population of developing countries. In many cases, the lack of trained personnel and medical facilities cause the equipment to lay idle. WHO believes that, being this capital-intensive technology an expensive commodity, it is ill-adapted to the economic potential of the developing countries: "financial resources in these countries are not sufficient to allow total population coverage by the conventional health technology which has been developed in advanced industrialised countries" (3).

Rather than stepping up a massive effort for education and training, it is believed that the goal should be to develop local sufficiency in producing and applying simple health techniques and reduce the dependence on imported technology (4). WHO also commends appropriate technology to the industrialised countries where the rising costs of health services give cause for concern (5).

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- (1) WHO, Inaugural Address to the Consultation on Appropriate Technology for Health, by Dr. V.T.H. Gunaratne, Regional Director WHO SEARO, Report of the Consultation on Appropriate Technology, op. cit., Annex 3, p. 18.
 - (2) WHO, The WHO programme in Basic Sanitary Services, Community Water Supply and Waste Disposal. The Advancement and Transfer of Knowledge and Methods CWSS/73.2, p. 4.
 - (3) Appropriate Technology for Health, op. cit. Annex I (EB61/26), pp. 1-2
 - (4) Appropriate Technology for Health, op. cit., Annex I (EB62/26), pp. 1-2.
 - (5) Appropriate Technology for Health, op. cit. Annex 2, p. 1.

The question of costs is however to remain a crucial problem, because the research and development in simple techniques and methods of primary health care often requires a fair amount of investigation, analysis, testing, and evaluation, particularly when searching to adapt known technologies, to develop new ones, and to blend indigenous knowledge and experience with that available in the industrialized countries.

The complex problem of producing low-cost as well as health effective techniques and methods may be at the root of WHO's attempt at making compatible distinct aspects of the problem of health care.

First, there is a need to evaluate in the field the type of technology needed according to the problem identified at the local level, and to make field-testing in the very situations where the technology will be applied⁽¹⁾. It is also true that pilot and test project are a necessary experience-gathering exercise. From an economic point of view, local institutions are obviously more adequate for this kind of task. However, from a social point of view, the costs may be high because the population (particularly in rural areas of the developing countries) is less apt to identify routinely the ill-effects of a new technology or a technological innovation.

Secondly, all research and development (whether it is carried out locally, or through a network of collaborating centres including institutions of the industrialized countries, or by commercial multinational enterprises), require adequate funding and even possibly the assistance of sophisticated and expensive techniques⁽²⁾, as well as rigor and exactness equal or greater than used in conventional bio-medical investigation⁽³⁾. On the contrary, if the technological capabilities of the developing countries were more adequate to design simple and low-cost technologies, as it is suggested, and they were not just apt to test and monitor new technology, then the research and development facilities of the developing countries should not be regarded as sorts of subsidiaries where appropriate technology is to be adapted, further developed, tested and eventually manufactured, as long as sufficient low costs are ensured⁽⁴⁾.

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- (1) Appropriate Technology for Health, op. cit., Annex 3: Global Plan of Action for the Programme of Appropriate Technology for Health, pp. 4-5 and Report of the Consultation on Appropriate Technology for Health, op.cit., p.17
 - (2) Appropriate Technology for Health, op. cit., and Report of the Consultation on Appropriate Technology for Health, op. cit., p.17
 - (3) Report of the Consultation on Appropriate Technology for Health, op.cit.,
 - (4) Appropriate Technology for Health, op.cit., p.2

The fact that "an essential component of the information collection and dissemination process is the field testing, analysis and evaluation of new and more appropriate technologies" (1) lends some credit to fears that the LDC's institutions, and even more the local populations, could be turned into a kind of testing ground for newly-developed and not fully proven technologies. Indeed, there may be some dangers in the institutionalization of national criteria and standards (2) on the assumption that decision-makers automatically search the well-being and improvement of the conditions of life of the whole population.

WHO recommends a series of criteria, or basic indicators, for measuring the impact of applying appropriate technologies (3), which are predominantly economic, and also socio-political to a lesser extent. Environmental criteria are also taken into account but generally because of their feed-back on economic and technical factors, such as for instance reducing the import requirements of material resources and energy, saving resources, and benefitting or at least avoiding harm to the environment with the consequent evidence of improvement of the quality of human life.

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- (1) Report of the Consultation on Appropriate Technology for Health,
op. cit., p. 4.
 - (2) The WHO Programme in Basic Sanitary Services, op. cit., p.6
 - (3) Report of the Consultation on Appropriate Technology for Health,
op. cit., p. p. 7-8

WHO has selected two fields of priority for the development and application of appropriate technology for health: primary health care and basic sanitary services. In both fields a detailed list of study areas has been established (1) trying to answer the question of what is needed and why?, What has been done?, What needs to be done?. Study areas are classified as:

- Health care: immunization and prevention
- Education and training
- Environmental health
- Management of health services

They involve substantial research and pilot testing, some of which has already been started.

Although the ultimate goal of the WHO programme is improved health, it recognizes that many other sectors such as agriculture, education, energy, etc. will have a direct bearing on health, particularly in relation to rural development (2). WHO thus regard village technologies, such as developed by UNICEF and FAO (3), as potential support to appropriate technology for health. In particular, technologies related to water, food resources, food conservation methods, solar and other sources of small-scale and decentralized sources of energy are of relevance to technology for health.

One of the instruments for the development of appropriate technology is an effort to curb the tendency to devalue and even denigrate simpler and more indigenous approaches to health care, in favour of complicated and more expensive imported technology. Thus WHO intends to help harmonizing traditional approaches with new technologies to develop the most effective but least expensive methods.

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- (1) Report of the Consultation on Appropriate Technology for Health,
op. cit., p. 15.
 - (2) Ibid.
 - (3) See section 6. FAO and 12. UNICEF

24. WORLD BANK

24.1. GENERAL POLICY ON APPROPRIATE TECHNOLOGY (1)

The World Bank's general policy on appropriate technology is linked to its recent interest in policies and actions that are expected to have a direct impact on the poor people's standards of living. The Bank's new strategy towards meeting basic needs, which emphasizes on reducing poverty, is not disconnected from its primary role, which is to guide the borrowing governments towards prudent financial and engineering decisions, and to urge implementing economic policies (mainly in the fields of exchange, wages, interest rates, and foreign trade) -- that contribute -- according to the World Bank's -- criteria -- to proper decision-making.

The World Bank considers that the extent of action towards reducing poverty is limited by the scarcity of financial resources: credits and loans to projects that benefit the poor should be evaluated against the need to conserve scarce financial resources, and to free capital for investment elsewhere. In this context, appropriate technology is thus generally regarded at the World Bank as a means to reduce poverty at the least financial cost.

From the technical-engineering point of view, the World Bank's operational definition of appropriate technology is pragmatic. Appropriate technology is regarded as "a relative concept and which technology is most appropriate, in a given situation, depends on the development goals of the country and the circumstances in which technology will be used" (2).

In general terms, the World Bank recommends to evaluate appropriate technology according to the basic objectives of the specific programmes of action and projects in which it will be introduced. Four criteria are put forward:

- appropriateness to goal: identification of the purpose which the technology is to serve and who the beneficiaries will be ;
- appropriateness of product: evaluation of the design of the product or service involved;
- appropriateness of process: evaluation of production techniques that should make the most economical use of available resources at the least social cost;

(1) World Bank, Appropriate Technology and World - Bank Assistance to the Poor, Central projects - Staff, March 28, 1978. World Bank, Appropriate Technology in World Bank Activities, Document of the World Bank for Official Use Only, July 19, 1976.

(2) Appropriate Technology in World Bank Activities, op. cit., p. 1 and following.

- appropriateness to culture and general economic, social, cultural and physical environment, including the size and standards of the local market, sophistication of the local work force and managerial skills, local environmental and cultural setting, locally available raw and semi-finished materials and capital goods, present and potential capacity for local planning, implementation and control of plans, etc.

The World Bank has produced a series of sectorial policy papers which apply these general policy and criteria to the specific fields of urban development, small-scale industries, civil construction, rural development, forestry, health, education and energy (1). These policy papers match with the different action programmes designed by the World Bank in the past 5 to 7 years. They generally urge that the technology chosen for the execution of sectorial programmes should be essentially cheap and/or simple. To this effect, the World Bank economists have designed a simple labor-intensive ratio for projects, where capital is divided by the number of man-years of employment created by the project. This capital/labor ratio must be below the national ratio that is derived from Gross Domestic Investment to Total Labor Force.

Urban and rural development projects (that are concerned with water supply, water disposal, education, housing, energy, transport, nutrition and health) are to be carried out at sufficiently low costs so to afford the population to buy these services. If any subsidy is needed, the World Bank recommends that arrangements be made to allow the termination of the projects undertaken with the afore-mentioned ratio of capital to labor.

On the other hand, the World Bank investigates the economics of alternative technologies, with a view to deliver a maximum of projects at the least cost of capital investment, while retaining the insurance of being re-funded the loans and credits advanced for the implementation of projects.

Finally, all the programmes of the World Bank are meant to increase the productivity of the poor's labor, to make full use of the existing unemployed and underemployed urban and rural labor, and to provide the poor with essential services at the lowest possible cost.

Given such conditions, the appropriateness of technology, from the World Bank's point of view, -- depend on pre-set objectives as much as on the particular circumstances under which such technology is used. "Thus, technology

(1) The specific policy papers are summarised in Appropriate Technology in World Bank Activities, op. cit., and Appropriate Technology and the World Bank Assistance to the Poor, op. cit.

is appropriate or inappropriate only in the socio-economic context of a particular project. The starting point is not the technology, but rather the development problems identified, i.e. low productivity, unemployment and underemployment, basic needs such as health, water and education, weak institutional capability to absorb new technology, etc." (1)

It must be added that the World Bank, while -- leaving final decision about the desirability of appropriate technology to the credit recipient appropriate institutions and governments, is also aware that not all the poor can be equally helped, at the least, in the foreseeable future. When dealing with productive activities, the World Bank restricts the sense of --- "poor" to mean small-scale farmers and industrial firms that employ less than 50 workers and/or hold fixed assets below US\$ 250,000. These are expected to be the beneficiaries of productive appropriate technologies (technologies that directly increase the productivity of labor force). With respect to social and environmental projects, the World Bank makes it clear that the magnitude of the identified basic needs for the poor will not be matched by the funds available within the planning horizon. It argues -- therefore, that aid should be extended to a selected number of beneficiaries (specific target groups) and, furthermore, that the standards of amenities and social services, rendered to this fraction of the needed population, should be reduced. Appropriate technology is thus implicitly associated, in the World Bank's policies and action programmes, with amenities of lower standards for low-income -- groups, and with simple techniques that increment productivity.

The World Bank plans that, by 1980, 10% of all its lending will finance the use of labor-intensive techniques.

(1) Appropriate technology and World Bank Assistance to the Poor, op. cit., pp. 1-2

24.2. APPROPRIATE TECHNOLOGY IN SECTORIAL PROGRAMMES

24.2.1. Urban Development

The objective is to improve the housing conditions by providing credit and materials to the residents of slums who build themselves water supply, storm drainage, sanitation and other basic amenities that upgrade slum housing. The strategy for the use of labor is thus based on the "community development" approach (also known as "self-help" or mutual help").

The World Bank recommends that squatters and slum dwellers should not be relocated far from sources of employment. They should remain in the same areas they are located, which usually are central or conveniently sided along public transport -- routes. This is to allow savings of construction additional infrastructure facilities.

The World Bank suggests greater use of traditional materials and the adaptation of new techniques to traditional building methods so as to lower costs and use more labor force.

The urban development programme of the World Bank is based on the following principles:

- the cost of improvements in urban services - should be paid by the urban residents who will benefit from these improvements;
- the cost should be low enough to be affordable to low-income families, which entails that standards of amenities may have to be reduced;
- there already exist many alternative technique to provide for urban improvement (water supply, waste disposal, education, housing, energy, transport, nutrition and health) but the ultimate success is determined by the search for efficient and appropriate capital-saving production methods that the manufacturing sector is to initiate.

24.2.2. Water

The World Bank Policy document (1) emphasises the supply of water for domestic use in rural areas, an area that has been largely neglected and for which experience and knowledge are lacking. The World Bank believes that it is evident that the poorer countries can afford only very simple systems in rural areas - typically shallow wells with hand pumps - if they are ever to achieve a significant increase in coverage" (2). The basic need of water can only be met by cheap means that provide the basic standard or minimum quality requirement. This is because capital investment and maintenance costs vary in proportion with the quality of the supply. The World Bank policy is thus the following:

(1) World Bank Village Water Supply, A World Bank paper, Washington, March
(2) Ibid., p. 7

"Standards should be set for quality to ensure that the water supply does not contain any chemical or biological constituents that could affect its safety or acceptability. A number of chemical characteristics and substances which affect the design of urban systems (e.g. hardness, chlorides, iron and manganese content) can be disregarded in village water design unless they affect acceptability or could cause technical problems through corrosion or encrustation". But, "since higher levels of services result in greater health benefits, they should be encouraged whenever villages feel the need and are able to pay for them" (1).

24.2.3. Health

The main objectives of the World Bank's "Reformed Health Service" are to reduce the inefficiencies and high costs associated with the present official systems of health care; to extend primary health care coverage to rural areas where it is notoriously deficient and poor; to fit the needs of primary health workers, and to supplement the activities of traditional healers.

As a result of laying down this programme of action, the World Bank places the strongest emphasis on the selection and training of new health personnel who should have a series of qualities that relate less to the formal technical and professional training of the health workers (and incidentally to the expectations of health personnel) as to their insertion and relations to the community served by this personnel. This means that the new health personnel envisioned by the World Bank should reside in the area they serve. Their main function would be to keep an on-going check of the community's health conditions, so that their curative skills would not be extensive and their health training cost would be reduced. As a result, the new health workers would have a brief and limited training in treating some of the most common diseases and would spend most of their time in preventive health activities (nutrition, immunizations, family planning, etc.) and in disseminating and supervising the construction of environmental works (supply of bacteriologically safe water, sanitation, construction of sewage and other waste disposal systems).

Most of the work envisaged by the World Bank in the field of health concerns "appropriate soft-ware" or know-how in institution building. The new rural health personnel is planned to be part of a whole new administrative structure which would include intermediary levels (auxiliaries) up to "primary-care managerial - physicians" who would be trained mainly in treating infectious diseases, performing emergency surgery with limited equipment, and would have an extensive knowledge of epidemiology, as well as acquaintance with local healing customs and traditional medicine, agronomy, nutritional value of crops and foods of the area in which this personnel is located.

(1) World Bank Village Water Supply, A World Bank Paper, Washington, March 1976, p.8

From its past 3-year experience, the World Bank has reached the conclusion that simplified health systems are technically feasible but require institutional arrangements that are generally lacking and are even more demanding upon financial resources and skills than those currently used in conventional health care systems.

The World Bank lends funds for health development whenever these activities are an integral part of larger projects in urban and rural development.

24.2.4. Education

The World Bank has produced several policy papers and studies on its approaches to appropriate technology for non-formal education and training of rural youth.

The overall objective is to combine education with training in specific skills. The World Bank has thus adopted UNESCO's approach to adult education through functional literacy whereby the teaching of reading and arithmetics is part of a training programme for a particular job. Preliminary estimates indicate that the cost of work-oriented education is much lower than primary schooling.

The World Bank also follows UNICEF's concept of "minimum learning needs" which refers to the types of essential knowledge and skills required for incrementing the productive powers and social participation of people.

24.2.5. Rural Development

The supply and use of appropriate technologies to the rural areas respond to several objectives, of which the main ones are to stop migration to the cities, and to increase the level of productivity in small-scale production, and/or in agricultural activities carried out on marginal lands.

Correspondingly, the activities planned for the fulfilment of these objectives consist of:

- creating jobs in non-agricultural activities, such as activities related to the upgrading of the living conditions of the living conditions of the rural people, and the production of inputs and outputs of agriculture, stockbreeding, pisciculture forestry;
- expanding the labor demand for the processing of primary products at the producer level (family or larger unit) such as for instance conservation (drying, storage, etc.), primary transformation (fermentation, etc.) and others;
- expanding the demand of labor and other inputs for the productive use of marginal lands (for instance, fertilizing techniques, reafforestation);

- increasing the demand of cheap materials and advanced technical and scientific knowledge applied to local ecological conditions, and to the socio-economic conditions of small-scale production in rural areas;
- supplying innovations that reduce the risks inherent to agricultural activities as for example through the R and D varieties that are resistant to pests and to weather changes;
- increasing knowledge and production of alternative or famine crops (also known as "poor man's crops"), such as sorghum, millet, yams, pulsus, upland rice and others;
- designing and disseminating small-farm equipment, including transfer of prototype specific actions to local manufacturers.

Many of these activities entail agricultural R and D which is promoted and financed by the GCAI (Consultative Group on International Agricultural Research), with a view of extending to LDC's superior varieties of essential crops and improved systems for the production of food plants and animals. The World Bank is one of the four sponsors of the GCAI (others being UNDP, UNEP and FAO), as well as its Chairman. It consists of 32 governments, international and regional organizations and private foundations that support the work of its research.

The World Bank advocates the organizing activities along community, groups and associations lines; improved planning techniques, including participatory planning; more credit to small-farmers in particular to enable them to buy industrial inputs; and finally greater scientific and technologic research. The ecological areas that merit special attention are: arid lands, mountain regions, areas of low-quality soils where shifting cultivation is practiced, rain forests.

24.2.6. Forestry

The World Bank has a special interest in forestry due to the particular contribution of this activity to the other branches of production and services. Forestry produces not only timber and therefore inputs to the industry; it also provides firewood which the World Bank expects to be the main source of energy for the rural people in the foreseeable future. It finally plays an important role in conserving and improving soils and has great potentials for contributing to livestock production.

The World Bank policy with respect to forestry thus go beyond the guidelines established for rural development in general, though forestry is often an integral part of it. This policy is rather flexible. On the one hand, the World Bank has been looking forward to finance inventories of natural resources, as well as research on all factors related to the ecologically-sound use of forestry resources. Furthermore, it has committed itself to withhold financial support to "projects that might result in desintegration of a (natural or physical) habitat not elsewhere represented in the country and not under suitable protection". On the other hand, the World Bank also supports new settlements in zones of high tropical forest, though it is conscious that, due to the rate of migration to these areas (which adds 15 million ha. of tropical areas into cultivation each year), "only in a small percentage of this area will it be possible to introduce a more rational approach to tropical forest land use."

24.2.7 Small-Scale Industries

The World Bank policy on appropriate technology in industry starts with the premise that "scarcity of capital in developing countries is a major constraint to the expansion of employment opportunities", and that small-scale enterprises are to become a major source of employment. (1)

The World Bank believes that "labour intensive alternatives are not invariable to be preferred - quality standards, economies of scale, and management or skilled labor requirements may sometimes tilt the balance toward capital-intensive options - - but virtually in all cases, at realistic opportunity-cost wage and interest rates for LDCs, labor-intensive or intermediate alternatives are economically sensible". (2)

World Bank sees many benefits in promoting small-scale enterprises, apart from the advantages of capital savings, foreign exchange savings and employment generation. These include: stimulating entrepreneurship, decision-making and private ownership; setting up production systems that have less adverse environmental impact; increasing or implementing sub-contracting of industry-related activities to the surrounding rural.

The policy of the World Bank is to increase loans to small-scale enterprises through national banking intermediaries, though these funds should not restrict to assisting small-scale firms and entrepreneurs. In 1977, the World Bank devoted to small-scale enterprises 12.2% of total lending through financial intermediaries. The percentage is to step up to 20% in 1978 and reach progressively 30% by 1981 (about 10% of its total lending).

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- (1) Employment and Development of Small-Scale Enterprise, World Bank Paper, 1978, quoted in Appropriate Technology and the World Bank Assistance to the Poor, op. cit., p. 65 and following.
- (2) Appropriate Technology and the World Bank Assistance to the Poor, op. cit., p. 66.

About 380 million US\$ are earmarked at present for loans and credit to artisan, cottage, small and medium sized firms in about 20 countries (see list of projects in Annex). Capital investment per job is expected to range from US\$ 100 to US\$ 400 among artisans and cottage industries, and from US\$ 2,000 to US\$ 8,000 in small and medium-sized firms.

Considering that adequacy and accessibility of information on technology alternatives is a major constraint to further small-scale/labour intensive industrial enterprises, and that appropriate technology information referrals are ill-served, the World Bank has recently started to "explore with the other international and national agencies, and with the numerous private organisations having expertise in this field, how their resources could be mobilized more effectively to apply existing technological information quickly and practically to specific LDCs situations and needs." (1)

In the long run the World Bank also plans to create or strengthen the linkage between supply of appropriate technology (Local LDCs institutions that create or know about appropriate technologies) and the demand (entrepreneurs, trade associations and financial institutions, etc.)

Plans for the medium-term (1977-1981) include:

- at least 10 experimental projects (about US\$ 50 million loans and credits) to test new financial intermediaries, new approaches such as cooperative programmes, cottage industries, etc., and R and D initiatives;
- at least 8 projects for industrial estates that support in part small enterprises; and
- reaching by 1981 the 30% figure for lending to labour-intensive firms.

24.2.8 Civil Engineering and Building Construction

The World Bank's policy in this field is that appropriate construction methods are those that make efficient and maximum use of unskilled labor and minimum use of capital equipment provided that the labor can be employed at low or "reasonable" wages, and that technical considerations do not dictate the use of machines.

The basic aim of this programme is to substitute human labor for machines. The reasons that are generally given are: to reduce open and disguised unemployment; to get the beneficiaries to do the construction work and maintenance, to save on transportation and exchange.

(1) Appropriate Technology and the World Bank Assistance to the Poor,
op.cit., p.70

Since 1970, the World Bank has conducted a major research and pilot implementation programme in civil engineering construction methods.

Its partial conclusions have been extended to other infrastructure and building construction projects.

The World Bank has also produced special guidelines with respect to educational building construction, in connection with its sectoral policy in education. (1)

The World Bank argues that construction standards and building methods, for any level of educational building and facilities, should be the most economical ones, maximizing reliance on local materials and building techniques, with a view to saving a maximum of foreign exchange, and local currency by getting the beneficiaries to do the construction themselves, as well as the up-keep and maintenance. The economic benefits, including the possibility of improving building techniques, should be evaluated against the disadvantages of shorter building life, more frequent maintenance, and ultimately higher costs in the long run, as a result, for instance, of repeated replacement combined with inflation.

The World Bank has warned that the potential benefits of building operations of the self-help type, which entail community participation, may well be offset by the creation of dual standards of facilities and state services. This situation is likely to exacerbate resentment towards such discriminatory treatment and could result also in the exploitation of the labour of the community. Both of these possible consequences would produce difficulties in organizing and implementing construction works, would extend the implementation periods and hence would increase the final costs of the operation.

(1) Education: Sector Policy Paper, World Bank, December 1974,
quoted in Appropriate Technology and the World Bank Assistance
to the Poor, op. cit., p. 43 and following.

III. SELECTED REVIEW OF ACTIVITIES

This chapter is intended to illustrate action taken by the various organizations of the United Nations system in specific areas of concern to environmentally-sound and appropriate technology.

Although the review is not exhaustive, it gives a general idea to the point that there is more variety than coherence within activities carried out by the organisations, both within each of them, as well as across the system.

The review tries ^{broadly} to picture picture the types of activities that need to be identified, and evaluated prior promoting and financing new areas of co-operation, taking into account the amount of overlap found within the UN system and the trend towards the uncoordinated proliferation of programmes and projects that are promoted by different organisations with their own approaches, methods and emphasis.

UNEP and ECLA started in 1977 a programme to contribute to the theoretical understanding of human settlement technology in the Latin American region and to promote the development and use of adequate technology in this field. The programme involve several activities including the research and development of norms and design of principles for human settlements; selection of ecotechnics; water supply and sanitation; public services; building materials and construction methods; technologies which conserve energy as well as use non-conventional energy sources and methods of using energy. UNIDO has also investigated recently the possibilities of manufacturing low-cost modular pre-fabricated wooden constructions. ILO is initiating a programme on housing technology and is to public in 1978 a study on the economics of low-cost housing.

UNESCO has carried out activities to promote and develop local technical skills and design capability in appropriate technologies for urban and rural housing. The UNESCO programme of housing science is aimed at the training and information on appropriate technology for the lowest-income population groups and is implemented on a regional basis. Activities already done in the African and Arab regions will be extended to the Asian and Latin American regions.

The former Centre for Housing, Building and Planning (now Habitat) undertook in 1977 a compilation of procedures for the choice of appropriate technologies in housing, as well as the possibilities for international and regional cooperation in this field. It has been suggested that the project may continue jointly with ILO, UNID and UNESCO. WHO is also undertaking studies on the improvement of existing rural housing in Latin America, in collaboration with non-UN organisations.

Since 1972, the World Bank has supported a great many site-and-services projects, including over 20 urban shelter projects that are designed to upgrade existing settlements. The site-and-services projects provide alternative physical lay-out typologies for settling low-income population groups, or for the re-location of squatters from areas that are improved. The World Bank provides loans for the selection of new tracts of urbanized land in convenient locations and for the installation of basic supporting services (access ways, water, drainage, waste disposal). In some cases, future dwellers receive an initial loan to purchase building materials, whereas core housing units with rudimentary sanitary and washing facilities are provided in places where the population can afford to pay for them.

In most cases, the construction of shelters is expected to be done by the inhabitants themselves, or by local artisans. Since 1972, the World Bank has financed this type of urbanisation projects in Zambia, El Salvador, Philippines, Indonesia, among others for a total of about US\$ 80 million. Projects are to be continued in India, Upper Volta, Peru, and Botswana.

The World Bank has also provided loans for the design and construction of school buildings (El Salvador), workshops for primary school children (Rwanda), and schools (Thailand). Several low-cost construction designs have been tested: the constructions are very simplified (waist-high, non-bearing walls, for instance) and make intensive use of locally-available building materials (bricks, asbestos, tiles, corrugated iron sheets, etc.).

ILO has been interested in similar urban projects from the point of view of the employment potentials of labour-intensive building techniques.

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2. HEALTH

2.1 Environmental Sanitation

The following organisations have been involved in activities related to environmental sanitation, which includes the supply of water, and disposal of water and domestic wastes and refuses.

The WHO has sponsored since 1966 many studies in community water supply and wastes disposal. Studies underway include the testing of simplified methods for surveillance of drinking-water quality and for removal of deleterious minerals from water. Studies are planned on the effects of local materials and skills on implementing water supply projects; the testing of monitoring systems of drinking-water quality; techniques to screen refuse components in water; efficiency of conventional treatment processes in removing organic pollutants and development of new processes; case studies of community participation in interim measures for wastes disposal facilities in fringe and slum areas; health hazards in disposing of typical solid wastes from selected industries (with UNIDO); health aspects of the reclamation of wastes (with FAO and UNIDO). Some of the research done by ECE on treatment and organic and toxic waste disposal have a bearing on environmental sanitation (see below).

The World Bank has also been engaged in water and sanitation research and pilot-projects, often in conjunction with the projects it finances in housing and urbanisation. Projects for low-cost urban water supply, sometimes coupled with low-cost sewage treatment (ex stablization ponds), waste disposal, and drainage have being implemented in Indonesia, Tunisia, West Pakistan, Afganistan, Egypt, Zaire, and Brazil. In addition, one of the main activities of the World Bank in this field is research on water supply costs and on comparative capital and operating costs for different systems of water supply and waste disposal. Consequently, studies are undertaken on economic, environmental and sociological effects of public vs. private tap connections, variations in quantity of water supplied and water pressure levels, and intermitten supply water, as well as on the scope for designing technical improvements of the existing intermediate technologies and for increasing their transferability and acceptance by users.

The UN Centre for Natural Resources, Energy and Transport has been very active in disseminating knowledge of technology in community water supply and management and waste-water disposal.

2.2 Technologies for prevention and control of diseases.

The WHO programme on appropriate technology for health has began in 1977 an extensive programme to search, develop and test simplified techniques such as the production and provision of reagents and simple equipment for laboratories; rugged, inexpensive and heavy-use radiological equipment; cheap, re-usable nylon or plastic syringes; coils boxes and vaccine carriers; oral rehydration; diagnosis through flowcharts (tested in Guinea-Bissau and Sudan); use of herbal medicines. UNDP is to support these measures and help experimentation with alternatives. UNICEF is also co-operating with WHO in the field of improvement of equipment and search of simple medicinals.

UNIDO is on the other hand investigating the industrial use of medicinal plants, whilst UNCTAD and WHO established recently a list of essential pharmaceuticals.

FAO is to continue its programmes on technologies which improve nutrition, food quality control and monitor on food contamination. The World Bank is also engaged in testing low-cost methods of processing food made of locally available agricultural products, (soybeans, unexpensive milk substitutes, fortification of food staples, etc.) in a large-scale rural development project in Brazil.

ILO programme for the improvement of working conditions and environment is to continue its work on diseases and accidents related to occupation, including agricultural occupations and the relation of such diseases to the technology in use. Priority sectors are: agriculture and forestry, mining and quarrying, manufacturing industry, seafarers, building and construction, dockwork, and shipbuilding and repairing. Further activities concerning rural working conditions are planned in collaboration with WHO and FAO.

2.3 Systems of health delivery.

WHO, UNICEF and the World Bank have been engaged individually and jointly in the design of new systems of management of health services.

A common feature of these programmes is the reformulation of national health services in order to establish health workers at the community level and low-cost infrastructure. All programmes stress the need to train health workers in "simplified medicine"; community participation in the choice of health workers, the financing by the community of capital and recurrent costs of health centres construction; and the revision of medical curricula and training for auxiliaries, middle-grade physicians, etc. For instance, WHO has trained rural health workers in Cameroon with UNDP support.

A typical example is a health programme in Indonesia, financed by World Bank as part of a US\$30 million loan to re-settle migrants. It aims at low-cost improvement and environmental sanitation, together with active involvement of the community. The villagers are expected to elect a health committee, to select members for training as health workers, to finance a village health insurance scheme as a way of pre-paying health services instead of giving fees, and to contribute with labour and construction materials to the erection and maintenance of simple health posts, hand-dug wells and pit latrines, as well as contribution to health campaigns.

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3.

EDUCATION

UNESCO has been engaged in the study of low-cost and simplified-maintenance equipment for radio, press and audio-visual communication, training and teaching. Pre-investment studies to apply such equipment were conducted in Thailand, Afganistan and the Philippines.

The World Bank has been investigating ways of reducing the costs of providing education. A credit was extended recently to Mauritania to support Koranic schools which are already established (thus do not require any additional building facilities) and which are expected to provide a basic education at both primary and adult levels. Functional education, such as UNESCO promoted in the 60's for adult education, is also being attempted by World Bank in Botswana is primary school level. Academic subjects are combined with practical training in skills that should enable school-leavers to become self-employed.

ENERGY

Most of the UN bodies, including regional commissions, are engaged in research and/or pilot testing of technologies for tapping un-conventional sources of energy, saving on current levels of energy consumption, or recycling waste heat.

The forthcoming UN Conference on Science and Technology for Development is to report on non-conventional sources of energy, including activities within and without the UN system, as well as on the trends and developments in research for non-conventional and non-polluting energy sources. An international conference on new and renewable sources of energy may also be held in 1981, for which a number of similar surveys are bound to be done, particularly by the UN Centre for Natural Resources, Energy and Transportation and UNITAR which has been engaged in dissemination of un-conventional technologies and now plans to hold in the future two conferences on petroleum microbiology and low-energy resources.

UNESCO is investigating the scientific and technical fields related to energy, with emphasis on un-conventional and renewable sources of energy (solar, biothermal, geothermal, hydropower, ocean energy). UNDP is to start supporting applied microbiology to energy sources, in particular for production of biogas.

UNIDO, FAO and the World Bank are concerned with energy requirements for rural areas, the development of low energy consuming devices, and fuel production from agro-forestry wastes, aquatic plants, molass, rice husks, groundnuts, etc. FAO is also to engage in water-related energy sources (windmills, etc.) and in wood-related fuel improvements (charcoal, wood-fueled stoves, etc).

UNDP has supported advisory services in Africa and Latin America for introducing simple methods of making charcoal. Such devices are also investigated by UNICEF, at its village technology unit (Kenya). ESCAP is to test similar small-scale energy devices through the Asian Centre for Science and Technology. ECLA, ECA and ECWA have also shown interest in carrying out research and pilot-testing on non-conventional sources of energy. At present many of the low-cost energy installations are being operated by local LDC's research groups and centres.

The problems of energy conversion, storage, conservation have drawn particularly the attention of UNESCO and ECE. The ECE has done many studies on energy-saving and energy-efficient equipments and techniques⁽¹⁾. It now plans to research the environmental aspects of new technologies for energy production, as well as the requirements for medium and long-term planning of energy savings. Energy planning is also a field in which the World Bank is active.

(1) Selected examples are: waste heat from thermal power plants; use of low calorific coal; new uses for gas; new techniques for energy production and use, and socio-economic constraints, to introducing energy-saving plans; efficiency of gas-using equipment, etc.

5. LAND-BASED PRODUCTION

5.1 Agriculture and food production

Several types of activities are being promoted in the field of agriculture and food production.

As a leading organisation in this field, FAO is active in individually, as well as through the GCAIR and the eleven international research institutes attached to the Group in the development of new seeds for high-yielding varieties of rice, maize, peas and beans, potatoes and forage legumes. Other fields are plant resistance to stress (pests and weather extreme variations), biological control of pests, improved productivity of given agricultural subsistence and cash crops such as oilseeds, coconut, tropical roots, food legumes and aquatic plants. For instance, FAO has set up two regional projects in the field of food legumes, one involving ten Asian countries, and the other the countries of the Central American and Caribbean areas. The first project aims at increasing production and improving the productivity of coarse grains and protein-rich feed for livestock. The second is a research project to collect basic data on production of food legume production. Tropical root crops are also research region in the South Pacific by FAO and international research centres. In Latin America, FAO conducted in 1977 an in-depth assessment, of current research on oilseeds. Among other findings, the studies identified the need to search for efficient rhizobium races, which might become a field of intensive scientific research in the forthcoming years for its promises as a technique for substituting synthetic fertilizers.

The World Bank also finances projects that involve similar agricultural research (e.g in Brazil) and the introduction of new crops such as legumes for livestock.

UNITAR has been contributing to identify another new field for scientific research, that of tissue culture which may have practical agricultural applications through cells, tissues and organs transplants of plants and animals.

Pre- and post-harvest conservation and processing techniques have been given much attention lately, particularly at FAO, but also at UNICEF and UNU. At the present stage, most projects are involved in the collection of information and knowledge of, and sharing experience on storage, conservation, processing and product development. A few of them are concerned with designing, fabricating and testing storage structures (UNICEF Village Technology Unit, FAO/UNDP assistance to an Indian grain storage institute).

Traditional methods of cultivation, feeding, and prevention of food losses are to be researched by FAO, UNU, UNICEF, UNRISD and ILO, from the point of view of either gaining knowledge on these techniques, and/or taking advantage of the labour-intensiveness of these production processes. ILO, in particular, has produced many studies on the employment effects of different labour-intensive and mechanized techniques in the cultivation of a variety of crops and ecological/geographic areas in order to promote labour-intensive techniques in agriculture for increasing both the levels of output and employment and the adoption and diffusion of technology in rural Bangladesh. Recent research and publications include: the effect on employment; of change in technology, in coffee and tea plantations in India; technological change and application for sugar cane in Argentina; employment and technology choice in Asian agriculture; farm size factor productivity and technical change in developing countries. The relationship of technology and environment in agriculture is of marginal concern in the present research and operational projects and will be touched upon by a joint UNEP/UNCTAD study.

The promotion of small-scale farming and labour-intensive methods of production is a priority of UNDP, ILO and the World Bank. These two last organizations plan to research the technological policies and factors that contribute to innovation in agriculture and forestry.

The World Bank, in particular, has launched in 1977, eight large-scale projects (5 of them in India) to support local institutions that specialize in delivering know-how on low-cost and labour-intensive technologies to small-scale farmers.

5.2 Stockbreeding

Comparatively little is done within the UN system in the field of new techniques and methods of stockbreeding on the potentials of natural pastures and the use of aquatic plants and wastes for animal feed. Projects for the production of new animal sources of meat and milk have not become operational on a large scale despite past indications of the potentials of non-conventional animals. For instance, CGAIR recommended a few years back that a Buffalo Research Network should be established, but with bilateral funds.

Some of the most important research on animal husbandry supported by FAO and CGAIR is still aimed at the eradication of animal diseases, especially trypanosomiasis and the East Coast Fever.

Interest towards legumes for livestock is shown, for instance, by a recent US\$ 5 million loan, granted by the World Bank, for the establishment of a legume (Townsville stylo) on about 80,000 ha of fallow and permanent grazing lands in Thailand. The legume is a nutritive, rain-fed annual, well adapted to dry climates and poor soils. It also supplements the soil's nitrogen requirements for crop production it is thus expected to reduce overgrazing and contributing to soil conservation.

FAO and World Bank, with UNDP as the financing agency, have been the two organisations traditionally involved in forestry projects. For instance, the World Bank financed 15 projects from 1970 to 1976 (only 3 from 1953 to 1968) involving loans and credits of about US\$ 240 millions. Activities mainly concerned the establishment of industrial plantations, forest extraction, pulp and paper projects. They marginally involved rural development forestry projects (3 projects in Finland, South Korea and the Philippines) and forestry conservation (2 per cent of total project costs).

Both FAO and the World Bank are now expanding their traditional work towards reafforestation and dissemination of fast-growing pulpwood, to include multiple-product forestry, small-scale forestry (household and village woodlots), arboriculture (tree farming), agri-silviculture, and silvipasture. These activities are to be given priority at FAO, and UNDP, as well as the processing of forest products at the household, artisan and small industry level. Renewed interest has arisen, out of this new focus, towards charcoal making, woodstoves and similar small-scale and labour-intensive devices, on which investigations had been phased out in the early 60's. It is expected that the projects financed in the future by FAO, the World Bank and UNDP will take advantage of the experience gained (1) and include components to increase the output from the under-utilized forest activities and products.

ILO's new interest in this field has led to launching a research-operational project on "intermediate" or "improved" labour-intensive technologies in the Philippines, which may be possibly extended to Indonesia.

(1) FAO multiple forest use projects include: Upland Forest and Fodder System on Private Lands (Indonesia), Forest/cattle system (Sahel), Integrated Mae Sa Watershed management (Thailand). The World Bank has carried out projects on small holder farming (the Philippines) and Village Fuelwood Plantation System (South Korea).

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WATER-BASED PRODUCTION

A joint study has been undertaken recently to assess current marine and coastal technology and the new technological needs of LDC's in this field by the Ocean Economics and Technology Office, in collaboration with UNIDO, UNEP, FAO, UNESCO, ITU, WMO and IMCO.

In the field of technical cooperation, FAO (and lately to a lesser extent the World Bank) have been supporting the establishment of projects where aquaculture is the main core or a component part of the activity. The scope of these activities range from improving traditional fishponds and pisciculture techniques, to the broad application of advanced improvements for fish breeding and disease control.

FAO is executing with UNDP funds a large inter-regional aquaculture development and coordination programme, which includes the establishment of regional centres for aquaculture, or networks of aquaculture centres in Latin America, Asia and Africa, as well as promotion of aquaculture and fisheries in the South China Sea, the Sahel zone and the Lake Chad. A total of thirty national projects are also executed by FAO either with its own resources with UNDP funding or with bilateral aid for research, evaluation, culture, production and training in fishfarming. In at least one case, the project is to recycle domestic wastes through fish culture (India, with NORAD aid).

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7. WATER AND LAND CONSERVATION AND MANAGEMENT

UNESCO has several major research programmes on the field of water and land conservation and management, focusing on the need to improve knowledge of the terrestrial biological resources and of the inter-relations between human activities and terrestrial ecosystems. The Man and Biosphere programme to which FAO, WHO, WMO and UNEP contribute, is a long-term international and inter-disciplinary research which involves a series of national and regional projects in the following areas:

- the ecological effects of increasing human activities on tropical and subtropical forest ecosystems;
- the ecological effects of management practices and different land uses on temperate and mediterranean forest, landscapes;
- the impact of human activities and land-use practices on grazing lands;
- the impact of human activities on the dynamics of ecosystems in arid and semi-arid zones, in particular the effects of irrigation;
- the ecological effects of human activities on the value and resources of lakes, marshes, rivers, deltas, estuaries and coastal zones;
- the effect of human activities on mountain and tundra ecosystems;
- ecology and rational use of island ecosystems;
- the conservation of natural areas and of the genetic material they contain;
- the ecological assessment of pest management and fertilizer use on terrestrial and aquatic ecosystems;
- the effect on man and his environment of major engineering works;
- ecological aspects of urban systems, with particular emphasis on the use of energy;
- the interaction between environmental transformation and the adaptive, demographic and genetic structure of the human population;
- the perception of environmental quality;
- environmental pollution and its effects on the biosphere.

UNESCO has also undertaken an International Geological Correlations Programme which seeks, among other objectives, to evaluate the origins and distribution of mineral and fuel resources. The International Hydrology Programme, operated by UNESCO in collaboration with WMO and UNEP, partly searches for solutions to problems related to use of water.

Apart from these major inter-agency, long-term research programmes, other organizations have been involved in research and technical cooperation projects. Knowledge on the resources of desert ecosystems has been promoted by UNITAR, through its dissemination activities.

FAO has been involved since 1970 in the promotion of legumes and since 1974 in the development of a larger programme together with UNEP, on biological nitrogen fixation involving rizhobia. A state of knowledge report is to be released soon, assessing the present importance of both grain and forage legumes, and their future potential for development, as well as evaluating the institutional and other limiting factors that affect the widespread use of symbiotic nitrogen fixation. Activities to stimulate free-living soil bacteria for the production of nitrogen are to be given additional support by UNDP. Although these investigations generally seek, in the first place, to reduce the consumption of synthetic fertilizers, they could also lead to increasing the scientific knowledge of the soil and and water productive capacities, as well as knowledge for adequate conservation and management of land and soil, particularly with respect to the conservation and restoration processes that take place automatically when ecosystems regenerate spontaneously.

The introduction of legumes in rotating systems and the practice of multiple cropping is now promoted by FAO on a pilot scale with the double objective of increasing agricultural production and conserving land resources

Integrated watershed projects, as means of conserving and managing land and water resources, have also been executed by FAO and the World Bank, usually coupled with forest land-use and in general as a component of larger operational projects on forestry use for industrial purposes. However, some overall evaluation is being done. For instance, FAO is carrying out a large regional research effort in 14 countries of the Near East and North Africa to review and evaluate the research previously undertaken in land and water use to determine gaps in knowledge and indentify constraints and new areas of research and operations for soil and water conservation methods.

8. AGRICULTURAL IMPLEMENTS, TOOLS, VEHICLES AND EQUIPMENT

The design, production and testing of simple agricultural implements and tools, vehicles and equipment, to be used in labour-intensive production either by hand, through animal-power, or through unconventional sources of power is a field of interest to FAO, ILO, the World Bank, UNDP, UNIDO, UNICEF, and the Office of Science and Technology (ACAST), among other organizations.

For instance, ILO executed a UNDP-financed project in Tanzania to assist in designing and testing simple agricultural tools and it intends to place greater emphasis on research aimed at animal-drawn and hand-operated farm tools and implements. Simple methods of making charcoal have also been supported by UNDP, ILO, FAO and UNICEF. FAO is helping Kenya to test agricultural equipment used in West Africa, Swaziland and India.

FAO is also executing some pilot projects to test new techniques of flood spreading ("reticular modules" in Colombia), incorporating advanced technologies to existing irrigation systems, use of recycled water for irrigation, and transfer of animal-powered water-lifting devices. Other activities include the dissemination of knowledge on building wells with simple, low-cost and labour-intensive techniques, irrigation techniques for villages, ways of using food waters and, small-pumping and water-lifting devices, etc. The World Bank has also financed several projects for small-scale irrigation schemes, low-cost borehole drilling, installation of handpumps, testing of bamboo wells, and other similar small-scale devices.

Windmills for water lifting are being experimented by UNICEF, as well as improved agricultural tools implements and food processing simple machinery made of wood and simplified metal parts.

ILO, FAO and UNIDO have jointly designed a project proposal, for submission to UNDP, for a comprehensive programme of development, manufacture and use of farm tools and implements. UNIDO has launched a five country programme to promote the local manufacture of improved agricultural hand tools and implements. The first phase consists of making available to these countries the chosen implements, designs and standards, and assist local research and development institutions to adapt, manufacture and test the tools and implements. The second phase will consist of establishing a pilot demonstration unit in each country. Another UNIDO project is to disseminate small and low-cost agricultural tractors for wet and dry lands. Another project is concerned with low-cost transport equipment for rural areas. The use of plastic products in agriculture is to be promoted by UNIDO which intends to establish in Upper Volta a permanent centre for plastics in agriculture, as a follow-up of a previous mobile demonstration project. The centre should take advantage of special techniques for building plastic irrigation systems developed in Malaysia (for paddy fields) and in Indonesia and Iran (for soil treatment), using asphalts and polymers.

Small-scale improved storage facilities have been given priority by UNICEF, FAO, UNU and UNDP.

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Whereas initial work in this field was done by WHO with a view to health problems, most of the support given by UNDP, UNIDO, ECE, FAO, ESCAP and UNITAR to agricultural wastes and by-products is oriented towards the productive re-use and recycling of such substances. A forthcoming report, prepared for UN Conference on Science and Technology for Development, is expected to treat exhaustively the trends and developments in waste-recycling technology and use of non-food agricultural materials.

FAO has engaged lately in a compilation of available technologies for the industrialisation of agricultural waste and residues, and is to prepare a survey of needs and opportunities in this field. A large conference organized by UNITAR on microbial energy conversion has already provided an indication of the scientific and technical scope and trends in this field.

Waste recycling and reutilisation for composting has also been investigated by FAO, as well as the ECE (equipment and techniques for manure treatment). UNDP, on the other hand, has manifested interest in supporting activities to convert agricultural wastes into protein-rich animal feed, a field in which both FAO and UNIDO have been engaged. The possible uses of sugar cane by-products has been particularly given attention to by FAO, and UNIDO has helped the establishment of a bagasse pilot plant in Cuba. The treatment of straw for animal feed has also been given attention lately by FAO. Investigations are also to be promoted in the use of agro-wastes for cement-like materials, in particular by ESCAP. A UNIDO programme consists of collection, consolidation and dissemination of technical knowledge on the utilization of agricultural waste in paper making.

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Most of the research and operational activities in the field of industry fall into one of two categories, namely the search for scaling-down industrial processes and the promotion of small-scale industrial activities; and the search for technological processes that permit savings of raw materials, energy and/or avoid the production of waste either throughout the process or at the end of the production line.

ILO programme on rural industrialisation for small-scale, artisan and rural crafts, which is to expand in the year future, falls into the first category, as well as UNDP commitment to the development and adaptation of selected industrial technologies that are suitable to labour-surplus economies. The same can be said of the World Bank's research and lending activities to the small and medium-scale industrial firms, and some of FAO support to agro-based industries. The possibilities of organic linking between small and large firms have been researched by ILO, while the World Bank has granted substantial loans and credits to implement this in the field. Various types of links have been developed and researched: those related to the supply of inputs, materials and machinery, to small-scale firms, to the sale of output (subcontracting of small firms) and to the transfer of know-how and skills from the large to the small firms. Small-scale industrial estates have also been established in a joint UNDP/ILO/UNIDO project.

The industrial estates established in recent years by the World Bank in five countries (Pakistan, Mauritius, Indonesia, Yemen and Tanzania) work on the following arrangement. Large firms located in the industrial estate sub-contract part of the production to medium and small-scale manufacturers. These are generally expected to use more labour-intensive methods for the manufacturing of simpler components or for the processing of labour-intensive operations needed by the larger firms. The World Bank has also provided loans to seven development finance companies, since 1975, which channel credit to small and medium-sized enterprises. On the other hand, ECE, UNIDO and FAO have been searching for industrial processes that either produce less waste, save material inputs, lengthen the useful lifetime of equipment and products, or use waste produced at the end of the production line.

10.1 Metal-related industries

The branches of iron and steel, metal mechanics, and other ferrous and non-ferrous metals have received the attention of UNIDO, ECE, World Bank, ILO, among others.

ILO case-studies on employment in manufacturing relate to substitution of machinery with labour and include tin can manufacturing (Kenya, Tanzania, Thailand), engineering machinery, metal works (Mexico, Ghana), and mineral processing industry (USA, Zambia, Zaire, Chile).

UNIDO's research and pilot-plant programmes include the following activities:

- establishment of a pilot unit to adapt technologies in the foundry, forging and sheet/metal processing operations for adapting to these equipments to the conditions of developing countries;
- research project on moulding in foundry through the adaptation of ferrous and non-ferrous foundry technologies, and particularly the parts related to moulding materials, foundry moulding sand and the use of suitable cupolas such as the simple recuperative hot blast cupola that has been developed in some Asian countries; study of natural and synthetic moulding sands; problems of commercialisation of these innovative technologies;
- research on technology for low-grade ores, including the identification and application of suitable methods of mineral beneficiation in order to enable the exploitation of low-graded mineral resources;
- research on the application of aluminio-thermic techniques in ferro-alloys production, due to the fact that the aluminio-thermic techniques do not require any electric, gas or oil-fired furnaces and are simple to operate and maintain;
- research and development of substitute alloys based on indigenous alloying elements for the production of special steels and alloys;
- research and dissemination activities on the techno-economic feasibility of mini-plants in the iron and steel sector to be implanted in developing countries that have a small market and limited natural resources;

- research project in Iran on the choice of both technology and products in relation to a given production capacity of copper and copper alloy products, including assessment of factors such as site, utilization of natural resources, demand of the domestic market and surplus capacity for exports;
- comparison and evaluation of alternative industrial techniques, in selected branches, including an assessment of the use of existing research activities of the research institutes of developing countries, a survey of indigenous technologies developed by them, and the stimulation of cooperation among developing countries research institutes, as well as between these and those of the developed countries.
- programme for technological innovation in light engineering and rural workshops.

The ECE project on non- and low-waste technology has researched among other sectors, the iron and steel industry. Other ECE programmes include:

- the technical-economic effectiveness and the production of engineering equipment for the prevention of pollution;
- policy and other measures for saving raw materials in engineering industries;
- the technical-economic aspects and results of anti-corrosion measures in engineering industries;
- the use of steel in motor-vehicle manufacturing and the inter-relationship between the iron and steel industry and the steel consuming industries;
- some research and assessment work has been undertaken by ECLA on the economics of adaptation of technology, and the relevance of choice between innovation in technology vs. imports of technology, and improvements vs. replacement of equipment.

Other smaller activities include the study of technology and environment of mining and process industries (UNCTAD/UNEP), small-scale mining (conference planned by UNITAR), research and development of machine tools for the textile industry (ESCAP), capital/labour substitution in mechanical engineering (World Bank).

10.2 Chemical-related industries

Most of the activities in the field of chemical-related industries, including pulp and paper, cement and some building materials, are shared by UNIDO and ECE.

The fertilizer, chemicals, drugs and pharmaceuticals, cement and building materials industries, as well as paper products and small pulp mills are all priority sectors in UNIDO's programme of industrial appropriate technology.

Small paper mills, cement, clinker and ammonia fertilizer small plants have been researched by the World Bank, jointly with FAO and UNDP.

The ECE has devoted some efforts in case studies on non-waste technology for pulp paper making, tyres and packaging, as well as ways of using toxic chemicals and the use of raw materials and waste products as inputs in the chemical industry. For instance, UNIDO has been executing a pilot and demonstration plant for clay bricks and demonstration kilns for lime. ILO has researched labour-intensive methods of cement block manufacturing and the scaling-down of industries that produce construction materials.

10.4 AGRO-INDUSTRIES

The scaling down of agro-industrial plants is being promoted mainly by FAO, and UNIDO, as well as the World Bank, ILO and UNDP, in several branches including:

- milk processing plants (FAO)
- sugar industry (UNIDO/UNEP, ILO)
- equipment for hard-wood (UNIDO)
- rice-bran stabilization (UNIDO)
- saw-mill (UNDP, World Bank)
- jute processing (ILO)
- pyrentrin (UNDP)

A joint FAO/UNIDO programme on conservation and processing of food and agricultural products has been established. Also direct industry to industry contacts were established under the FAO Industry-Twinning programme to develop small and medium-scale palm oil industries in five developing countries and to pursue the transfer of small-scale technology in the fields of processing fruit and vegetables, milling cereals and extraction of oil seeds.

FAO has also been developing a wide-ranging portfolio of small-scale, labour-intensive and economically feasible wood-based panel mills. The portfolio has been designed entirely for the developing countries, and was started with contributions from renowned consulting and engineering companies from the developed countries, though it also now includes case studies prepared by specialists from the developing countries.

UNIDO plans to undertake in five developing countries a pilot project on integrated rural industrialization and appropriate technology development in order to evolve a methodology for action which national government could adopt. The proposed four phases would consist of first assessing existing industrial activities, the requirements of the rural population and the resources available, and the elaboration of a development programme for implementation within the country's own resources. The second phase would include an integrated manufacturing development programme for a selected product or product mix, including pilot plant, design, repair and maintenance, marketing, etc.; a local manufacturing development programme to produce other products essential for the region, with appropriate technologies; and action on policy and institutional requirements. Phases three and four would be concerned with the dissemination of the pilot-project results.

In addition, UNIDO is carrying out, or plans to execute shortly, a series of programmes of study new technologies for the industrial use of some well known and unconventional agricultural products. These include, for example:

- exchange of know-how for the utilization of medicinal plants in developing countries where there is still a sufficient number of medicinal plants in use, so as to sustain an industry of reasonable size;
- dissemination of an Indian small-scale multipurpose pharmaceutical units which would produce drugs in small quantities and could be adopted by developing countries where the commercial outlets of bulk drugs are limited;
- research on the possibilities of using jute to reinforce plastics;
- research and development on cotton textiles with specific end-use properties to enhance the competitiveness of cotton-fibre textiles vs. synthetic-fibre textiles, including market research and testing;
- development of an integrated technology, from collection to processing, for the extraction of oil from semi-desertic Balanites A. trees;
- study of four different technologies for fractionating palm oil and the assessment of the suitability of technology according to specific product requirements;
- research on the substitution of whale oil with oil extracted from the jojoba plant;
- research on an integrated coconut-processing technology that will make use of non-fully exploited coconut characteristics;
- promotion of new processes, using conventional equipment manufactured for the plastic industry, in order to convert natural rubber into thermoplastic solid and liquid rubbers that could be transported easier;
- study of detoxification technology for castor beans.

UNIDO has also proposed a work programme on the production of Fuels Based on Agro-Forestry Wastes in order to develop and disseminate the technology for the pyrolytic conversion of agro-forestry wastes and low-grade timber, to obtain carbon, charcoal, oil and gas. It consists of the preparation of technology manuals, case studies, applied research and development on converter design and on stabilization of oils of establishing a pilot plant for training.

11. INDUSTRIAL WASTES AND RECYCLING

It appears that ECE is the UN body that has conducted most of the research and operational activities in this field, as well as UNIDO to a lesser extent though the report on trends and development in waste and recycling, which is being prepared in view of the forthcoming UN Conference on Science and Technology for Development may through additional light on the activities conducted in this field within the UN system. As it has been already mentioned, some previous outlining work was done in a UNITAR international meeting on the new trends and technological advances in chemistry, bio-chemistry and biological recovery, recycling and re-use of wastes and residues and a report on technological trends in the use and recycling of basic resources and materials has already been prepared by ECE.

UNIDO has established a programme for the recycling of industrial lubricants which involves the exchange of information on available technologies and their promotion and improvement through research and development in existing institutions, the search for appropriate planning processes and the manufacture of prototype equipment for the recovery of the industrial lubricants. Another UNIDO programme concerns the recycling of polymer wastes (a field that ECE has also researched). UNIDO is interested in the exchange of information and documentation on existing technology and in strengthening institutions in selected developing countries that could undertake applied research and development and build equipment locally.

The UN Centre for Natural Resources, Energy and Transport is elaborating a research on recycling and substitution of mineral raw materials, metallic residues and substitution of metals.

The World Bank has promoted unconventional organizational methods for the collection of waste inputs to a paper industry in Colombia.

Apart from these scattered examples, the ECE has been engaged in several programmes that search productive uses of industrial wastes and by-products. Briefly stated, these programmes include:

- an inventory of air pollution emissions from power and industrial plants;
- technologies for the recycling and recovery of toxic chemicals and toxic substances;
- the possible impact and economic uses of waste heat from thermal power plants;
- technologies for the utilization of coal wastes during extraction and processing;
- policies for re-utilization and recycling of wastes;
- utilization of wastes in and by the chemical industry;
- water supply and effluent disposal.

The great majority of the programmes and projects in this field have been carried out through labour-intensive methods, or have been concerned with researching ways of promoting these labour-intensive techniques through policies, improved tools, etc.

Since 1970, the World Bank has undertaken a major research and pilot implementation programme to test, in various developing countries, a series of labour-intensive technologies in road construction and civil engineering projects, in general, including rural and feeder roads, irrigation projects, etc. Thirty roads, dams and irrigation canal sites were investigated in India and Indonesia. The research involved the review and the field testing of a great deal of variables (standards of construction design, tools, transportation vehicles for construction materials, relative costs of haulage by man, animal and machine; health and nutritional aspects of the workers, etc.). These operational activities have also been researched jointly with ILO and will lead to a publication in civil engineering. Pilot schemes on the same labour-intensive basis are presently conducted with World Bank financial loans and credits in Benin, Kenya, Honduras, Lesotho and Mexico (see also the activities of the World Bank in housing and urbanisation).

ILO has began shifting from pure evaluation of labour-intensive road, housing and irrigation construction techniques to the application and implementation of projects. ILO is giving assistance to the Kenya rural access roads programme (jointly with the World Bank) and intends to implement a labour-intensive road construction programme in Guatemala. The ILO has also surveyed and evaluated lately the labour-intensive building techniques, the labour-intensive construction of irrigation works and the labour-intensive techniques for the construction industry. It expects to undertake shortly a UNDP financed research and development project in Bangladesh in the field of irrigation and flood control. The project is to contribute to the development of improved tools, equipment and techniques of construction which will enable an increase in output per worker employed without requiring a heavy capital investment in equipment, as well as researching the requisite management systems for recruitment of labour and site supervision.

ILO has also conducted ergonomic studies on heavy construction work sites (Thailand), as well as a number of evaluations on the income distribution effects of feeder roads and small-scale irrigation schemes.

FAO has been involved in a number of projects for the labour; intensive construction of wells, small hydraulic works and the rehabilitation of irrigation systems.

TRANSPORTATION

Apart from a UNIDO project on ways of pre-fabricating timber bridges, most of the work known in the field of transportation relates to institutional and organisational methods to diminish urban congestion through restraining the use of the urban traffic network. One of these project is supported by the World Bank in Singapore, and is monitored by UNEP and the US Department of Transport. It consists of enforcing a licensing scheme, applicable to central areas congested with car traffic and parking lots. Cars that wish to transit in the licensed areas must purchase and display the licence. Buses and commercial vehicles are exempted. Monitoring provides data on travel behaviour, traffic performance, business activity and environmental effects.

Another World Bank programme in this area involves studies of urban transport and land use in some 12 cities. The overall objectives are to rationalize, through pricing and traffic priorities, the use of road space in congested areas, to improve the efficiency of transport companies, to reduce transport requirements and demand, to cater for cyclists and pedestrians who cannot afford even low-cost public transport.

14. INSTITUTION BUILDING

Most of the organizations of the UN system are engaged, in one way or other, in promoting the establishment or the strengthening of national institutions in the developing countries since this activity is regarded as an essential means towards the overall objective of increasing the developing countries capabilities in scientific and technological research, development planning and management.

ILO, FAO, UNCTAD, UNDP, UNESCO, UNIDO, UNOST(ACAST) and WIPO, along with the ECA, ECWA and ESCAP, have been promoting the establishment of regional centres for transfer of technology and development, together with governmental regional organizations such as the OAU, Arab financial organizations, etc. Sectoral Centres for the transfer and development of a particular product-oriented technology (such as, for example, food processing) have also been encouraged by FAO, UNCTAD and WIPO, among others. In general terms, these centres are expected to play an important rôle in adapting imported technologies to local conditions, and to research and develop new technologies that are also more adequate to the given economic, social and ecological characteristics of the areas served by the centres.

In addition to the multi-agencies undertakings, several organizations are providing assistance to establish specialised centres, institutes networks of institutions and other mechanisms in the developing countries. For instance, ILO is presently studying the feasibility of creating an international mechanism for the promotion of appropriate technology. The World Bank has also suggested a study along similar lines to provide an international mechanism that would facilitate the access of industrialists from developing countries to reliable information about technological alternatives. UNESCO is assisting countries to establish centres at the regional and sub-regional levels to exchange information on scientific and technological requirements for new energy sources. A UNESCO-sponsored Centre for Energy, Heat and Mass Transfer has been actually created for the Asian and Pacific region.

FAO is helping the establishment of a Centre on Integrated Rural Development, also in the Asian and Pacific area, as well as a National Food Technology Institute in Mexico.

UNCTAD has been carrying on a large programme to assist countries in the preparation of national technological policies and plans.

UNIDO's programme of action for appropriate industrial technology contemplates the building up of institutional infrastructure and training programmes, as well as assistance to study national and international policies for the development of science and technology. UNIDO also intends to strengthen and/or establish over 100 technological institutes both for general-purposes and specialized, which would contribute to the choice, acquisition, absorptive application and development of new and appropriate technologies. One of these institutions would be a demonstration centre for small-scale plants that produce building materials. In addition, with the results of a survey of indigenous technologies in selected industrial branches, UNIDO is to prepare a common register of global research projects to promote co-operative research programmes for developing such indigenous technologies.

as well as to assist countries in the identification of sponsors and means of finance. In parallel, UNIDO Industrial and Technological Information Bank is being set up to help, among other objectives, the selection of appropriate technology.

All of these activities intend to stimulate the concern of countries about practical and effective research and development in the field of science and technology.

Dissemination programmes are part of the normal activities of all the agencies that are engaged in appropriate technology, in the form of publications (manuals, guidelines, newsletters, bulletins, technical memoranda), technical cooperation services and consultations (meetings, seminars, conferences, etc.). Some organizations, such as FAO and UNEP, also have referral systems on specific items. Suggestions for the establishment of a global system of exchange of information and transfer of appropriate technology through an information referral system or through other mechanisms, are still at the stage of discussions.

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