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THE APPROPRIATE TECHNOLOGY CONCEPT IN U.S. GOVERNMENT PROGRAMS FOR TECHNOLOGY TRANSFER AND TECHNICAL ASSISTANCE TO THE DEVELOPING NATIONS

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ABSTRACT

The appropriate technology (AT) concept attempts to work within the economic, political, cultural, and environmental settings of the developing nations to provide technologies, products, and processes for economic growth suited to their circumstances. This idea is discussed as an alternative approach to the familiar processes of technology transfer and development assistance in conjunction with the particular problems faced by the developing nations. Both the advantages and limitations of appropriate technology are treated and the integration of the AT concept into various U.S. Government programs is reviewed.

CHAPTER ONE: INTRODUCTION

Prior to the early 1970s, the policy of the United States Government concerning development assistance was largely based upon the "trickle down" theory. This theory embodied the concept that money spent on financing a modern technical infrastructure within developing countries would produce benefits which would "trickle down" to the masses. Despite some apparent successes, this idea was found insufficient as a development strategy. Development assistance of this genre usually accentuated and perpetuated the differences between rich and poor rather than acting to narrow the range of income distribution. Following recognition of the inability of U.S. development assistance efforts to adequately achieve all of their objectives, a new approach to foreign aid began to evolve.

Many of the traditional U.S. foreign assistance activities are being replaced by programs which are designed to nurture an indigenous scientific and technological capability, promote the transfer of technologies which meet the needs of the major segments of the population other than the industrial sector, and develop products and processes which can be utilized without heavy dependence on foreign nations. Appropriate technology (AT) 1/ is one component of this developing policy orientation. This paper discusses in general the role of AT in the evolving U.S. development assistance program and addresses specifically how the appropriate technology concept differs from the Nation's previous technical aid ideas; how AT contributes to the attainment of U.S. foreign aid

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1/ The term "appropriate technology" is used throughout this paper. However, it should be noted that, in practice, other terms terms including "intermediate technology" and "alternative technology" have been utilized to refer to essentially the same concept.

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NOTE: The original study, dated August 22, 1977 was prepared in response to a request by the House International Relations Committee. It was subsequently released as a CRS Report (77-25 SP) with the permission of the committee.

objectives; how appropriate technology may be implemented as part of an alternative strategy, and how it may be institutionalized within the operations of the U.S. Government. The study delineates the setting in which economic growth generally takes place within the so-called "Third World" and offers a conceptual and working definition of AT. The introduction, application, and limitations of appropriate technologies within the context of the less developed countries (LDCs) are discussed in terms of the various factors controlling the invention, selection, and/or adaption of technology. This paper examines past and present development assistance strategies and discusses Federal legislation and programs designed to implement the appropriate technology concept in U.S. foreign assistance activities. In combination, these factors point to the role played by AT in the Nation's international efforts and indicate modifications which might be considered in light of changing demands on the international assistance process.

I. INTERNATIONAL TECHNOLOGY TRANSFER

Technology transfer is the process whereby a product or process developed in one area or for one purpose is utilized in another area or for another purpose. The transfer from the public to the private sector, from one governmental unit to another, from a government to a foreign country, or from industry to industry enables technologies to have benefits beyond their originally intended usage. In a general sense, international technology transfer is accomplished through one of three processes. The technology in its original form can be transferred from one country or one industry to another and utilized for an identical purpose. In another situation, the technology may be applied to a different purpose in another nation while retaining its original construction

or components. Or finally, the technology may be adapted for application abroad to new and different problems and environments.

A. Mechanisms of Transfer

The transfer of technology both domestically and internationally, can be effected through various mechanisms. Among these are:

The sale or purchase of hardware
The sale or purchase of technical information
The sale of licenses
The sale of patents
Technical assistance contracts
Cooperative ventures (government-government, industry-government, industry-industry)
Co-production (foreign and domestic companies produce together)
Turn-key manufacturing plants 2/
Multinational corporations
Training
Education
Scientific and engineering exchanges
Conferences and professional meetings
Trade and professional journals
International organizations
Technical information services
Foreign aid programs
Theft and espionage

B. Methods of Transfer

The international transfer of technology has various dimensions and can be conceptualized in various ways. These differing orientations serve to delineate the means and methods by which the transfer process operates. The transfer effected may be (1) direct or indirect; (2) formal or informal; (3) personal or impersonal; (4) based upon technical product acquisition, data acquisition, or "know-how" acquisition; (5) "embodied" or "disembodied";

2/ Turn-key manufacturing plants are those built and operated by a foreign company which also trains employees on the job and then turns ownership and operation over to a domestic source according to a prearranged agreement.

(6) horizontal or vertical; (7) the result of technological "push" or demand "pull"; and/or (8) some combination of any of these. Rarely does a method of transfer fit exclusively into one descriptive category, nor are the categories mutually exclusive. The following paragraphs briefly describe these types of transfer.

Direct technology transfer involves the point-to-point transfer of a product, process, or technical specifications. It can include, but is not necessarily limited to, licensing or purchase of patents, trademarks, and/or design drawings; direct investment; the purchase of hardware, capital equipment, or intermediate products; turn-key manufacturing plants; the purchase of software and information systems; management contracts; and cooperative ventures. In contrast, indirect transfer is the transfer of information in a more general sense, that not specifically associated with a product or process. These indirect methods include training, education, and personnel exchanges. In addition, industrial shows and conferences serve as vehicles for transfer. Publications, such as professional and trade journals, also provide for indirect transfer, as do personal contacts between scientists and technicians.

Formal and informal technology transfers involve similar concepts. Formal transfer concerns the exchange of technology through the negotiation of contracts, technical, industrial, or scientific agreements, or the purchase of patent, trademark, or design rights, all of which have legal, governmental, or contractual sanction. Informal transfer occurs in instances where information and know-how are transferred through unstructured channels such as published material, personal contacts, and professional meetings.

Personal technology transfer requires the exchange of information and/or processes through face-to-face contacts with skilled workers and experts

cooperating with the recipient countries or industries. Impersonal transfer involves those transactions where the transfer is effected through the acquisition of tangible property such as design specifications, equipment, turn-key plants, and patents.

An additional approach to technology transfer is to view it as technical acquisition, data acquisition, or "know-how" acquisition. The first relates to the purchase, gift, or exchange of technical products, machinery and equipment, prototypes, and/or turnkey operations. The second, data acquisition, concerns the purchase or gift of technical information, including licenses and patents. In contrast, "know-how" is acquired through people, transferred through training, experience, and demonstration.

Following much the same reasoning, technology may be conceptualized as being transferred "embodied" in other inputs of production such as in the purchase of equipment, turn-key operations, and total systems, or "disembodied" through specific contractual arrangements such as the purchase of patents or industrial and technical cooperation agreements. 3/

Horizontal technology transfer occurs when a technology is transferred between industries or institutions and is adapted to an environment other than that for which it was originally developed. As described by Harvey Brooks, "horizontal transfer occurs through the adaption of a technology from one application to another, possibly wholly unrelated to the first

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3/ Egea, Alejandro Nadal. Multinational Corporations in the Operation and Ideology of International Transfer of Technology. Studies in Comparative International Development, v. 10, Spring 1975: 11.

. . ." 4/ Vertical transfer concerns the movement of technical knowledge within an industry or institution and from the general to the specific with regard to application. Vertical transfer includes:

> . . . the process by which new scientific knowledge is incorporated into technology, by which a 'state-of-the-art' becomes embodied in a system, and by which a confluence of several different, and apparently unrelated technologies, leads to a new technology. 5/

The "push" approach to technology transfer relies on the availability of a technology and its subsequent development into a marketable product. This development occurs in response to an expectation of the creation of a market and a user demand for the new technology. On the other hand, the "pull" approach to technology transfer is based upon the notion that a technology should be developed or adapted mainly in response to a specific market demand or to a previously defined user need. In this case, the technology is "pulled" from the unutilized store of research to be developed and/or commercialized because it will address a specific existing problem or oppportunity.

C. Limits of Transfer to Underdeveloped Nations

Technology transfer is a vital element in a country's growth and development. This may be especially true in the case of the developing nations. It provides the means by which countries can acquire new technologies and generate indigenous ones to meet the needs of the nation without duplicating extensive research and development. However, there are various barriers to technolgy

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4/ Brooks, Harvey. "National Science Policy and Technology Transfer," In Technology Transfer and Innovation. NSF 67-5 (Washington, U.S. Govt. Print. Off., 1967. p. 54.

5/ Ibid., p. 54.

transfer to the LDCs. Small domestic markets in underdeveloped countries generally provide only small returns on investment in technology and production. The technical skills of the local population are often insufficient to support advanced manufacturing procedures and upkeep. Above all, the needs and resources of the developing nations are usually different from those of the countries providing the technology, thus necessitating adaptation and flexibility in application. In an attempt to deal with technology transfer to the developing world, the appropriate technology concept seeks to provide options within the limits imposed by the environment in which the transfer is effected.

II. THE SETTING

The phrase "Third World" has become a popular term to to describe the more than 125 countries which have not yet attained a level of technological development commensurate with the West (the United States, Canada, and Western Europe which, with Japan are also referred to as the "First World") or the Soviet Bloc and China (the "Second World"). However, it should be noted that the term connotes a cohesiveness and uniformity among these nations which does not exist. There are large social, economic, and political differences among the underdeveloped and developing countries which must be taken into account when discussing growth and development in, and technical assistance to, this area of the world.

Although diverse, a major concern of these developing nations is the conduct of an orderly, nondisruptive, successful growth process, a part of which is the acquisition of the benefits of technology. At the same time, the developing world is attempting to build economies

capable of competing in the international marketplace. In doing so, the LDCs look mainly to the West and Japan as their model for industrialization. The sophisticated technologies, production techniques, distribution systems, and financial practices of the western industrialized nations may indeed be useful in selective applications but are often viewed as panaceas for the underdeveloped situation in the LDCs. The conditions under which the West industrialized and the environment in which western economies operate are vastly different from those in the developing world. For the most part, the LDCs are characterized by a large, unskilled, and un- or underemployed labor force, few capital assets, and, at best, a limited technological infrastructure. As a consequence, the wholesale transfer of complex, capital-intensive technologies from the industrialized nations cannot, in itself, ensure the modernization of these nations.

The West began its industrialization process at a period when new technologies were largely mechanical in nature. 6/ Competition for innovation and for profit built up a technological infrastructure (an underlying framework of technical knowledge, know-how, and understanding which provides support for the science and technology endeavor) within which industrialization progressed. This infrastructure was flexible enough to adapt to extensive changes brought about by technologies based on an expanded knowledge of the nature of matter and energy. It has been able to support continuing innovations and industrialization rooted in

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6/ This disucssion is based upon: Myrdal, Gunnar. The Transfer of Technology to Underdeveloped Countries. Scientific American, v. 231, September 1974: 174.

physical and chemical laws. This modernization process in the West is built upon the foundation laid during the Industrial Revolution of the late 18th and the 19th centuries. It largely took place within those countries which possessed an organized governmental structure and a strong sense of nationhood, whether authoritarian or not. Many of the developing nations today lack this stability.

The developing nations are currently attempting to industrialize, often without the necessary technological infrastructure. They appear to rely on the transfer of technologies in the interest of modernization while the economic, cultural, or technical context to support the integration of these technologies into the economy is not evident. Although technology is a vital component of the economic growth process, the placement of advanced technologies within an underdeveloped economy, void of economies of scale, markets, communications or transportation networks, without a technically skilled or innovative working population, and without a technological infrastructure is unlikely to result in a secure modernization process leading to a viable, sound economy. For these reasons, the concept of appropriate technology has evolved to offer a new perspective on development, one that is designed to take into account the special characteristics of the LDCs.

III. APPROPRIATE TECHNOLOGY DEFINED

The concept of appropriate technology seeks to provide an alternative approach to traditional processes in light of the limitations

of present transfer activities in fostering modernization. Discussing the definition of AT, the Report of the National Academy of Science on "Appropriate Technology for Developed Countries" states:

> The term appropriate has come to be most widely used, perhaps in recognition that there are many conditions determining the degree of suitability of a particular technology to any environment: the political and economic objectives of each country, its social structure and functioning, and the availability and quality of its productive resources. 7/

A similar view is expressed by Nicholas Jeqiuer who acknowledged that:

> . . . appropriate technology . . . represents what one might call the social and cultural dimension. . . The idea here is that the value of a new technology lies not only in its economic viability and its technical soundness, but in its adaptation to the local social and cultural environment. 8/

The testimony presented at hearings on appropriate technology held in July 1978 by the Subcommittee on Domestic and International Scientific Planning, Analysis, and Cooperation of the House Science and Technology Committee, indicated that there is considerable agreement concerning the definition of AT. The importance of the choice of a technology which reflects the needs, resources, and skills of the local environment in which it is to be introduced was emphasized by the statements presented by the witnesses. As articulated by Mr. Tom Fox, Executive Director of

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7/ Eckaus, Richard S. Appropriate Technologies for Developing Countries. Washington, National Academy of Sciences, 1977. p. viii.

8/ Jequier, Nicholas, ed. Appropriate Technology, Problems and Promises. Paris, Organization for Economic Co-operation and Development, 1976. p. 19.

Volunteers in Technical Assistance, appropriate technology is ". . . technology which fits the local needs and conditions of the user or consumer." 9/ A similar definition was offered by Dr. Sander Levin, Assistance Administrator of the Agency for International Development, who characterized AT as those goods and processes which are ". . . appropriate to the specific needs and local conditions under consideration." 10/ Perhaps the most encompassing definition of what appropriate technology is, is that offered by Francis Luzzatto, Director of the International and Special Assistance Division, Office of Voluntary Citizen Participation, ACTION, who wrote:

> The essence of appropriate technology is its responsiveness to local needs, resources, labor, skills, and values. It implies technical development on a scale that can fit within an existing situation without unduly disturbing traditions or risking undesirable ecological or cultural side effects. It implies technical development which can help people reach self-sufficiency in meeting their basic human needs and in coping with the increased pressures on their land and their time. 11/

As construed within an international setting, appropriate technologies are those technologies introduced to, or developed within, a country designed to complement the technical skills, indigenous resources, and needs of that nation. These technologies represent

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9/ U.S. Congress. House. Committee on Science and Technology. Appropriate Technology. Hearings, 95th Congress, 2nd sess. July 25-27, 1978. Washington, U.S. Govt. Print. Off., 1978. p. 123.

10/ Ibid., p. 326.

11/ Ibid., p 384.

an attempt to work within the socio-economic structure of the LDC to ensure that they meet the country's industrial, financial, educational, and employment capabilities.

Appropriate technology requires a concerted effort to combine local requisites with indigenous technical skills and resources to provide products or processes which can be utilized by the population. It usually involves low-cost outputs made from lowcost inputs. The products and processes derived from AT are generally designed to match the needs of the population while simultaneously requiring relatively little maintenance, and being easy to operate and easy to replace. The technologies sought are responsive to demand, and adaptations can be made as changes are indicated. Meeting these criteria, appropriate technologies tend to foster self-reliance and decentralization in the provision of goods and services.

Recognizing that the advanced technologies of industrial nations are not necessarily the answer to the development problems of the LDCs, the appropriate technology concept attempts to deal with alternative orientations to the economic environment within these nations. The idea behind AT is that there is more than one way of accomplishing an objective. Basically, the underdeveloped nations have a large unemployed, underemployed, and unskilled labor force, few capital assets (with the exception of the oil-rich states), and a limited technological infrastructure. The appropriate technology concept incorporates these conditions for development and attempts to work at promoting modernization and the provision of needed goods and services within these constraints.

The concept of choice is critical to appropriate technology. Selection of a product or process is to be made based upon a realistic assessment of the overall environment, needs, and capabilities of the country. While AT encourages the use of small-scale technology, it also recognizes that sophisticated technologies must be components of the communications, transportation, and power networks necessary for industrialization and economic growth. The national economic productivity engendered by these "high" technologies generally is greater than any feasible alternative. In making a choice, all levels of technical complexity must be considered for, while advanced technologies alone do not hold the key to economic growth, they do contribute to the general development of a country.

Examples of appropriate technologies are numerous. They span the everyday range of activities from cooking and heating by solar energy to integrated pest management on farms using biological methods as a substitute for expensive and environmentally risky chemical insecticides. Other appropriate technologies include tillage and cultivating equipment compatible with animal power or small tractors utilized on the small farms in the LDCs and anaerobic digesters to produce gas for fuel used in heating and generating electricity for production. Wind-driven irrigation pumps and electric generators, as well as new methods of making bricks for building from local materials also are considered within the range of appropriate technologies.

Appropriate technologies can be original inventions designed to meet the specific needs and resources of a country or adaptations made of already existing products and processes. They may be developed by

local inventors or transferred from abroad, but in all cases appropriate technologies should be reflective of indigenous patterns of consumption, labor, and materials. AT displays a sensitivity to the differences inherent in the markets of the less developed world. Measurements of "appropriateness" are thus subject not only to technical criteria, but to other considerations including economic, social, environmental, cultural, taste, energy, and value standards. 12/

The concept of appropriate technology attempts to deal with the total benefits of technological development. While its production methods and distribution channels may not operate at optimum economic effiency, AT criteria require that the social, economic, environmental, and political advantages to be derived from a technology be considered. A trade-off may have to be made between economic efficiency and other values. Appropriate technology addresses itself to this idea and provides alternatives; the governments of the developing nations must decide if and how these benefits are to be assured and distributed.

12/ Jequier, op. cit., p. 19.

CHAPTER TWO: TECHNOLOGY IN THE DEVELOPING WORLD: POLICIES AND PROBLEMS

Integration of the appropriate technology concept into the everyday environment of the developing world may necessitate new or revised institutional structures, new fiscal policies, a reorganized market structure, and different technologies and production methods. Acceptance of AT as an alternative to traditional economic activities will require showing that appropriate technology is not simply "old," "discarded" technology designed to slow the development of the Third World. While applicability and opportunities to integrate AT into the system vary with the situation, a new orientation to development and economic growth--and the various related policies and practices--may be implied in some LDCs.

I. FACTORS OF PRODUCTION

The factors of production--labor, land, and capital--are present in the economy of the LDCs in proportions different from those of the industrialized nations. The economies of the LDCs are frequently dominated by a relatively large work force faced with high unemployment, underemployment, poverty, and limited skills. As a consequence, income distribution is uneven. The economies of the developing nations also typically are characterized by a lack of developed or aggregated markets, unorganized distribution systems, limited capital assets for investment, dependence on imported goods and raw materials, and little capacity for indigenous innovation.

The capital-intensive technologies of the industrialized nations may not be compatible with these economic and social conditions. Given the developed countries' concern with efficiencies, the technologies of the West tend to be labor-saving, energy intensive and designed to promote economies of scale. However, the economies of scale inherent in western production often do not apply equally to the LDCs. 13/ The established communications, distribution, and transportation networks which are available in the developed nations, and fundamental to this concept of scale, are not present in most developing countries. Markets have not been established or aggregated. Thus, as the basis for a program of development, capital-intensive technologies often do not deal with the problems and possibilities inherent in the particular situations found in LDCs. The idea presented by the AT advocates is that labor-intensive technologies should be adaptable to provide overall benefits equal to, if not superior to, highly technical innovation within the economic constraints of the developing nations.

Development of the means of production utilizing appropriate technology can provide an opportunity to expand the range and scope of job possibilities within the economy. The increased number of jobs can effect the level and distribution of income within the country. Utilization of native resources can reduce capital outflow from the LDCs to the multinational corporation or the foreign nation. AT is designed to strengthen

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13/ Teitel, Simon. On the Concept of Appropriate Technology for Less Industrialized Countries, Technology Forecasting and Social Change v. 11, 1978: 357.

indigenous innovation which limits the reliance on outside skills and technologies as well as to develop products and processes which do not necessitate foreign investment and large capital expenditures.

II. LDC GOVERNMENT POLICIES

The technologies transferred to the LDCs by the nations of the West and those developed within the countries themselves reflect governmental policies toward science, technology, and industrialization. Among the barriers to the acceptance and utilization of appropriate technologies are the attitudes of the LDCs themselves. In modeling their development planning after the West, many developing nations aspire to the advanced, capital-intensive technologies which characterize the economies of the industrialized countries. While these technologies may have a definite place within the LDCs, the uncritical acceptance of this form of transfer can put strains on the economic and political viability of the country.

In general, the past and present policies and priorities of the developing countries have served to promote the transfer of captial-intensive technologies. 14/ Various policies have made capital inexpensive relative to the price of labor, thus promoting technologies which favor the former. Many LDCs have artificially underpriced foreign capital by distorting exchange rates. Favorable rates of exchange have been established on foreign currencies which serve to encourage the development of technologies which utilize a high proportion

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14/ House Science & Technology Committee, op. cit., pp 71, 253-254.

of imported goods and resources rather than higher priced domestic materials. Technologies from the West thus become a "better buy" and the replacement supplies for these captial-intensive production methods are purchased from foreign sources.

Other policies of the LDCs promote artificially low prices for capital. Low-interest loans for the purchase of foreign capital goods and production methods are subsidized by the government. Preferential tariffs on capital goods are combined with preferential foreign exchange rates to favor the transfer of capital-intensive technologies. Accelerated depreciation allowances on the tools of production, which are themselves capital-intensive, also serve to make it more economical for local entrepreneurs to promote advanced technologies. Many LDCs do not have well planned protectionist policies and thus tend to create high-cost, high-profit industries with no competition, catering to luxury items and capital goods.

The predisposition of various persons involved in the technology transfer also may create barriers to the acceptance of AT if those persons are oriented toward advanced technologies and production methods, economic efficiency concepts, and labor-saving manufacturing. In many of these cases, the elements of appropriate technology are generally unfamiliar and require an ability to adapt products and processes, an activity which is not part of the training of individuals involved in this type of production.

Additional constraints to the adoption of appropriate technology within the developing nations revolve around the entrenched self-interest of various specialized segments of the population. Institutional structures, as well

as political alliances, often work to promote the capital-intensive technologies and methods of production which tend to benefit the wealthier elements of society. Economic policies favorable to business and capital-intensive industrialization have created established economic structures. In conjunction with business, such groups control the economic development of many LDCs and can work to suppress innovation in the areas of appropriate technology.

While the economic programs of the developing nations have artificially lowered the price of capital and thus capital-intensive production methods, labor has often become expensive through the implementation of minimum wage laws, lay-off restrictions, and mandated fringe benefits. 15/ The wage structure can be affected by exogenous factors, often designed to benefit labor, which have contributed to massive urban unemployment in the LDCs. Among the benefits often required in addition to wages are housing, sanitation, water supply, and medical and educational facilities. When these amenities are made obligatory, they add substantially to the cost of production in labor-intensive manufacturing. Thus, there is a sizable economic disincentive to the implementation of labor-intensive technologies.

III. INNOVATION

Most developing nations, with their limited technological infrastructures, have not developed innovative capabilities among their populations.

15/ Erickson, John R. and Jerry R. Ladman. The Multinational Corporation and Appropriate Technology in Less Developed Countries. Arizona Business, v. xxiii, Nov. 1976: 6.

Without indigenous innovation a country cannot maintain long-term development, which requires adaptation and evolution of processes and products as needs, demands, and resources change over time. Local entrepreneurs and innovators are necessary to sustain the adoption of technologies suited to the local environment as well as the development of domestic resources. The institutional and societal flexibility necessary to promote this process is not often present in the LDCs. This is partially a result of limited technological expertise in the population and of government policies which work to discourage innovative projects.

Technical education and training are necessities for indigenous innovation. However, in developing nations there is a limited supply of skilled persons to draw upon for innovation. Attempts to improve this situation by sending students abroad to study often results in "brain drain" when these individuals remain abroad to take advantage of other environments where their talents can be better utilized and rewarded.

The economic policies of the governments within the LDCs usually are not constructed to foster indigenous innovation and often pose (whether intentionally or unintentionally) direct obstacles to the innovation process. 16/ Inflated foreign exchange rates, excessive depreciation allowances, and preferential tariffs act to favor capital-intensive, imported technologies. At the same time, high interest rates on domestic loans and inadequate credit

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16/ Jequier, op. cit., p.44 and House Science and Technology Committee, op. cit., pp. 71-77.

systems which do not cushion the risks related to investments in innovation serve as deterrents to local entrepreneurs. Further disincentives arise due to lack of effective market diffusion and product distribution channels. This both dampens demand for the results of innovation and makes returns on investment less likely.

Low levels of innovation also result in the inability of LDCs to adapt western technologies to the particular environments of the developing nations. 17/ Indigenous ingenuity to provide flexibility in approaching technological problems is lacking. The appropriate technology concept seeks to provide a method by which low-cost, adaptive innovation can be fostered. In the best circumstances investment costs are minimal, the technologies are not technically sophisticated but address the problem, and local resources are utilized. Thus, the risks involved in innovation and the barriers to it mentioned above can be circumvented while providing the method by which domestic innovation can be encouraged to assist in the country's development. [Costs, risks, and limitations of the AT approach are treated in subsection v.]

IV. THE MULTINATIONAL CORPORATION

The multinational corporation (MNC) is a major source of technology transfer to the developing nations. 18/ By establishing manufacturing plants within the LDCs, multinational companies have provided for this

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17/ Jequier, op. cit., pp. 43-44.

18/ Sutter, Rolf. Technology Transfer into LDCs. Intereconomics, v. 12, December 1974: 380.

transfer through the importation of machinery and tools used in production. The technical expertise and training made available by the management and employees of these companies play an important part in the transfer of information and skills. At the same time, multinational corporations inject capital and foreign exchange into the economies of their host countries. While some MNCs can take advantage of cheap, trainable labor in the LDCs, generally the technologies favored by these multinational firms are capital-intensive. In such cases the income derived from the activities of these companies is not widely distributed. The number of employees needed to operate these production mechanisms is small and the wages benefit only a particular portion of the population, usually the wealthier, educated segments.

Within the headquarter countries of the multinational corporations, labor is often the most expensive factor of production and the development of labor-saving technologies is the rational course followed by the large companies. This does not hold true when applied within the LDCs. While in the developing nations labor is more abundant, the MNCs often have no incentive to utilize less capital-intensive technologies. Given the nature of the products and processes in which these companies are involved, it is often difficult and costly to alter manufacturing patterns. Familiarity with proven methods of production can form a bias towards continuance of existing practices which may be reinforced by a lack of information on alternatives. In other cases, the propensity of multinationals to export high technologies is encouraged by the economic policies of the LDCs. While cheap labor can be an advantage, the MNCs often respond to artificial

barriers to the utilization of labor imposed by governments and consequently provide capital-intensive technologies.

Multinational corporations have contributed to the westernization of the markets within the developing nations. The criticisms now often leveled at the MNCs concern whether these companies are transferring technologies at odds with the economic and developmental environments of the LDCs. The current theories of economic growth tend to concentrate on the idea that innovation and technology must stimulate demand and employment--the critical economic issue within the less developed countries. The technologies introduced by the multinational companies, when capital-intensive, do not act effectively to expand employment, innovation or demand. However, these practices generally are supported by the government policies and priorities of the LDCs.

There are various economically sound reasons for the continued utilization of capital-intensive technologies by MNCs. 19/ In the past, there has been a concerted effort by the developing nations to encourage the involvement of multinationals in order to promote industrialization. The governmental policies described above all contribute to the continuation of the emphasis on western, advanced technologies. Economically, it is costly for companies to adapt technologies to the collective environment of the LDCs and even more so for adaption to each particular country. Markets are too small to recover large investments and

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19/ Erickson and Ladman, op. cit., p. 67.

research and development costs for special techniques or processes designed to be labor-intensive or to use domestic resources. Capital-intensive production methods can save scarce monetary resources by consuming less money per unit of output. 20/ Also by operating within LDCs, multinational corporations bring managerial and technical experience and skills which are of benefit to the recipent country and can have future impact on the development of expertise in the working population.

V. LIMITATIONS OF LABOR-INTENSIVE, LOCAL TECHNOLOGIES

Advocates of the appropriate technology concept who restrict their definition of the concept to small-scale, labor-intensive technologies rather than a mix of technological sophistication will find difficulty in addressing all the issues associated with economic growth in the developing countries. These small-scale technologies can usually address local problems but often fail to deal with the broad aspects of economic development. Aside from a reluctance to use what the LDCs may perceive as old, undeveloped, or discarded technology, there are limits to what small-scale technologies alone can do to promote modernization. With respect to the international marketplace, the small-scale nature, the dispersed production sites, and the reliance on unskilled labor make small-scale, local technologies less economically efficient than capital-intensive ones. These characteristics reduce the ability of the LDCs to produce on a large scale and develop a broad foreign market. 21/

20/ Helleiner, G.K. The Role of Multinational Corporations in the Less Developed Countries' Trade in Technology. World Development, v.3, April 1975: 163-167.

21/ Schroeder, Dennis. In Search of "Appropriate" Technology. International Development Review, Focus, v. 18, 1976: 4.

In the industrial nations, capital-intensive technologies utilize resources to provide the maximum output while consuming the least amount of input per unit produced. Thus, scarce financial resources are used most efficiently and that portion saved can be put to other use. 22/ The production methods provided by advanced technologies are based on efficiency criteria which ensure that the output is produced in the least amount of time. Production by advanced technologies is often the cheapest, most efficient way to manufacture in large quantities and thus compete on the world market.

In the development of a national market, additional considerations make capital-intensive technologies more economically desirable. The dispersion of local industries leads to problems with market aggregation and distribution. The underdeveloped transportation and communications networks hinder both the provision of inputs to production as well as the distribution of outputs to the population. Nor are markets aggregated to develop substantial demand for a product (new or otherwise) such that its manufacture is profitable. Labor-intensive technologies do not provide the quality control which can be built into machine-made outputs. Together, these factors often cause the return on investment in labor-intensive technologies to be below that which can be obtained through the utilization of advanced technologies.

22/ Askin, Peter. Intermediate Technologies: An Informal Study. Washington, U.S. Department of State, Senior Seminar on Foreign Policy [1975-1976]: 8.

Other aspects of the labor-intensive components of appropriate technology argue against its substitution for capital intensive technologies. As discussed previously, labor is expensive relative to capital in the developing nations. In addition, this labor is largely unskilled, uneducated, and located in urban areas. Labor and production management skills are not widespread and most of the expertise is based in capital-intensive methods of production. The increased necessity for effective management techniques arising from reliance on labor-related technologies makes its absence more noticeable. Capital-intensive manufacturing, when combined with training, provides those management and technical skills needed for modernization of the economy of the LDCs.

Thus, in relation to some aspects of development, these conditions cause the economic costs associated with the production of labor-intensive, local technologies to be higher than those inherent in capital-intensive, western technologies. The products of these technologies often cannot compete in the world marketplace because they are not manufactured in quantities large enough to export, nor are they manufactured efficiently. Poor distribution channels (both national and international), small domestic markets, and uneven quality control can prevent an adequate return on investment. These factors, coupled with the absence of technical education and the problems of national pride and psychological resistance to using labor-intensive, local technologies provide coherent arguments against the implementation of small-scale technology--or the exclusion of advanced technology--in the developing nations. What needs to be determined for each situation is the proper balance between economic efficiency and other cultural, ecological, and social values.

U.S. planners also recognize that development directions, economic, social, technical and otherwise are, and should be, principally determined by the country in development. Though externally provided material and advice can be helpful, indigenous leadership, conditions and social forces essentially make or break any development effort. It remains to be seen whether the AT concept can be integrated into the technical assistance arena to produce the desired impacts. The evaluation of the results is yet to come.

CHAPTER THREE: DEVELOPMENT OF THE U.S. TECHNICAL ASSISTANCE PROGRAM

Appropriate technology, as generally defined, offers a new approach to technological development and economic growth in the LDCs. As such, the concept has gained some acceptance acceptance within the U.S. development assistance community and various governmental programs are beginning to integrate AT ideas into their operation. This has come about as a result of both changing development strategies and congressional legislation requiring the implementation of AT-related activities.

An understanding of the strategic foundation upon which U.S. development assistance programs are based provides the framework within which to view the role played by appropriate technology. The characteristics of self-reliance, decentralized decisionmaking, small-scale products and processes, and labor-intensive manufacturing associated with the AT concept match many of the "new directions" mandated by the Foreign Assistance Act of 1973 (P.L. 93-189) which altered the Nation's development assistance policies and placed emphasis on meeting the "basic human needs" of the world's poor. This legislation, in effect, provided an acknowledgement of the AT concept which offers a mechanism to achieve the objectives of the new policies. In recognition of this, Congress passed several additional laws which legislated various programs and activities to further foster AT which are discussed below. Concurrently, the executive branch departments and agenices have embarked on certain programs designed to integrate and implement AT considerations in the developing world.

I. U.S. FOREIGN DEVELOPMENT ASSISTANCE STRATEGIES

A. Prior Strategies

After World War II, attention was directed to the developing world and efforts were begun by the western nations to narrow the economic gap between

the rich and poor countries. Aid was viewed as a mechanism to exert influence at the time of the Cold War, to gain support for U.S. diplomatic efforts, and to control relations with countries rich in needed resources. It was considered that reduction of economic privation would enhance the prospects of peace, reduce the appeal of communism and constitute a morally sound action in and of itself. At that time, it was widely believed that rapid growth would be brought about through industrialization 23/ and that the LDCs could advance economically by imitating the development processes of the advanced, western countries. This approach, identified in the Report of the Pearson Commission on International Development, stressed the "linear path" to development along which all countries moved. 24/ According to this theory, all nations had to follow similar developmental strategies and there were few, if any, alternatives. Instead, there were certain "components" missing in the LDC environment which were preventing growth, but once these were provided or developed, the LDCs would be able to meet their economic goals.

These growth theories led to foreign assistance programs and policies supported by the United States which stressed rising productivity; increased international trade and exports; improved fiscal and monetary institutitons; infrastructure building; savings; and investment. 25/ Industrialization was given top priority. Conventional thinking ran along the lines that the development of a technological

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23/ Rothstein, Robert L. The Political Economy of Redistribution and Self-Reliance. World Development, v. 4, July: 593.

24/ Streeten, Paul. Changing Perceptions of Development. Challenge, v. 20, Nov.-Dec. 1979: 63.

25/ Rothstein, op. cit., p. 594.

infrastructure would bring about increased benefits to the population of the LDCs as a whole. This "trickle down" theory held that high growth rates and increased production would reduce poverty as profit, employment and government income gains would flow to the masses. As described by Ted Owens in testimony before the House Science and Technology Committee:

> The approach to economic growth followed by most countries and aid agencies the past quarter century has come to be called "trickle-down". It is based on the notion that the big farm, big factory, big technology production systems of the rich countries should be copied by the poor. Such production systems were considered by economists to be the most efficient means of increasing production and therefore the fastest way of increasing GNP. As GNP rose jobs would be created in abundance. People would have more money and hence would be able to afford nutritionally adequate diets, better houses, medical services and so forth. Governments would be able to collect more taxes and build roads, irrigate fields, train teachers and otherwise improve public services for the benefit of all. That is, the great mass of the poor, though uninvolved in planning and management, were supposed to benefit from the benefits that would "trickle-down" from a planning-production system dominated by a handful. 26/

Growth was measured in terms of a nation's gross national product (GNP), and in terms of GNP, the developing countries were expanding rapidly. In the 1960s, the LDCs had a 5.5 percent average annual increase in GNP which was greater than the industrialized countries' experienced in their developmental stage. 27/ Concentration on industrialization and centralized planning

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26/ House Committee on Science and Technology, op. cit., p. 156-157.

27/ Grant, James. Development: The End to Trickle Down? Foreign Policy, v. 12, Fall 1973: 44-45.

contributed to the increased growth in the less developed nations, as reflected in the gross national products of the countries. The United States was seen as a source of technical assistance and capital to fuel the infrastuctural growth and development in these countries.

The forms of international aid provided during this period of time generally encouraged and institutionalized LDC dependence on foreign technical assistance and capital. It reinforced utilization of imported, advanced technologies and discouraged use of indigenous talent and resources. One estimate concluded that the U.S. bilateral aid program stimulated between 50¢ to 90¢ worth of American exports for every $1.00 of AID development assistance funds spent. 28/ Training and innovation were generally overlooked in favor of capital-intensive infrastructure development. This affected the development path the LDCs might have followed given different forms of assistance from the western world.

Yet, despite the rapid growth of the developing countries as measured by the gross national product, many of these nations were in fact failing to meet the needs of the major portion of their populations. The gap between rich and poor often widened as the benefits derived from foreign assistance directed at industrialization remained in the hands of the middle class and the wealthy. In recognition of this, a new direction in foreign assistance thinking began to emerge, of which AT is a component.

28/ Richard V. L. Cooper. The Additionality Factor in Tied U.S. Development. Washington, D.C. Agency for International Development, July 1972. Report R-974. Cooper's report is reviewed in: U.S. Library of Congress. Congressional Research Service. The Impact of the United States Bilateral Development Assistance Program on U.S. Exports and Other Economic Variables. [Washington] p. 4 (Report No. 77-53E).

B. New Strategies

Much experience gained since 1946 has led to a rejection of the idea that there is only one path on which development occurs. There has evolved an acceptance of the notion that the industrialized nations and the LDCs do not have identical needs and resources and therefore should not necessarily follow the same path for economic growth. The new strategies also reflect the existing differences between individual countries and the different development patterns which they must follow to achieve economic goals. The political, social, economic, cultural and historical perspectives in the world today differ from those existing when the United States industrialized. Thus, one developmental model, based upon the U.S. experience, is no longer sufficient to ensure modernization. Much of the experience of the developed countries is not relevant to the problems and environment of the LDCs nor can the less developed nations be simply considered and treated as inferior states in terms of western standards. 29/

The limits of reliance on using GNP to measure economic growth goals are widely recognized. 30/ Certain factors of growth and income distribution, as well as various benefits to the population cannot be measured and are, therefore, not reflected in the gross national product. Changes in the distribution of income as a result of economic growth are not evident in these figures. Nor does absolute growth necessarily prove that the poor

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29/ Amin, Galal A. Dependent Development. Alternative, v. 2, December 1976: 80.

30/ Streeten, Paul. Development Ideas in Historical Perspective. International Asienforum, v. 9, May 1978: 31.

have received any benefits. Rather, a strong case has been made that, while overall economic growth occurred during the 1960s, the gap between rich and poor persons within the LDCs also increased.

Certain U.S. assumptions have been altered. The development strategies now proposed are based upon self-reliance within the LDCs, a recognition of numerous options for growth, rural development, and meeting "basic human needs." The movement is away from uncritical acceptance of the industrial, market economy of the West toward a philosophy of development assistance directed toward the nurturing and utilization of domestic talent and resources. There is renewed emphasis on promotion of development strategies whereby the developing countries, eventually, if gradually, will discontinue dependence on foreign assistance rather than grow reliant upon it as a permanent component of economic growth. 31/

In the pursuit of meeting "basic human needs," 32/ the emphasis has shifted from the idea embodied in the "trickle-down" theory to that of increased employment to encourage a better distribution of income. Less industrialization, decreased imports of capital-intensive machinery, combined with a reliance on labor-intensive production methods, are part of this new approach to development. Rather than relying on and expecting the benefits of industrialization to filter down to the poor--which in many instances has proven not to be the case--increased employment in jobs

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31/ Amin, op. cit., p. 386.

32/ A term coined by the International Labor Organization at the World Employment Conference in 1976. See U.S. Congress. House. Committee on International Relations. Rethinking United States Foreign Policy Toward The Developing World. Hearings, 95th Congress, 1st sess., 1977, Washington. U.S. Govt. Print. Office, 1977: 1-9.

which do not require sophisticated technical skill will serve to increase the earned income of the poor and formerly unemployed.

An increased emphasis is now being put on agriculture and rural development. There has been a recognition of the impact the rural sector has on economic growth. Both in terms of the provision of foodstuffs and jobs, the farm plays a vital role in LDCs. Traditional patterns of aid tended to assist industry far more than the agricultural activities of the LDCs. This reinforced the trend of populations in the LDCs to move to the cities in search of jobs which resulted in overcrowding, inadequate services, and massive urban unemployment problems in numerous developing countries. A renewed concentration on agricultural assistance, improved farm yields, rural small scale industries and jobs, and local decisionmaking is an attempt to relieve some of the pressures of urbanization, meet more of the needs of the population, and increase economic growth through increased productivity and use of local resources.

One of the components of the new approach to development assistance is decentralized decisionmaking. This is designed to promote regional and local participation in decisions affecting economic growth policies, taking into account the factors present in the local environment. Such a process can encourage policies which will reflect the ability of the country, region, or area to absorb and utilize effectively the foreign assistance available. The past failures in accounting for differences within and among LDCs can possibly be minimized by abandoning centralized planning and relying instead on local participation which can ensure incorporation of local needs. This option, of course, is conditioned upon the views of governments in the developing nations.

C. Congress and "New Directions" Legislation

The Foreign Assistance Act of 1973 signaled acceptance by Congress of new strategies for development assistance. Spurred on by the failure of some

past activities, declining public support for foreign aid, and the food, population, and energy crises, 33/ the legislation refocused the American bilateral assistance program away from large, capital-intensive projects toward those programs which would directly help the poor and the rural sectors of the developing world. Entitled, "New Directions," this law states that the U.S. development aid program must be ". . . revised to reflect the new realities." As part of this law, the President was directed to develop a bilateral aid program which would, among other things:

-- Concentrate increasingly on technical assistance, agriculture, and industrial goods which meet critical development problems rather than on large-scale capital transfers;

-- Concentrate on critical problems which affect the lives of the majority of the LDC population, including food; rural development and nutrition; population planning and health; and education, public administration, and human resources development; and

-- Allocate responsibility for development planning to each sovereign country with the United States providing assistance on a collaborative basis. 34/

In his introduction of the legislation, Senator Hubert Humphrey outlined the situation calling it:

33/ U.S., Congress, Senate, International Relations Committee. Implementation of "New Directions" in Development Assistance. (Prepared by the Agency for International Development.) Washington, U.S. Govt. Print. Office., 1975. p. 37.
At head of title: 94th Congress, 1st session. Committee Print.

34/ P.L. 93-189.

> . . . the veritable intellectual revolt among scholars of development who are turning against the long-held view that growth alone is the answer that will trickle benefits to the poorest majority. These scholars, and now this bill, start from the proposition that the poorest majority must share in the work of building a nation and must share more equitably in the fruits of development at the onset . . . 35/

The passage of this legislation created a new development assistance mandate which incorporated the precepts upon which the AT concept is based. To meet the requirements of this law, various activities associated with, and characteristic of, appropriate technology would have to be implemented. The legislation established that there was a role to be played by AT in the U.S. foreign assistance program. It also instigated a series of additional laws which further defined the contribution of AT in assistance activities and which provided some framework for certain agency AT efforts. These laws are discussed in the following section.

II. U.S. LEGISLATIVE INITIATIVES FOR AT

In keeping with the mandate of the "New Directions" legislation, the Congress first dealt specifically with the appropriate technology concept in the International Development and Food Assistance Act of 1975 (P.L. 94-161). In recognition of the role of the Agency for International Development as the primary agency responsible for development assistance, the law amended section 107 of the Foreign Assistance Act of 1961 and mandated a program of appropriate technology within AID. The legislation authorized $20 million for fiscal years 1976, 1977, and 1978 for ". . . activities in the field of intermediate technology, through grants in support of an expanded and coordinated private effort to promote the development and dissemination of technologies appropriate for developing countries."

35/ Grant, op. cit., p. 43.

In response to this mandate, on June 30, 1976, AID submitted to the Senate Foreign Relations Committee and the House International Relations Committee a proposed plan for a program to carry out these objectives. 36/ The program called for the establishment of an independent, private, nonprofit organization to assist the less developed countries in adapting and utilizing appropriate technologies while at the same time promoting the development of a science and technology infrastructure. This arrangement was favored to ensure improved flexibility of operation, decreased bureaucratic red tape (as associated with AID's activities), and a faster response time. Subsequently, Appropriate Technology International (ATI) was created to manage the AT effort in the areas of: (1) communications and coordination--information and modeling programs; (2) national priorities for appropriate technology--efforts to encourage AT oriented policies in the LDCs; (3) specific appropriate technology projects; (4) educational programs; and (5) U.S. business involvement in international AT projects. A $1 million grant to set up the office, acquire staff, and put together a program was approved by the Congress on June 27, 1977. The operating grant for ATI was submitted to AID in February 1978, but was not received until August 31, 1978. ATI was allocated $5 million for three years with a commitment from AID for an additional $15 million over the same time period. In this manner, primary appropriate technology responsibility was shifted outside the Agency for International Development, but AID continues to be the major source of funding for ATI.

In the 95th Congress, congressional concern relevant to appropriate technology began to focus on energy development in the LDCs. This activity

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36/ U.S. Agency for International Development. Proposal for a Program in Appropriate Technology, Washington, U.S. Govt. Print. Off., July 17, 1976.

was spurred by the worldwide energy crisis and the recognition that developing countries do not have sufficient foreign exchange reserves to pay for continued increases in conventional fuel prices. In response to this, the Congress passed five laws specifically authorizing U.S. activities to assist the LDCs in energy development, which are discussed in the following paragraphs.

The International Development and Food Assistance Act of 1977 (P.L. 95-88) amended the Foreign Assistance Act of 1961 and authorized funding up to $18 million for fiscal year 1978 for LDC related programs in research, development, and utilization of small-scale, decentralized energy technology which would use renewable resources. Section 114 of this law adds a new subsection 119 to the 1961 Act authorizing the Agency for International Development, in cooperation with the Energy Research and Development Administration (now incorporated within the Department of Energy) to operate a program for the developing countries emphasizing those energy technologies ". . . which are acceptable, and simple and inexpensive to use and maintain."

In the second session of the same Congress, the Nuclear Non-Proliferation Act of 1978 (P.L. 95-242) was enacted which gave primary responsibility for similar LDC energy development programs to the Department of Energy. This law directs the United States to cooperate with other nations, international institutions, and private organizations in the development of non-nuclear energy resources and assist the developing countries in "the application of non-nuclear technologies consistent with . . . economic factors, . . . material resources . . . and environmental protection." Title V of the legislation authorizes the Department of Energy to conduct this program under the guidance of the Department of State and in cooperation with the Agency for International Development and other relevant Federal agencies. DOE efforts were directed to include

evaluations of energy alternatives, facilitation of international trade in energy products and processes, development of energy resources, and application of energy technologies. Funding for the program was to be provided by the annual Department of Energy authorization acts. A report from the President to Congress was required 12 months from the date of the bill's enactment. The report was to detail the feasibility of expanding the cooperative efforts of the initial program.

The International Development and Food Assistance Act of 1978 (P.L. 95-424), which also deals with energy development programs for the LDCs, does little to clear up the apparently conflicting lead agency responsiblities for such programs. Section 111 of the law amends section 119 of the 1961 Foreign Assistance Act and authorizes the President to furnish assistance for cooperative programs with LDCs in energy production and utilization of small-scale, decentralized, renewable energy sources for rural areas. "Such programs shall also be directed toward the . . . development and use of energy technologies which are environmentally acceptable, require minimum capital investment, are most acceptable and affordable by the people using them, are simple and inexpensive to use and maintain, and are transferrable from one region of the world to another." The legislation continues with a new subsection (b) to section 119 which states that "the agency primarily responsible for administering this part shall coordinate with the Department of Energy, to the maximum extent possible. . ." Thus, it appears that P.L. 95-424 reaffirms the primary responsibility of the Agency for International Development in the conduct of international LDC alternative energy programs in contrast to the intent of the Nuclear Non-Proliferation Act requirements which give similar authority to the Department of Energy. The ambiguity continues.

Other sections of the International Development and Food Assistance Act of 1978 concern appropriate technology. Section 101 of the legislation amends the Foreign Assistance Act of 1961 by inserting new sections 101 and 102, the latter of which states that U.S. development activities shall emphasize the effective involvement of the poor in development by "expanding their access to the economy through services and institutions at the local level, increasing their participation in the making of decisions that affect their lives, increasing labor-intensive production and the use of appropriate technology." The law also amends section 107 of the Foreign Assistance Act of 1961 to require that the President emphasize use of small-scale, cost-saving, labor-intensive technologies "that are generally most appropriate for the small farms, small businesses, and small incomes of the poor." Funds are to be available for activities in the area of appropriate technology including support of an expanded and coordinated private effort to encourage the development and dissemination of AT in the developing world.

Additional incentives for the use and development of alternative, small-scale energy technologies are included in two laws which mandate activities to promote the export and demonstration of such technologies. Title I, section 105, of the Foreign Relations Authorization Act for fiscal year 1979 (P.L. 95-426), provides for the demonstration of solar energy and other renewable energy technologies in foreign countries through the utilization of these techniques in U.S. Government buildings abroad. The purpose of this endeavor is to provide incentives to the development and use of local alternative energy sources; to encourage cooperation in the development of alternative energy technologies in conjunction with section 119 of the Foreign Assistance Act of 1961, as amended; to develop markets for American solar technologies; and to prevent interruption of services due to conventional fuel shortages. The

Secretary of State is directed to select and implement such projects in consultation with the Secretary of Energy.

The legislation also expresses, in section 609, the sense of Congress that the United States should encourage the United Nations to convene a World Alternative Energy Conference in 1981 ". . . for the purpose of considering ways to meet the energy needs of the world through the development and use of alternate energy sources." The Secretary of State is directed to transmit to the Speaker of the House and to the Chairman of the Senate Foreign Relations Committee a report on action taken pursuant to this section.

The second law dealing with the export and marketing of alternative energy technologies in the developing world is the Financial Institutions Regulatory and Interest Rate Control Act of 1978 (P.L. 95-620). Title XIX, section 1907 of this law directs the Board of Directors of the Export-Import Bank to designate an officer to advise the Bank's president on ways of promoting the export of ". . .goods and services to be used in the development, production, and distribution of non-nuclear renewable energy resources." The law also requires the dissemination of information on opportunities for support of such activities on behalf of the Bank. The Bank's energy officer is to serve as a liaison between the Bank and the Department of Commerce, as well as between other relevant departments and agencies. The Bank is required to report on specific activities and programs undertaken to achieve the policy mandated under Title V of the Nuclear Non-Proliferation Act of 1978 and section 119 of the Foreign Assistance Act of 1961, as amended.

The 95th Congress enacted two additional laws which demonstrated an interest in the application of appropriate technology concepts to the

international development assistance endeavor. The first of these, the Foreign Relations Authorization Act for fiscal year 1978 (P.L. 95-105), directs the President to take steps to ensure that an emphasis on light capital technology is made in conjunction with the position of the United States at the August 1979 United Nations Conference on Science and Technology for Development.

Title VIII of the International Bank for Reconstruction and Development Act (P.L. 95-118) instructs the United States Government to "promote the development and utilization of light capital technologies, otherwise known as intermediate, appropriate, or village technologies. . ." through its participation in the International Bank for Reconstruction and Development, the International Development Association, the International Finance Corporation, the Inter-American Development Bank, the African Development Fund, and the Asian Development Bank. The legislation also requires annual reports by the Secretary of the Treasury on U.S. efforts to carry out this provision. The first such report to the Congress pursuant to this law was submitted on April 3, 1978.

These two laws, in combination with section 101 of the International Development and Food Assistance Act of 1978, which (as described above) states as policy that U.S. assistance activities emphasize the use of appropriate technology to assist the poor in the LDCs, serve to institutionalize the AT concept by mandating its inclusion in policy and decisionmaking.

CHAPTER FOUR: GOVERNMENT PROGRAMS AND COORDINATION RELATING TO APPROPRIATE TECHNOLOGY AND TECHNICAL ASSISTANCE FOR THE DEVELOPING COUNTRIES*

The congressional interest in appropriate technology and its characteristics as demonstrated by the "New Directions" legislation and the subsequent public laws relating to AT is reflected to some extent in the operation of international programs in the executive branch departments and agencies. Appropriate technology considerations, as defined here, have been incorporated into the relevant activities of agencies involved in providing technical assistance to the LDCs. Most programs are not specifically directed toward AT; instead they integrate the concepts associated with appropriate technology in their decisionmaking and assistance processes. The extent of this commitment differs dependent on various factors discussed below.

I. PROGRAM RESPONSIBILITIES

The ability to integrate AT concepts into governmental program operations is influenced by the legislative authority under which the department or agency conducts international technical assistance programs for the developing countries. The responsibilities differ among the several agencies of the Federal Government, and generally fall into two categories: (1) departments and agencies which have primarily international responsibilities and (2) those which are essentially domestic in orientation but provide assistance in the international endeavor at the request of another agency. These categories are not mutually exclusive and some departments, including the Department of Agriculture and the Department of Health, Education, and Welfare have responsibilities within both areas.

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*The information in this section is derived from department and agency responses to an AT questionnaire (dated October 3, 1978), the House Science and Technology Committee's AT hearings, and interviews with knowledgeable officials.

The Agency for International Development has primary responsibility for furnishing technical assistance to the developing world. AID operates under the provisions of the Foreign Assistance Act of 1961 (as amended) which specifies those areas in which the agency is to concentrate its activities, which include: (1) food and nutrition; (2) population planning and health; and (3) education and human resources development. The Agency is also authorized to furnish assistance in other areas, including housing, energy, environment, urban development, and science and technology. In carrying out this mandate, AID draws upon its own resources as well as those of other Federal departments, including the domestic mission agencies. As will be discussed below, the Agency funds most of the AT and other technical assistance programs for the LDCs through other Federal departments.

The concept of appropriate technology has been incorporated into many of the programs and projects of AID. According to the testimony of Dr. Sander Levin, Assistant Administrator of AID, given at the hearings of the Subcommittee on Domestic and International Scientific Planning, Analysis and Cooperation of the House Science and Technology Committee,

> . . . the application of the full concept of appropriate technology to the development process fits the AID strategy of addressing the basic needs of the poorer segments of the population while promoting equitable economic growth. 37/

He continued that

> . . . nearly all of the Agency's technical assistance is intended to meet the criteria of appropriate technology. The rate of introduction of the appropriate technology concept into AID projects has been accelerating so that it now permeates all programatic planning. 38/

37/ U.S. Congress. House. Committee on Science and Technology, op. cit., p. 326

38/ Ibid., p. 332.

Accordingly, the Appropriate Technology Liaison Office was responsible for writing and implementing the proposal mandated by P.L. 94-161, the International Development and Food Assistance Act of 1975, which created Appropriate Technology International. This Office reported directly to the Assistant Administrator of the Technical Assistance Bureau until the fall of 1977 when the Bureau was reorganized into the Development Support Bureau. Appropriate technology responsibility was then placed within AID's Office of Science and Technology.

In addition to the AT orientation of various AID projects, the Agency is in the process of implementing appropriate technology programs in various missions in Latin America, Africa, and Asia. The purpose of these projects is to develop dissemination methods for appropriate technologies and to develop techniques to improve acceptance and utilization of these products and processes. The major responsibility for program operations resides in the mission director. Washington's function is to provide guidelines, policy, liaison, and information dissemination.

Other Federal departments and agencies have mandates to provide technical assistance to the developing nations. The Peace Corps, as one such agency, has been active in appropriate technology since its inception in 1961. Due to the basic nature of the Corps mission of assistance to developing nations at the village level, the volunteers have had to adapt and modify technologies, approaches, and processes in the course of their jobs. Peace Corps personnel integrate themselves into the language and culture of their host country and consequently are forced to cope with the everyday problems of development. By utilizing local resources and and addressing local needs, the volunteers implement technologies suitsuitable to a specific time and place.

In the past three years, the Peace Corps has made an effort to collect information on field-tested technologies. As a result, a series of manuals have been issued which are used by development organizations and local groups throughout the world. The Information Collection and Exchange Office in the Office of Programming and Training Coordination serves as a resource base and clearinghouse for technical support in appropriate technology. In addition, the Corps, under the sponsorship of the Overseas Development Council, is beginning a world-wide energy survey to determine the real needs in the LDCs based upon the experience of persons involved in the day-today energy utilization patterns of these countries.

Of concern to the Peace Corps is the prevailing concept of what the organizaton is. In order to become more effectively involved in appropriate technology and LDC development activities, the Corps believes that it must be viewed as more than just a volunteer-sending organization with a yearly budget which reflects the costs of recruiting, programming, training, and the transportation of volunteers. Instead, they want to become an "appropriate development" agency which can integrate voluntary action and appropriate technology and provide technical assistance on the village level in the developing world. 39/

Both the Department of Energy and the Department of Agriculture have specific legislative authority to work with the developing countries. DOE's Office of International Affairs provides decisionmaking on energy assistance programs and activities for the LDCs, although there are jurisdictional conflicts with the Agency for International Development arising from ambiguous legislative requirements (see Chapter Three, section II, U.S. Legislative

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39/ Ibid, p. 400-401.

Initiatives for AT). At this time, the Office is working in Egypt and Peru to develop country-specific energy technologies for application on a country-by-country basis, utilizing energy assessments to determine the appropriateness of the technological alternatives. Teams of specialists from various program areas within DOE have been created and sent to conduct evaluations and make recommendations for action. It should be noted, however, that there has been criticism of this Office in terms of their commitment to appropriate technology. Testimony presented at the House Science and Technology hearings on AT indicated that the major portion of the work conducted by the DOE LDC Program Office involves non-nuclear technologies which are fairly sophisticated rather than what is generally considered appropriate technology. 40/

In order to develop alternative options for expediting the commercialization and/or export of solar energy technologies, the Department of Energy has established a Solar Commercialization Program. In conjunction with this endeavor, an International Solar Commercialization Working Group was formed to deal with the issues associated with the international export and marketing of solar technology. The ideas being studied have application to the transfer and use of alternative energy technologies in the developing nations.

The Domestic Policy Review of Solar Energy was initiated by President Carter on Sun Day, May 3, 1978, to formulate policy options and recommendations for development and economic utilization of solar energy technology for both the short- and long-term. Conducted at the Cabinet level and chaired by the Secretary of Energy, the review was prepared for use in

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40/ Ibid., 378-382.

formulating the fiscal year 1980 U.S. budget and in 1979 legislative activiities.

To carry out the review, an intergovernmental task force was created which involved approximately 30 Government departments and agencies. Six interagency panels were organized to address the several aspects of the problem: Research, Development, and Demonstration; Financial and Economic Incentives; Institutional Barriers and Incentives; International Activities; Federal Operations; and Impacts of Solar Technologies. Twelve public forums, as well as briefings by representatives of industry, labor, utilities, advocacy groups, the financial community, public interest and consumer groups, architects, builders, and technical specialists were held.

The International Activities Panel published its report in October 1978. 41/ In it were discussed existing Federal programs for international solar energy, legislative authority of these activities, existing policies, and an assessment of major programs for solar energy. The report also identified and delineated various options for commercialization and cooperation with the developing world in terms of the provision of solar energy technologies.

Additional assistance is available in other program areas within DOE, although not specifically directed toward the developing nations. Of major interest is the Small Grants Program for Appropriate Technology which, while domestic in orientation, can provide valuable information of applicable small-scale energy technologies which use renewable resources. Other programs in solar, geothermal, and wind energies may be of interest and are potentially applicable within the LDCs. It is expected that the LDC Program Office will coordinate and utilize the information obtained through these efforts in providing technical resources for development.

41/ U.S. Department of Energy. Domestic Policy Review of Solar Energy. Washington, October 1978.

The Department of Agriculture works with the Agency for International Development in many of its programs and in others it collaborates with the host country on decisionmaking. According to Dr. Quentin West, Special Assistant for International Scientific and Technical Cooperation, the Department has

> . . . long believed that economic development in many countries depends largely on progress in rural and agricultural sectors, where most of the people reside and where the most employment opportunities exists. The rate of progress has depended to a considerable extent on the scientific skill (theoretical knowledge base) and technological skill (ability to apply science to development problems) existing in these countries. The quantity and quality of existing skills varies markedly from country to country. Appropriate matching of technology programs to the particular needs and abilities will continue to be a foremost challenge. 42/

In conjunction with efforts to encourage agricultural development through application of appropriate technologies, USDA has provided for direct technical assistance and information dissemination in the developing world. The Office of International Cooperation and Development is responsible for a major portion of these various activities which include training, information, and technical assistance in the areas of food production, land and water management, nutrition, marketing, forestry, energy, and financial planning. In fiscal year 1978, more than 600 USDA and university specialists participated in these programs. 43/ Training for skill development, management expertise, and basic information was provided through the International Training Office. These activities are funded out of the Department of Agriculture budget or on a reimbursable basis from the Agency for International Development.

42/ Ibid., p. 409.

43/ Department of Agriculture response to Appropriate Technology questionnaire, dated Nov. 20, 1978, p. 1.

The Department of Health, Education, and Welfare has numerous programs which provide for technical assistance to the developing world. Many of these programs are conducted in conjunction with the Agency for International Development which provides extensive funding. Overall coordination of the Department's international program is the responsibility of the Office of International Health. Many of the agencies and services which comprise HEW have statutory authority to provide technical assistance and information in the international endeavor. Although there are no specific appropriate technology programs, the Department maintains that it integrates the AT concept into its decisionmaking process.

The Department of State provides direction for the U.S. international endeavor. It has responsibility for coordinating the international efforts on behalf of the Federal Government, for formulating foreign policy to serve as a guideline for the international activities of the other departments and agencies, and for U.S. participation in international organizations. According to the provisions of the International Development and Food Assistance Act of 1978, the State Department is responsible for ensuring that U.S. development activities must emphasize the effective involvement of the poor in development by "...increasing labor-intensive production and the use of appropriate technology." This law also requires that U.S. policy (provided by the Department of State) emphasize use of the small-scale, cost-saving, labor-intensive technologies for the small farmer, the small businessman, and the poor. In addition, P.L. 95-105, the fiscal year 1978 Foreign Relations Authorization Act, requires that the State Department emphasize appropriate technology in its preparations for the United Nations Conference on Science and Technology for Development. As a consequence, the Department has undertaken several

initiatives to apply appropriate technology in scientific and technological cooperation programs with developing countries.

Other Federal departments and agencies have primarily domestic mission responsibilities and only participate in the international arena at the request of another government agency, generally the Agency for International Development. These Federal units thus operate in the international field in a responsive manner and rely on guidance from the Department of State, AID, or other agencies. These international activities are generally extensions of domestic programs and are funded by the requesting organization.

The Department of Commerce has no specific mandate or budget to provide technical assistance to the developing world, but it works in cooperation with AID and other international funding agencies to use the capabilities of the Department on behalf of the LDCs. As such, the Department has two programs of technical assistance for the developing nations which, while not specifically devoted to appropriate technology, nonetheless involve related activities. These two programs are operated on funds provided by the Agency for International Development.

One of these programs, in the Office of International Relations of the National Bureau of Standards (NBS), is designed to teach standardization and measurement technologies as well as production and quality control techniques in order to develop some of the know-how necessary for building a technological infrastructure. While the emphasis is on standardization, the Office will respond to special requests for assistance in other areas. In addition to holding seminars and meetings and acting in an advisory capacity, NBS is currently conducting eight surveys to help develop manufacturing and industrial standards in the LDCs. As part of this program, teams of specialists are organized to meet a

specific request from a developing country or to conduct an assessment of that country's technical needs and opportunities. In addition to NBS personnel, experts from other agencies can be involved. Rounding out the team may be members from other developed countries who have themselves dealt with problems similar to those of LDCs. The participating agencies pay the salaries of their employees for the duration of a project while NBS pays per diem, travel, and other expenses. The success of the program has depended on the cooperation and willingness of the participating departments.

The second Department of Commerce program is in the National Technical Information Service (NTIS). It is a program of scientific and technical information transfer funded, in part, by the Agency for International Development. This effort is organized around local, LDC-based cooperating agencies which receive, disseminate, and contribute to the information supplied by the NTIS network located in the United States. Materials supplied on a voluntary basis by approximately 400 Government agencies, research institutes, universities, and private businesses are organized into packages designed to the user's specification. A special publication was issued containing selected appropriate technologies for the developing countries. 44/ NTIS will also train personnel in these cooperating agencies in information analysis, production, dissemination, processing, and networking. Country seminars sponsored by the Service acquaint potential users in the LDCs with available information resources.

In countries where there are no cooperating agencies, a monthly publication, "Application of Modern Technologies to International Development," (AMTID) is mailed to potential technical information users. AMTID contains abstracts of

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44/ U.S. Department of Commerce. National Technical Information Service. Selected Appropriate Technologies for Developing Countries. Washington, 1979.

selected NTIS offerings which are available for purchase at U.S. user prices with the Agency for International Development covering the costs of air mail.

Currently, NTIS is operating two roughly parallel programs which differ mainly in their geographical orientation. One program is funded by the Latin American Bureau within the Agency for International Development and deals with Latin America and the Caribbean. A program funded by AID's Office of Science and Technology services the remaining LDCs throughout the world. In addition to these activities, the Latin American Bureau has established four regional computerized information retrevial networks which translate NTIS material into Spanish and which have accumulated documents through the Service specifically tailored to the needs of the rural poor.

Other departments are also involved in technical assistance programs relevant to appropriate technology as a consequence of a request from another, internationally-oriented agency. The Department of Housing and Urban Development has not had a program of technical assistance for the LDCs since 1973, but it will undertake certain activities at the request of, and in cooperation with, the Department of State and other U.S. Government agencies. These projects are generally handled through HUD's domestically-oriented international information system and a small foreign visitor program.

The Environmental Protection Agency has had limited directed technology transfer experience in the LDCs but has been active in various United Nations organizations dealing with environmental problems under the guidance of the the Department of State. Also responsive to requests for assistance by the

Department of State or the Agency for International Development are the Departments of Labor and the Interior which receive funding from the requesting agency for the conduct of such activities.

In a singular position is the Treasury Department which has oversight responsibility for the multilateral development banks. Under P.L. 95-118, the International Bank for Reconstruction and Development Act, the Treasury Department is required to keep track of the activities of these international banks in terms of the promotion of appropriate technology and the alternative mechanisms for developments in the funding decisions of the banks.

II. PROGRAM INTEGRATION

The dichotomy between the primarily domestic-oriented and the international-oriented departments and agencies gives rise to the question of whether there is sufficient interaction between the relevant activities within the Federal units. In those programs which are basically domestic in focus, international activities are generally the result of a request for assistance by another organization. In these situations, integration of programs is usually achieved through the utilization of professionals and experts in the domestic areas by assigning them international responsibilities. The LDC programs within these agencies are most often extensions of activities that are being conducted for other purposes. The AT functions are adaptations of non-LDC activities designed to fulfill the domestic mission requirements. Thus, in the majority of these agencies, the same personnel participate in both the domestic and international efforts.

The primarily international agencies also utilize and benefit from domestic-international program interaction. The Agency for International Development uses domestic program personnel in other government departments, consulting firms, and private institutions who can contribute to the Agency's

foreign development responsibilities. Contacts are made with organizations which have domestic experience relevant to the international endeavor and grants have been made to universities and not-for-profit organizations to provide assistance to AID's mission.

The Department of State has exhibited an interest in program integration. In preparation for the United Nations Conference on Science and Technology for Developent in August 1979, the State Department has looked at both domestic and international programs, including those concerned with appropriate technology, to determine which can support the international activities of the conference. Among the areas of study were: health, nutrition, and population; energy, natural resources and environment; food, soil, water, and climate; industrialization and trade; employment and manpower utilization; urbanization, transportation and communications; and education and training for the science and technology infrastructure. However, it is currently unclear whether the information obtained in this endeavor will be put to use on a continuing basis for improving interagency cooperation on projects of parallel interest.

The augmentation of domestic and international coordination among and within departments would require increasing the staff and money available for providing assistance to the LDCs. Limitations on resources in the domestic area, as well as demands on staffs, reduce the time and manpower that the domestic mission agencies can apply to the international effort. Coupled with this is the lack of authority in the domestic agencies to work in the international endeavor. This limits the resources which can be applied in development programs and reduces the extent to which information obtained in pursuit of national objectives can be adapted and adopted in the LDCs. In addition, the lack of a mandate to work in this area often

results in the domestic agencies' participation in international endeavors on an ad hoc basis rather than on a continuing one in which structure can be given to supporting parallel domestic and international activities. It has been recognized that U.S. international activities benefit the Nation's domestic R&D, and vice-versa. Formalizing this relationship could produce increased knowledge and expertise in both sectors. A mandate to undertake international technology transfer and assistance, incorporating the AT concepts, could allow the domestic mission agencies to play a greater, more constructive, and continuing role in international planning.

III. BARRIERS AND INCENTIVES TO AT IN INTERNATIONAL TECHNICAL ASSISTANCE PROGRAMS

The domestic mission agencies do not all have mandates or legislative authority to conduct research and development or supply technical expertise in the international arena. When technical assistance to the LDCs is not a specific responsibility, international programs are often limited to those activities which compliment an agency's domestic efforts. In other cases, these agencies are prohibited from utilizing domestic program funds for international activities. Thus, such agencies must rely on funding from other departments or outside sources in order to conduct work related to the international effort. Given the tremendous technical resources existing in these organizations, the present limitations generally pose as a barrier to efforts toward increasing the U.S. response to the needs of the developing world.

If Congress or the executive branch decides to promote further the AT concept, and there are reasons, discussed above, which may preclude such a decision, a situation now exists where the absence of a mandate for domestic mission agenices to operate in the international arena reflects a concurrent lack of resources, both monetary and manpower, to fully operate

international technology transfer and appropriate technology programs. Demands on staff and funds already committed to domestic activities limit the time and effort which can be expended on technical assistance to the LDCs. Reliance generally must then be placed on obtaining a commitment of funds from an external source which reduces control over program planning and orientation.

The absence of authority to operate continuing programs of international technical assistance (and possibly appropriate technology programs) has created a situation where domestic mission agencies generally participate in the international endeavor on an ad hoc basis, as already mentioned. However, responding to requests from other Federal units permits neither continuity or coordination of effort within the agency nor a reliable commitment of funds. This has tended to result in a situation where information on which various agencies can make decisions concerning approaches to technical development is scarce. The lack of information on the needs and capabilities of the developing world tends to hinder a coordinated effort to address LDC issues utilizing the resources of all Federal departments.

If the Government chose to pursue a policy even more supportive of international AT, certain activities could be carried out to further involve the domestic agencies. Among the activities which could help the domestic mission agencies overcome some of the identified barriers to international appropriate technology programs and expand their role in international technical assistance are:

-- Formulation of a mandate or policy directive for domestic mission agencies to operate international programs;

-- Increased manpower resources for international activities in the domestic mission agencies;

-- Increased funding in these departments;

-- Continuity of involvement in international efforts; and

-- Improved information on which to base decisionmaking.

Following any determination to augment AT activities, a policy mandate to use domestic agencies in the international endeavor could help to free personnel and resources for appropriate technology and technical assistance in the LDCs. Increased staff and monetary resources could increase the departments' abilities to develop and implement such programs and decrease the time necessary to accomplish this. It would also lessen the reliance on outside agencies for direction and funding of international projects. Improved information on appropriate technology and the needs of the developing countries is also a potential result of increasing manpower and funding. Augmented resources could provide the necessary policy-oriented studies on the needs and capabilities of the LDCs on which to base decisions concerning appropriate technology.

IV. INTERAGENCY COORDINATION

As was noted previously, policy guidance for the international endeavor is generally provided by the Department of State. In conjunction with the developing world, the Agency for International Development also provides coordination through funding of other agencies' activities for LDCs. A portion of this effort is accomplished through the Development Coordination Committee which is made up of agencies which have operational or policy responsibilities relating to development programs. Various subcommittees have been created to deal with issues and topics within specific areas.

The departments and agencies work together through formal arrangements, including Participating Agency Service Agreements and Resource Support Service

Agreements. Most of these agreements are made between the Agency for International Development and another mission agency, where AID is funding work done by the other Federal unit.

Interagency committees, often ad hoc in nature, are also utilized as a source of coordination and communication between departments involved in similar international concerns or projects. Additional interagency cooperation is achieved through various international organizations, especially those associated with the United Nations. In preparations for the U.N. Conference on Science and Technology for Development, the Department of State undertook to identify U.S. resources which could be applicable in the LDCs. Most agencies, both domestic and international, participated to some extent in this endeavor which has been described above.

Although it is apparent that interagency coordination is taking place, there are additional considerations which could increase the scope and effectiveness of these activities. For example, expanded cooperation with the private sector and with international organizations involved in appropriate technology and development assistance may be useful in many cases. Activities in these areas could benefit the program operation at the Federal level as well as encourage the use of the private sector resources, thereby lessening the reliance on government funding and manpower. A continuous coordination function could also be implemented to supplement the present ad hoc system. An improved mechanism would be necessary to increase the role that domestic agencies play in the international technical development activities of other government agencies. An ongoing, coordinated arrangement should improve and expand the existing informal, ad hoc arrangements between technical departments. In order to accomplish

this objective, increased staff and resources would be necessary to ensure continuity. A legislated mandate or policy directive, broadened programmatic responsibilities, or improved interagency funding mechanisms for LDC activities concerning the domestic mission agencies could allow for a larger role in international policy formulation and less emphasis on participation on an "as needed" basis as defined by another agency.

CHAPTER FIVE: CONCLUDING OBSERVATIONS

Economic development in the developing world has traditionally been patterned after the industrialization of the West. The LDCs have relied on the importation of technologies, many of them sophisticated, to ensure modernization. However, this has generally occurred without the economic, social, or technical context necessary to fully integrate these advanced products and processes into the economy and thus derive the full benefits of industrialization. The "technological infrastructure"--the underlying foundation of technical knowledge, know-how, and organization--which provides the material and intellectual base for indigenous research, development, and implementation is absent. A developed infrastructure is necessary to allow and encourage local innovation to support and sustain long-term growth through the development of new products and processes designed to meet the technical needs of each LDC.

Though there have been a number of successes, the transfer of advanced technologies to the developing world has not been successful in alleviating all the problems of economic growth and development. The movement of sophisticated technology without accompanying support networks, economies of scale, skilled labor, trained technicians, or an innovative population, has not resulted in a secure growth process as was hoped for under the "trickle down" theory on which prior U.S. technical assistance activities were founded. Much has been learned from the experience of 25 years in development assistance and some ideas have changed while technology transfer continues to be recognized as a vital factor in the economic development of the LDCs. Technology transfer provides the means by which the developing nations can acquire technologies without extensive research and development. But, it is being recognized that for a technology or technological process to be effectively

transferred, innovation and adaptation are required to integrate it into the unique environment within each developing nation. Development necessitates self-sustaining growth--the ability to institute changes and adaptations as situations, needs, and demands change over time. Local entrepreneurs and innovators are crucial to the sustained development of technologies which use domestic resources and which are suited to the local environment.

The AT concept has evolved in response to the increasing awareness of the special environments and needs of the LDCs. Appropriate technologies are those technologies introduced to, or developed within, a nation that are designed to complement its indigenous resources, technical skills, and needs. These are generally small-scale technologies which utilize local materials, are labor-intensive, and are easy and inexpensive to operate and maintain. Recognition of the AT concept developed as U.S. assistance efforts with recipient governments proved insufficient to meet the needs of the major segments of the population in many LCDs. A new strategy evolved which emphasized technical assistance to meet the "basic human needs" of the world's poor. This new direction in U.S. policy was mandated in the Foreign Assistance Act of 1973 which established a bilateral aid program designed to (1) concentrate on technical assistance, agriculture, and industrial goods which meet critical development problems rather than on large-scale technology transfers, and (2) concentrate on critical problems which affect the lives of the majority of the LDC population.

The "basic human needs" strategy and the Foreign Assistance Act of 1973 gave legitimacy to the concept of AT and provided for its eventual role in the U.S. development program. The provisions largely defined the basic characteristics of appropriate technology and made their

integration into development assistance mandatory. While not specifically employing the term "appropriate technogy," the fulfillment of these legislative requirements would, by definition, include many of the factors associated with AT.

Appropriate technlogy offers one mechanism to meet the objective of the current U.S. development strategy. The role of the AT program is to develop, transfer, adapt, and/or utilize technologies to meet "basic human needs." This can be accomplished by increasing employment through labor-intensive production and the use of labor-intensive technologies on the farm and in the cities. The use of these types of products and processes, with selection for easy operation and maintenance and small investment costs, expands the population able to utilize technology. The use of indigenous renewable energy sources, for example, can decrease many costs of operation while lessening dependence on foreign energy supplies and drains on capital reserves. The adaptability of appropriate technology increases its utility in addressing local needs. And finally, AT provides a choice of technologies or processes to achieve the programmatic goals both of U.S. technical assistance and of the developing nations.

Appropriate technology is not necessarily a panacea for development problems. Critics indicate that there are various limitations to the idea of AT when its definition is restricted to the concept of small-scale, labor-intensive technologies rather than a mix of technological sophistication. The decentralized nature of the endeavor, the reliance on unskilled labor, and the small amounts of goods produced generally preclude the development of large domestic and international markets for the products. Often, small-scale, labor intensive manufacturing is not as economically efficient as capital-intensive production

which utilizes resources to provide the maximum output in the shortest amount of time. Complicating these factors is the situation in the developing world where labor and production management skills are in short supply. Taken together, there is an argument against the implementation of small-scale technology, or the exclusion of advanced technology, in the LDC that must be acknowledged.

However, the role of appropriate technology has been expanded in various laws which require U.S. assistance to developing countries to emphasize small-scale, renewable energy technologies which are decentralized and meet the needs of the poor. Other legislation, including the International Development and Food Assistance Act of 1978, mandate that U.S. policy for the LDCs must emphasize small-scale, labor-intensive, appropriate technologies.

Although the legislative basis exists for the integration of the appropriate technology concept into U.S. development efforts, there is concern whether or not AT ideas are being incorporated into the assistance activites of the Federal departments and agencies which administer these programs and whether or not they should be. While there still are few programs which specifically use the title of appropriate technology, many of the technical assistance efforts integrate the factors associated with AT into their operations and stress the consideration of alternative choices of technology when making decisions or policy. The viability of the appropriate technology concept is generally recognized where it encompasses the idea of choice and the understanding that advanced, as well as small-scale technologies, are "appropriate" in certain circumstances.

While the role of AT in U.S. development strategy has been generally defined by legislation and practices, it is a dynamic role which would be expected to evolve as the U.S. relationship to the developing world is modified and as U.S. technical assistance activities progress.

BIBLIOGRAPHY

Amin, Galal A. Dependent Development. Alternatives, v.2, December 1976: 379-403.

Appropriate technologies in civil engineering works in developing countries: an explanatory appraisal of the state of the art. New York, United Nations, 1976. 64 p.

Askin, Peter W. Intermediate technology: an informal study. Washington, D.C., U.S. Department of State, Senior Seminar on Foreign Policy, 1975-1976. 59 p.

Balogh, Thomas. Failures in the strategy against poverty. World development, v.6, Jan. 1978: 11-12.

Brooks, Harvey. National science policy and technology transfer. In Technology Transfer and Innovations. Washington, U.S. Govt. Print. Off., NSF 67-5, 1967.

Brown, Norman L. and James W. Howe. Solar energy for village development. Science, v. 199, Feb. 10, 1978: 651-657.

Bybczynski, Witold. After appropriate technology. Paper presented to the American Academy for the Advancement of Science, 15 Feb. 1978.

Charles, Kollpillai J. The Third World's struggle to use people power. The futurist, v.8, December 1975: pp. 285-286, 291-292.

Church, George J. The case for a global marshall plan. Time, v. 111, June 12, 1978: 77-78.

Cunningham, George. Splendours and miseries of aid agencies. Ceres, v.9, July-August, 1976: 29-31.

Dickson, David. The politices of alternative technology. New York, Universe Books, 1974. 224 p.

Dunkerley, Harold B. The choice of appropriate technologies. Finance and development, v. 14, September 1977: 36-39.

Eckaus, Richard S. Appropriate technologies for developing countries. Washington, National Academy of Sciences, 1977. 140 p.

Egea, Alejandro Nadal. Multinational corporations in the operation and ideology of international transfer of technology. Studies in comparative international development, v. 10, Spring 1975: 11-29.

Ellis, William. AT: The quiet revolution. Bulletin of the atomic scientists, v. 33, November 1977: 25-29.

Goulet, Denis. The uncertain promise. New York, IDOC/North America, 1977. 320 p.

Grant, James. Development: the end of trickle down? Foreign policy, v. 12. Fall 1973: 43-65.

Harrison, Paul. Inappropriate AT. New scientist, v. 71, July 29, 1976: 236-237.

Helleiner, G.K. The role of multinational corporations in the less developed countries trade in technology. World development, v.3, April 1975: 161-189.

International development: can "North" and "South" cooperate? Great decisions '78, 1978: 48-57.

Jequier, Nicolas, ed. Appropriate technology; problems and promises Paris, Organization for Economic Co-operation and Development, 1976. 344 p.

Makhijani, Arjun. Solar energy and rural development for the Third World. Bulletin of the atomic scientists, June 1976: 14-24.

Marsden, Keith. Global development strategies and the poor; alternative scenarios. International labour review, v. 117, Nov.-Dec. 1978: 675-696.

Morgan, Robert. Technology and international development: new directions needed. Chemical and engineering news, v. 55, November 14, 1977: 31-39.

Myrdal, Gunnar. The transfer of technology to underdeveloped countries. Scientific american, v. 231, September 1974: 173-178, 180-182.

Parthasarathi, Ashok. Self-Reliance as alternative strategy for development. Alternatives, v. 2, Sept. 1976.

Pollnac, Richard B. Sociocultural factors influencing success of intermediate food technology programs. Food technology, v. 32, April 1978: 89-92.

Rothstein, Robert L. The political economy of redistribution and self-reliance. World development, v. 4, July 1976: 593-612.

Rudolph, Lloyd I. and Charles S. Lenth. Energy options: changing views from India. Bulletin of the atomic scientists, v. 34, June 3, 1978: 6-9.

Schroeder, Dennis. In search of an "appropriate" technology. International development review/focus, v. 18, 1976: 2-7.

Schumacher, Ernst F. Intermediate technology. Center magazine, v.8, Jan./Feb. 1975: 43-49.

------Small is Beautiful: economics as if people mattered. New York, Harper and Row, 1973. 290 p.

Sethna, H.N. Appropriate technology for developing countries. Indian and foreign review, v. 12, Feb. 14, 1975: 16-18.

Singer, Hans. Technologies for basic needs. Geneva, International Labour Office, 1977. 168 p.

----- Transfer of technology in LDCs. Intereconomics,v.1, January 1974: 14-17.

Streeten, Paul. Changing perceptions of development. Challenge, v. 20, Nov.-Dec. 1977: 63-66.

----- Development ideas in historical perspective. International asienforum, v. 9, May 1978: 27-40.

Sutter, Rolf. Technology transfer into LDCs. Intereconomics, v. 12, December 1974: 380-384.

Teitel, Simon. On the concept of appropriate technology for less industrialized countries. Technological forecasting and social change, v. 11, November 1978, pp. 349-369.

Timmer, C. Peter, John Woodward Thomas, Louis T. Wells, Jr. and David Morawetz. The choice of technology in developing countries, some cautionary tales. Boston Center for International Affairs, Harvard University, 1975. 114 p.

Tonelson, Alan. Foreign aid reform. The national, v. 226, June 10, 1978: 686-689.

U.S. Congress. House of Representatives. Committee on Foreign Affairs. The reorganization of U.S. development aid. Washington, U.S. Govt. Print. Office, May 1973. 48 p. At head of title: Committee Print

U.S. Congress. House of Representatives. Committee on Foreign Affairs. House Report 93-338, to accompany H.R. 9360, 93d Congress, 1st session, Washington, U.S. Govt, Print. Off., July 20, 1973.

U.S. Congress. House. Committee on International Relations. Rethinking United States foreign policy toward the developing world. Hearings, 94th Cong., 2d sess., August 4; October 12, and November 1, 1977. Washington, U.S. Govt. Print Off., 1977. 214 p.

U.S. Congress. House. Committee on Science and Technology. Appropriate technology. Hearings. 95th Cong, 2nd sess., July 25, 26, and 27, 1978. Washington, U.S. Govt. Print Office, 1978.

U.S. Congress. Senate. International Relations Committee. Implementation of new directions in development assistance. Prepared by the Agency for International Development. Washington, Govt. Print. Off., July 22, 1975. 86 p.

U.S. Library of Congress. Congressional Research Service. A concise summary of U.S. foreign aid, by Allan Nanes and Theodore Galdi. [Washington] 1975. 21 p. (Report no. 74-121).

U.S. Library of Congress. Congressional Research Service. The impact of the United States bilateral assistance program on U.S. exports and other economic variables. [Washington] 1977. 8 p. (Report no. 77-53E).

U.S. Department of State, Special Report. U.S. initiatives for world development. No. 28, Washington, U.S. Govt. Print Off., December 1976.

Vance, Cyrus. The Secretary of State. Speech, Foreign assistance and U.S. foreign policy. May 1, 1978.

Wade, Nicholas. Third World: science and technology contribute feebly to development: Science, v. 189, Sept. 5, 1975: 770-776.

Weiss, Charles Jr., Mobilizing technology for developing countries. Science, v. 203, March 16, 1979: 1083-1089.

Yudelman, Montague. Integrated rural development projects: the bank's experience. Finance and development, v. 14, March 1977: 15-16.