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WORKSHOP ON  
THE ROLE OF APPROPRIATE APPLICATIONS OF TECHNOLOGY TO  
PROBLEMS OF DEVELOPING COUNTRIES

REPORT OF PROCEEDINGS

PREPARED UNDER IQC CONTRACT NO. PDC-1406-I-03-1096-00  
WORK ORDER NO. 3

SUBMITTED TO:

THE OFFICE OF MULTISECTORAL DEVELOPMENT  
DIRECTORATE OF HUMAN RESOURCES  
BUREAU FOR SCIENCE AND TECHNOLOGY  
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(Final Submission, December 20, 1982)

- 1 -

TABLE OF CONTENTS

|  | <u>Page</u> |
|--|-------------|
| INTRODUCTION . . . . .   | 1           |
| SUMMARY . . . . .  | 3           |
| DISCUSSION AND RECOMMENDATIONS . . . . .   | 5           |
| Credibility Issues . . . . .   | 5           |
| Institutional Issues . . . . .   | 6           |
| Technology Assessment . . . . .  | 9           |
| CONCLUSIONS . . . . .  | 11          |
| AFTERWORD . . . . .  | 12          |
| Tab A: Panel Members . . . . .   | 15          |
| Tab B: Agenda . . . . .  | 17          |
| Tab C: Recommendations in graphic form . . . . .   | 19          |
| Tab D: <u>The Current Status of Appropriate</u><br><u>Technology, final draft.</u> . . . . . | 21          |

- 2 -

## INTRODUCTION

As part of an appraisal of its activities in the field of appropriate technology, the U.S. Agency for International Development (AID) requested Development Associates, Inc., to organize and conduct a workshop to discuss the present role of appropriate technology in development assistance. The workshop was held on October 29, 1982 in the board room of the American Association for the Advancement of Science, in Washington, D.C. On October 30th, the Chairman and staff members of AID and Development Associates participated in summarizing discussions at the firm's headquarters. (The list of participants is attached as Tab A and the agenda as Tab B.)

The workshop presented an opportunity to gather together a group of people experienced in applications of technology - "appropriate technology" or "AT" - to pressing problems in developing countries. They were to discuss important issues that have arisen in the years since this approach became reasonably well-defined. The objective of the workshop was, in the short time available for discussions, (1) to examine the varieties of experience with appropriate technology, (2) to help AID to evaluate its own role in this area of development assistance, and (3) to identify institutional and policy changes that would improve the effectiveness of AT projects.

Workshop participants were provided with a draft background document that served to introduce discussion of not only the status of appropriate technology but also some of the issues surrounding the concept. (A final draft of that document, "The Current Status of Appropriate Technology," including some revisions stimulated by the discussions, is appended as Tab D.)

This report will present the results of the workshop deliberations in terms of the major issues identified and the recommendations that followed, rather than present a detailed accounting of the discussions as they occurred.

## SUMMARY

Initial discussion focussed on the incompleteness of the background document in covering AT work being done by institutions in the U.S., particularly the role being played by some universities. Regrets also were expressed that it had not been possible to examine the host of indigenous activities taking place in the developing countries themselves. There was general agreement, however, that although the survey did not cover all worldwide activity underway in appropriate technology, it depicted more than the "tip of the iceberg" in that it presented a representative picture of activity in donor nations directed toward applications in developing countries.

Considerable discussion ensued on what is meant by the term "appropriate technology," the problems frequently encountered when the term is used, and the usefulness of seeking other terminology for the concept. Most panelists expressed serious concern about implications of retaining the notion of appropriate technology as a distinct and separable category of development project, and alternative approaches were suggested.

The panel agreed that without considerably more time and effort than was available for this study it was not possible to give careful enough consideration to each of the major development sectors - energy, agriculture, water management, health, population, nutrition, industry - to arrive at a meaningful catalogue of priorities for AID's activities in these fields. It recommended that further study be given this important issue.

Furthermore, the panel noted that no institutional structure currently exists within AID to help assess proposed technological solutions to development problems.

Finally, the panel made recommendations on ways AID might improve the effectiveness of the use of technology in its development projects. Tab C presents a graphic summary of some of the recommendations.

## DISCUSSION AND RECOMMENDATIONS

The panel identified three major issues as having to be addressed by AID if appropriate applications of technology are to become not only an accepted part of design and implementation of development projects, but a much more widespread approach to problem solving on a local and national level in developing countries.

### Credibility Issues

The history of appropriate technology as a movement - social, political, and technological - has created a credibility problem within the scientific and development communities. Some technologists (scientists and engineers) on the panel were comfortable with the term, having been professionally occupied with appropriate technology for many years. Nevertheless, the panel generally agreed that there has been an aspect of advocacy about the AT movement, particularly (but not exclusively) on the part of individuals and organizations concerned with the philosophy of the approach, that has created a feeling of skepticism and hostility among many scientists and engineers on the one hand, and host-country officials on the other. Even Peace Corps volunteers, working as they do at the local level, encounter hostility to the label "appropriate technology." Thus, although some may be reluctant to abandon a label that has become familiar and has a great deal of usefulness, a different term would have significant political and psychological advantages.

Clearly, the fundamental issue is the appropriateness of the use of science and technology in projects aimed at social and economic development. The four major concerns in judging appropriateness are: 1) the use of capital, 2) the creation of employment, 3) the use of local human and material resources, and 4) the extent that the local people concerned have participated in the technological choice. Since these concerns are mutually interdependent, the appropriateness of the technological component of a project can only be judged by a critical assessment of how well it meets what may be conflicting criteria.

- Does the technological component make the best - not necessarily the least - use of capital, in view of the need for jobs and the local availability of skills and materials?

- Does it create more jobs than it eliminates? Does it displace groups (e.g., women) from traditional income-earning activities by introducing machines or processes that other groups will be trained to use? Does it involve alternative employment for those displaced?
- Does it maximize use of local skills and material resources? Would the use of imported materials increase job opportunities and income without at the same time displacing traditional product manufacture and consequently destroying traditional jobs?
- Have the people whom the project is intended to benefit participated in the decision-making process? Were they consulted regarding the choice of equipment, machines, implements, or techniques to be used? Will they be involved in replicating the approach?

In spite of the panel's consensus on the criteria by which appropriate technology should be judged, it recognized that the issue of credibility remains.

The panel therefore recommended that AID consider requesting the National Academy of Sciences to examine this issue and place the value of the appropriate-technology approach within the context of scientific and technical research and development, as well as economic and social development. The study should include identification of priority areas within the major sectors to assist AID in setting guidelines for project design.

Institutional Issues

The panel concluded that two major kinds of institutional problems inhibit the wider use of appropriate technologies in AID projects. While both are related to the credibility problem already discussed, one relates to issues internal to AID, and the other concerns external issues.

A. Internal Institutional Issues - Most of those participating in the workshop discussion, have dealt with AID on issues of appropriate technology - some from within AID, some as consultants to AID, some as representatives of other donor organizations, and some as actors in projects in the field. The combined experience shows clearly that within AID, appropriate technology is considered both a separate and a separable activity.\* As a result of the

\*See p. 1, background document (Tab C).

existence of a separate, external organization (AT International) funded by AID, whose mandate is "appropriate technology," appropriate technology has been outside the mainstream of project development. What is worse, this separation has accustomed those responsible for project development and design to think of appropriate technology as appropriate only for separately identified and funded projects.

As a result, AT is subject to the same problems that have plagued the idea of "Women in Development" (WID). The consequence of this conceptual separation for WID was that the real problems of the role of women in social and economic development and the negative impact of many development projects on the employment and status of women were subordinated to "WID projects" - projects specifically designed for women, to involve women, apart from "normal" development projects. Only since WID has become a major policy issue within AID is it beginning to take its place in the mainstream of project development and design. The process involves a monitoring office within AID that can respond to interests outside the Agency and can provide advocacy, coordination, and assistance inside the Agency.

The panel strongly recommended, therefore, that the appropriate-technology approach be "mainstreamed" by making its incorporation in the project-development and -design process a matter of AID policy. To assist in implementation of this policy, the Bureau for Science and Technology should provide technical assistance to the regional bureaus. This assistance could take the form of expert consultants or joint funding of special studies, as may be needed.

Second, the panel urged AID to establish a mechanism to improve internal communications within the agency, to help project designers to learn from experiences with AT components in projects of other regional bureaus and other donors.

Third, the panelists discussed the use, by AID, of interdisciplinary teams to assist mission staffs in assessing opportunities for appropriate applications of technology in

9

designing projects. These teams would include people with a variety of skills and experience to assist with technology identification and assessment in conjunction with expertise in the various sectors involved.

B. External Institutional Issues - While institutional changes within AID are needed to place appropriate-technology concerns in the mainstream of project development, no external institutional structure yet exists to assist AID with technical expertise for the development, use, and evaluation of proposed technological solutions to problems of development.

The panel noted that whereas concern with problems of development and issues of social and cultural change have long been accepted fields of inquiry among economists, anthropologists, sociologists, and political scientists, this has not been generally true of scientists and engineers. Thus, there are many economists, anthropologists, sociologists, and political scientists with years of field experience in developing countries who are able to provide valuable assistance to AID in project development and design. However, few engineers and scientists have a working knowledge of problems in poor rural and urban areas of developing countries, or have expertise in specific technologies and their application and use in specific field situations in LDCs.

The panel suggested, therefore, that AID consider using the provisions of Sections 106 and 107 of the Foreign Assistance Act of 1961, as amended, to create one or more centers of excellence in examining technologies/devices/implements useful for application to LDC problems.\* If such funds were made available to engineering schools on a long-term basis, a body

\*Section 106(b)(2)(d)(2) authorizes the President to furnish assistance for "programs of research into, and evaluation of, the process of economic development in less developed countries and areas, into the factors affecting the relative success and costs of development activities, and into the means, techniques, and such other aspects of development assistance as the President may determine in order to render such assistance of increasing value and benefit." Section 107(b) states: "Funds made available to carry out this chapter should be used to the extent practicable for activities in the field of appropriate technology, including support of an expanded and coordinated private effort to promote the development and dissemination of appropriate technology in developing countries."

of expertise would be developed to assist AID in development, use, and evaluation of technological approaches to problems of development. Such an approach would facilitate the use of the interdisciplinary teams mentioned earlier.

In addition to creation of external centers of excellence in appropriate technology, the panel urged improved coordination of AID's liaison with existing institutions in both the U.S. and LDCs. Specifically, the panel had in mind both public and private institutions that have (a) the ability to work with local groups at the grass-roots level, and (b) the capacity to interact with the technical community.

Technology Assessment

Running through the workshop discussions was the recurrent recognition of the need for a technology-assessment function under field conditions. There are, of course, organizations in developing countries that engage in experimental use of new devices, implements, or techniques on a pilot scale, but no coordination mechanism exists to assemble the results and integrate the experience into AID's project-development process.

The panel recommended that AID consider establishing a coordinating group that would work with the centers of excellence, AID missions in the field, and other institutions in the U.S. and elsewhere, to assemble information on how appropriate technologies function in the field. The results would be compiled in a "catalogue" of appropriate technology, continually updated as new information is required. This catalogue would be different from those already available (such as the Village Technology Handbook by VITA), because its distinctive feature would be the information on how individual concepts or schemes have functioned in the field. The collection would be a valuable working tool for the interdisciplinary teams suggested earlier and, eventually, for the missions.

## CONCLUSIONS

It is abundantly clear from the workshop discussions and the background study that the issue of appropriate technology and its role in economic development is an important one for AID consideration. Discussion of the issue is complicated by disagreement on just what is meant by the term "appropriate technology," the advocacy image that many of its proponents have, and the view of some that it is outside the mainstream of useful science and technology. Nonetheless, there was no disagreement on the criteria by which the appropriateness of a technological component of a development project should be judged - briefly:

- optimal use of capital
- employment generation
- maximum use of local resources
- local cooperation

(In view of the frequency with which the pervasive importance of energy kept recurring in the discussions, a fifth criterion, efficiency of energy use, should probably be added to the list.)

Experience in the field teaches us that we must wait a long time -- five to ten years at least -- before the benefits of an AT project can be expected to be apparent. AT projects are not massive -- they do not involve large sums of money, large amounts of machinery or equipment, or large numbers of people, at first. Instead, they are concerned with adaptation and improvement of traditional techniques, and slow introduction of new ones. "Mainstreaming" will make these approaches components of larger projects. Nevertheless, the panel agreed that it is a mistake to expect short-term results or to downgrade the value of the AT approach because short-term results are not apparent. Visible results and a palpable beneficial effect on the economy depend on the dissemination of an appropriate technology by an indigenous extension system. The importance of this must not be overlooked. As one of the panelists put it, what is needed is a cadre of "barefoot engineers" to work with villagers to hasten the spread of a successful appropriate technology. Thus, it is essential that some provision for extension and replication be built into each project.

Finally, no disagreement occurred on the point that improvement of the quality of life of people in the developing world is strongly dependent on applications of science and technology to the problems that plague them, and that many such applications have been inappropriate.

Thus, woven into the discussions and the recommendations of this workshop is a design for institutional mechanisms to assist AID in ensuring that its projects involve technologies that are appropriate to the needs, resources, and conditions of the people it is endeavoring to help, based on the conviction that science and technology can be of enormous benefit to the world.

#### AFTERWORD

As a result of the shortness of time between the conclusion of the workshop and submission of the survey and the report to AID, it was not possible to incorporate reviewers' comments in either document. Nevertheless, comments were solicited and several have been received in the period since both documents were first submitted to AID. Some minor changes have been made in the survey document, as the result of suggestions received. To the extent that changes, additions or amplifications were suggested in the report, however, I shall summarize them in this note, rather than attempt to rewrite the report.

Although in my view and that of the chairman, the report represents a consensus of a variety of comments and opinions expressed during the workshop discussions, some panelists felt the need to clarify their points of view or express their differences with the consensus.

Two of the panelists, (Drs. Bates and Morgan), retain reservations about the advantages of abandoning the term "appropriate technology" in favor of a term with a less controversial history - one (Dr. Morgan) pointing out, quite rightly, that such a decision should certainly be preceded by examination of the desirability of any suggested alternative. Dr. Bates felt that the best way to "enhance the stature" of the term would be to document some clear cut success stories illustrating the value of AT as a "mainstreamed" strategy in AID projects. However, in view of the fact that it is precisely this "mainstreaming" that is lacking in AID's current approach to project development (as noted in the

discussion on pages 6 and 7) thus an evaluation of the impact of AT mainstreaming must await further development.

There was some comment on the criteria for appropriateness as discussed on pages 5 and 6. Dr. Bates feels that there should be more explicit emphasis on "enhanced self-sufficiency," although I feel this concept is implicit in the criteria listed. Dr. Hughes is concerned that the idea of replicability is too important to leave to the discussion in the conclusion section, and should, in addition, be included as a fifth criterion: "Does the technology lend itself to replicability of the project with local skills and resources?" Furthermore, he feels that the issue of the efficient use of energy is too important to be left unstated - a point of view with which I thoroughly agree.

Several commentators noted omissions in the survey, and to them I can only express my regrets. All omissions noted are indeed significant and are the result of deliberate decision or inadvertance on my part stemming from the tight schedule imposed for completion of this task.

Finally, one of the panelists, Dr. Robert P. Morgan, finds himself at odds with significant parts of the report. Dr. Morgan, who was unable to attend the entire workshop, feels sufficiently strongly about some of these issues that he wishes to disassociate himself from the conclusions and recommendations.

Norman L. Brown  
Project Director

December 20, 1982

Tab A: Panel Members\*

THE ROLE OF APPROPRIATE APPLICATIONS OF TECHNOLOGY  
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Tab B: Agenda

The Role of Appropriate Applications of Technology  
to Problems of Developing Countries

A Workshop on behalf of the  
Office of Multisectoral Development  
Directorate of Human Resources  
Bureau for Science and Technology  
Agency for International Development

October 29 - 30, 1982

- October 29 - Board Room, American Association for the  
Advancement of Science, 1515 Massachusetts Avenue,  
N.W., Washington, D.C.
- October 30 - (In the event it is necessary to continue discussions)  
Development Associates, 2924 Columbia Pike, Arlington,  
Virginia.

AGENDA

October 29

- 9:00 am - Welcome and Introduction of Chairman  
- Introduction of Participants  
- Opening Statement - Ms. Ruth Zagorin  
Agency Director, Directorate of Human Resources, AID  
- Administrative announcement
- 9:15 - Discussion of background document:  
Is this an accurate picture of the state of appropriate  
technology activities among the donor countries?
- 10:15-10:30 - Coffee break
- 10:30-12:30 - Demands/Needs:  
a. What kinds of demands for technology are being  
made by LDCs?  
b. How do these demands (i.e., perceived  
needs) compare with identified needs?
- 12:30- 1:30 - Working Lunch  
(Lunch will be brought in and served in the meeting  
room)

18-  
1:30-3:30

- Continuation of morning discussion as needed

Discussion of identified needs in terms of:

- a. The need to encourage the use of technologies/  
devices/systems already developed;
- b. The need to develop new technologies/devices/  
systems to solve urgent problems;
- c. The need to facilitate exchange of information  
among LDCs ("TCDC") and between LDCs and donor  
agencies.

How is the resultant matrix affected by concerns  
of national policy and scale of activity?

3:30-5:00

- Agenda for future action by AID:

- a. What are the gaps in the technologies with which  
AID and other donor agencies are assisting  
LDCs?
- b. What priorities should AID establish in deciding  
how best to allocate funds for applications of  
technology to development?

The panel recommended that AID establish an internal mechanism to ensure that the appropriate technology approach is brought into the mainstream of the AID project development process. It also recommended that a coordination, monitoring, and information function be created within AID to minimize duplication of effort and conflicts in planning and ensure that the benefits of experience in the field will be widely disseminated throughout the agency.

Figure 1 illustrates how these functions might be carried out through a special Office of Appropriate (or Applied) Technology.

FIGURE 1  
LINKAGES AND FUNCTIONS OF THE PROPOSED OFFICE OF APPLIED TECHNOLOGY

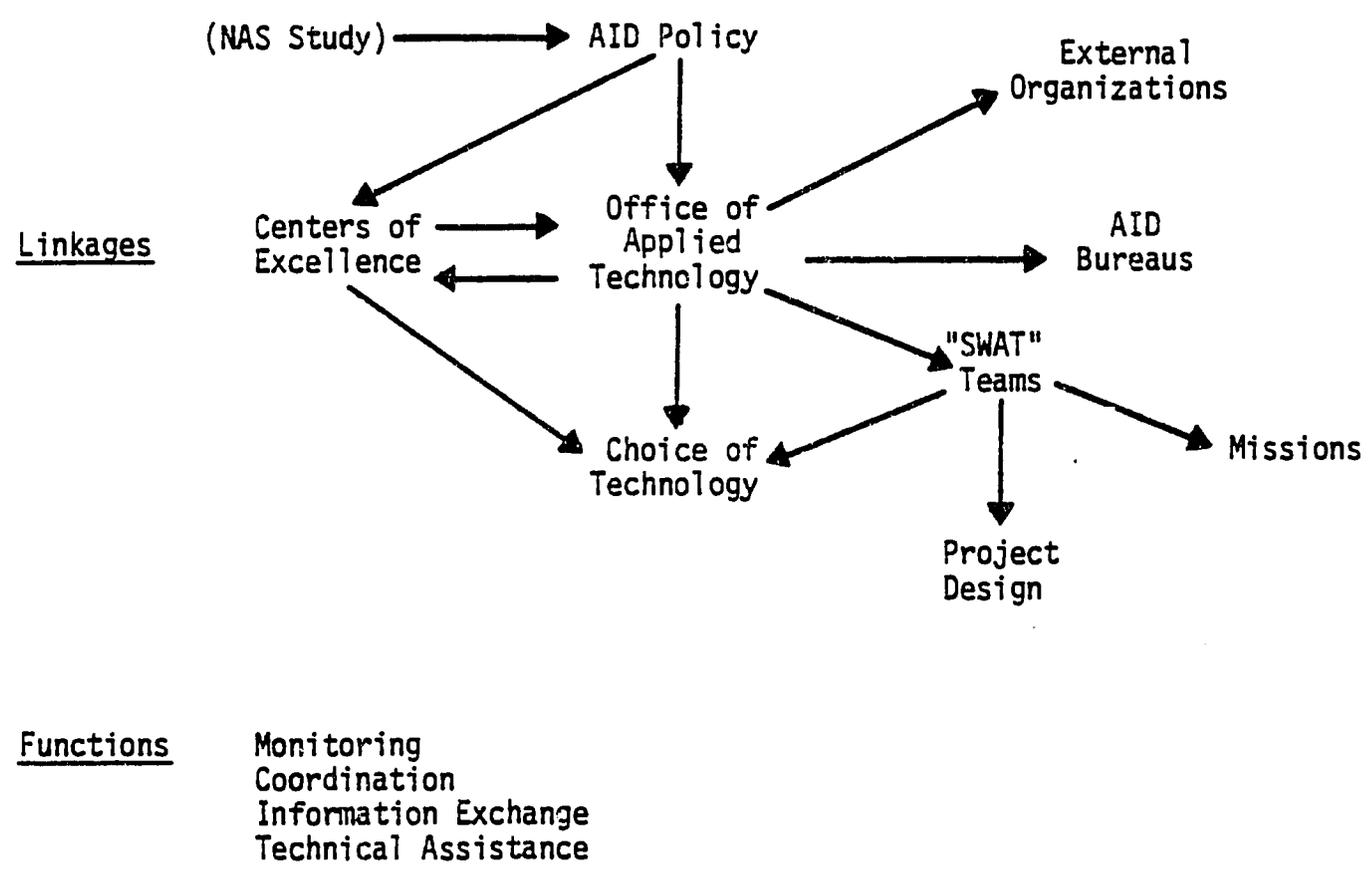
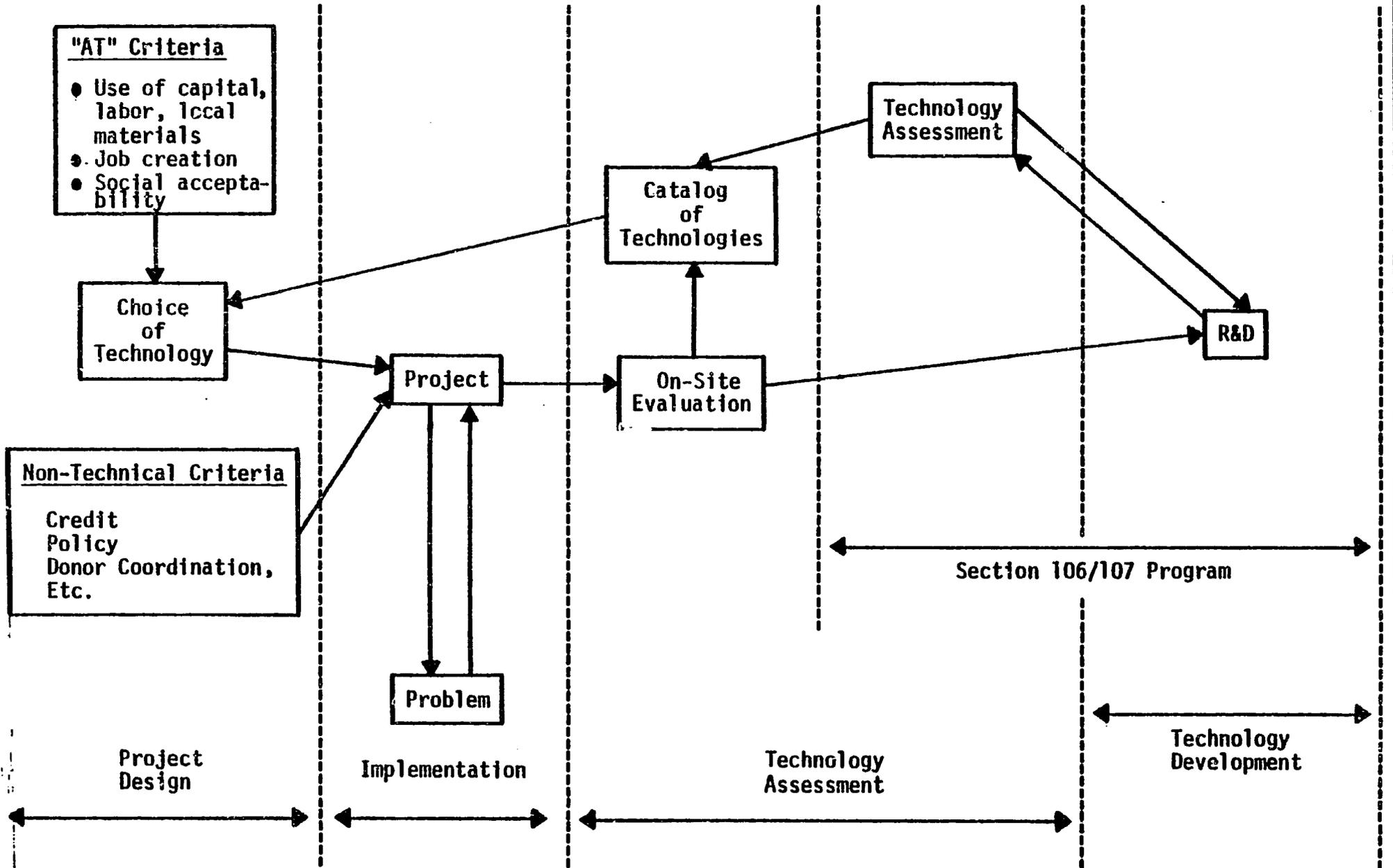


Figure 2 illustrates the contribution to the design process of a strengthened technology-assessment function.

FIGURE 2  
THE ROLE OF TECHNOLOGY ASSESSMENT IN PROJECT DESIGN



THE CURRENT STATUS  
OF APPROPRIATE TECHNOLOGY

Prepared Under IQC Contract No. PDC-1406-I-03-1096-00  
Work Order No. 3

Submitted To:

Office of Multisectoral Development  
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Agency for International Development  
Washington, D.C.

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November 1982

## TABLE OF CONTENTS

|  | <u>Page</u> |
|--|-------------|
| ACKNOWLEDGEMENTS . . . . .                           | i           |
| INTRODUCTION . . . . .                               | 1           |
| Discussion of Issues . . . . .                       | 3           |
| AT Activities Aimed at Developing Countries. . . . . | 8           |
| Activities in the U.S. . . . .                       | 8           |
| Activities in Other Donor Countries. . . . .         | 15          |
| Australia . . . . .                                  | 15          |
| Belgium . . . . .                                    | 16          |
| Canada . . . . .                                     | 16          |
| France . . . . .                                     | 19          |
| Germany . . . . .                                    | 25          |
| Israel. . . . .                                      | 27          |
| Italy . . . . .                                      | 28          |
| Netherlands . . . . .                                | 28          |
| Sweden. . . . .                                      | 32          |
| Switzerland . . . . .                                | 33          |
| United Kingdon. . . . .                              | 36          |
| Multilateral Organizations . . . . .                 | 38          |
| Conclusion . . . . .                                 | 43          |
| References . . . . .                                 | 45          |
| Appendix 1: List of Contacts. . . . .                | 47          |
| Appendix 2: Supplemental Publications . . . . .      | 55          |

## ACKNOWLEDGEMENTS

The information in this report came from a variety of sources -- personal interviews, telephone interviews, and published documents. Many people were most generous with their time, giving information and advice, and several put up with more than one contact as additional information was sought or old information verified. All of those contacted are listed in Appendix 1, but some should be singled out for particular thanks.

Dr. Charles Weiss, Science and Technology Advisor to the World Bank, has been particularly cooperative, not only in personal discussions, but in making available the time of his staff. Christopher Hennin deserves special thanks for lending valuable materials for the use of this exercise and showing forbearance to tardy borrowers.

Tom Lawand of the Brace Research Institute took time between trips to Africa to provide a fund of information, and Lewis Perinbam, Vice President of CIDA, took time from his busy schedule to provide valuable advice and suggestions.

Finally, for assistance in gathering information, thanks are due not only to Blair Rudes but also to Barbara Longley MacGregor without whose skill and cooperation all the details in finishing a report and arranging a workshop might never have been completed.

## INTRODUCTION

The Agency for International Development (AID) has embarked on an inquiry into the current role of "appropriate technology" in development-assistance programs. This inquiry is designed to establish the essentials of what is being done, where it is being done, why it is being done, and what should be done instead. This report is meant to be a preliminary look at what is being done, by whom, and where. It is not certain that an accurate answer can be obtained in most cases to the question of why appropriate technology is being done. Ideally the answer to, "Why?" would be, "Because there was an urgent need to solve a problem and this approach was chosen above all others because it was most appropriate." However, a truly responsive answer is never this simple. The real reasons, often obscured, frequently involve bureaucratic imperatives -- self-imposed deadlines, desires to commit funds while they are still available, familiarity of program officers with particular technologies and lack of familiarity with others -- and politics -- exigencies of national policy. Thus, this question is not addressed in this report.

At the outset, it should be noted that the major U.S. actor in this field has not been included in this survey because of the time constraints. That actor is AID itself. Project officers who are queried on this issue initially deny any appropriate-technology activity of their bureaus - except for specific projects or evaluations, such as those dealing with AT International, or the occasional study performed on the subject. Closer, detailed questioning, however, in specific sectors - agriculture and rural development, health, nutrition - generally results in the acknowledgement that rural construction, irrigation systems, seed-improvement projects, nutrition projects based on new foods or ways of processing them, forestry projects, education projects, all involve some technologies, equipment, or machinery, and some of these may actually be considered "appropriate." Only energy projects seem to be straightforwardly acknowledged as involving technologies. Thus, while an initial attempt was made to canvass the regional bureaus to gain a picture of the role of appropriate technology in AID's programs, it soon became apparent that the cursory look that could be given in the time available would not do justice to the issue. AID

would very likely benefit from an examination of its project portfolio, from the point of view of what technologies, techniques, and equipment are involved - directly or by tacit assumption - and why. Then, AID could grapple with the more serious question of whether and how projects could be improved by incorporating this awareness of the role of technology in the design process.

It was not possible for this study of appropriate technology activities to be either exhaustive or definitive, because of the time constraints imposed. Rather, an attempt was made to survey some of the major actors in the field, in both the United States and other donor nations. Unfortunately, there has not been sufficient time to receive responses from the major organizations in developing countries involved in appropriate technology activities, or to evaluate and sift the information available here in the U.S. This is another area where further study would be useful to AID. The information included in this study came from three major sources: personal and written reports of people personally involved in such activities in the field; personal and written reports of people responsible for funding or managing projects devoted to field activities; and, personal and written reports of people acquainted with what others are doing. While many organizations and individuals were not contacted, or did not respond within the time available, the combined sources have provided enough information to give a reasonable picture of current activities and trends in appropriate applications of technology.

## Discussion of Issues

Any discussion of "appropriate technology" (or "AT," as its practitioners\* are want to call it) almost necessarily begins with a definition of the term. A reasonably straightforward definition is that it means no more nor less than just that, technology that is appropriate to the needs, human and material resources, and social and economic conditions of the people for whom it is intended. However, even this straightforward definition founders on the meaning of the words "technology" and "appropriate."

To the scientist and engineer ("technologists"), technology means the scientific and engineering knowledge, skills, and techniques involved in making something that is tangible and useful. Metallurgy and forging techniques comprise the "technology" that results in a hoe. Metallurgy, thermodynamics, chemistry, chemical engineering, mechanical engineering, mathematics, physics, forging techniques, and machining skills comprise the "technology" that produces an internal-combustion engine. Aerodynamics, metallurgy, physics, electrical engineering, chemistry, chemical engineering, mechanical engineering, mathematics, forging techniques, and machining skills comprise the "technology" that produces a windmill electricity generator.

The hoe, the diesel engine, the windmill generator are not technologies; they are implements, devices, machines -- the products of technologies that represent a store of accumulated human knowledge and experience.

\*It is curious that people who deal with issues of appropriate technology, particularly in the field, are termed "practitioners" rather than technologists. Engineers are engineers, chemists and physicists are chemists and physicists or scientists, economists are economists, but "appropriate" technologists are practitioners. This distinction in terminology probably reflects a perception that people who try to apply the principles of AT in their approach to solving specific problems are somehow different from other problem solvers. It stems, perhaps, from the fact that AT advocates are seen by many as preachers of a new creed. After all, one "practices" the principles of a religion or an ethical system, but one "uses" the principles of science, engineering, or economics.

The confusion is compounded because there are many who view the processes and techniques of exchanging information, organizing groups of people to perform certain activities efficiently, administration of organizations, financing production, or delivering services, for example, as technologies. This is, of course, just as valid a definition as that of the "technologist," but it is not always clear whose definition is being used in discussions.

The serious confusion, however arises out of differences in opinion as to the meaning of "appropriate," particularly where the areas of application being discussed are the developing countries.\*

"Appropriate technology," or "AT," as a subject for discussion where developing countries are concerned, has been with us for at least a decade. Widespread public discussion was sparked by the appearance of Schumacher's Small is Beautiful in the early 1970s. It was about the same time that the international development community began having serious doubts about the wisdom of the "trickle-down" theory of development and became concerned with ways of directly improving the lives of the rural and urban poor in the developing world. Thus, the time was ripe for re-thinking policies that were meant to stimulate industrialization on the western model, and to focus on the appropriateness of technological solutions to development problems -- appropriateness to the human and material resources, and the political and social conditions existing in the third world.

In spite of the time and effort that have gone into agonizing reappraisals of AT during the past decade, a focus has not yet been achieved. Appropriate technology still means different things to different people, although some fundamental positions have shifted over the decade. For some time, the spectrum of disagreement extended over a broad range of definitions. At one end there were those to whom AT meant "primitive" or simple technologies that use only locally available materials and skills to meet the daily needs of living. At the other end were industrialists and technologists who held the entire issue in great

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\*Although some note will be given to AT activities in the United States and other industrialized countries later in this report, the discussion here will focus on the "practice" of AT in the developing countries by the donor countries and multilateral organizations.

great disdain and viewed the AT proponents as unrealistic dreamers. In between, there was a wide range of definitions of appropriate technology, often with no clear demarcations between them. For some, it meant only small-scale technology. Some concentrated on "capital-saving" technology to minimize the investment of capital in employment creation. For others, it meant technology that could be controlled by the local people, with the definition of "control" often not clear. Usually, but not always, this concept coincided with smallness of scale. For others, including Schumacher himself, it meant technology intermediate between the "primitive" technologies indigenous to rural people in non-industrialized societies, and the "high" technology characteristic of the products and processes of modern industrialized societies.

Taken alone, each of these definitions is, of course, too restrictive. The "primitive" technologist who makes use of modern tools -- pliers, screwdrivers, hack saws, etc. -- and constructs useful devices out of the discards of an industrialized society -- a Savonius windmill pump from an old 55-gallon oil drum, for example -- has already diluted his argument. For the true "intermediate technologist" ("small is beautiful") the large scale of a pyramid might be disturbing and the use of a tiller driven by a small gasoline engine -- a product of very sophisticated technology and an industrialized society -- should be unthinkable. The "appropriate technologist" concerned with individual or local control is really concerned with control of the products of technology, not the technology itself. A small windmill generator and its output are amenable to local control, but the generator requires bearings, silicon-steel laminations, insulated copper wire, and a variety of other components that are the products of sophisticated engineering and manufacturing skills that have been developed by our modern industrial society. Finally, proponents of "high" technology too often lose sight of the fact that large industries and their products -- household appliances, automobiles, plastic goods, packaged processed foods -- are developments of an affluent literate society and are not appropriate for people -- the majority of the developing world's population -- who live a precarious existence between bare subsistence and life-threatening food and health-care shortages, primarily in rural areas not served by electric power grids, in countries that cannot afford to import the oil needed to support such industrialization.

28

During the past decade, widening field experience has produced an evolution in the view of AT held by many people in the development community, among both donors and recipients. While there are still some whose views haven't changed significantly, one hears more and more frequently a diversity of views that fall into four general categories. These can be described as follows:

1. The first group maintains that there is still a need to develop (or assist in the development of) technologies (= devices) to solve urgent problems.
2. The second group thinks that the real need is to facilitate the exchange of information on appropriate technologies, both between LDCs and the industrialized countries, and among LDCs themselves.
3. There is a third group, however, that believes the problem is not the need to develop technologies (= devices, implements, or systems) but the need to assist and encourage the use of those already developed.
4. Finally, the fourth group argues that we should begin to focus on dissemination in LDCs of appropriate technologies (= devices, machines, equipment) already available from western manufacturers.

Although the adherents to the former extreme positions seem to have neither hardened their stand nor increased their numbers, further progress in the useful and appropriate applications of science and technology to problems of developing countries depends on avoiding the development of rigid demarcations among the four groupings listed above, and combining the positive aspects into a coherent policy. It is particularly important to be aware of the political risks involved in the perception of a policy that reflects the stands of Groups 1 and 4, however. First, some recipient countries are sensitive to having outside experts tell them what techniques and devices they should develop (Group 1) rather than having them work with local groups and individuals to adapt and improve locally developed methods and equipment. Second, although there seems to be an almost universal desire on the part of developing countries to have and enjoy the perceived benefits of the products of a modern industrialized society, actively promoting the role of U.S.-manufactured equipment to solve problems in rural areas (Group 4) may be viewed as neo-colonialism by the intended recipients. Besides, these devices often do not function reliably, or at all, under the prevailing conditions.

By the same token, the four general categories listed are not meant to describe well defined approaches. For example, one of the major figures in India involved

in field applications of "appropriate" technologies operates from the principle that the conception, techniques, organization, design, construction, operation, and maintenance of technological systems in Indian villages are best left to Indians. No western intervention or participation is needed or desired, with the possible exception of financial support.

On the other hand, one of the principal actors in formulating AID's formal entry into the arena of appropriate technology feels that the critical issue now is the need to merge economists and "employment thinkers" with the technologists, because there are basic issues of national policy to be resolved if a country is seriously interested in developing technologies appropriate to its circumstances.

These two approaches are related in that both are expressions of the idea that technology is not the problem, but what is needed is the encouragement and use of technologies (= devices, implements, systems) already developed or at least developable by local groups. The first is expressed from the standpoint of the technologist, while the second is from the standpoint of a social scientist with extensive development experience. Further, neither would find it inconsistent to encourage the exchange of information -- indeed, the technologist participates in such exchanges as an accepted part of his profession.

Another aspect of the third-category approach noted by those with the most field experience is the need to develop the capacity within the communities being assisted to absorb and use the technologies already available. (To paraphrase the way one of the respondents put it, delivering the letter to the mailbox is not enough. The letter must be read and understood by the addressee before its contents can be acted on.) Thus, the value of information-exchange systems and computerized data bases can be realized only if the capacity to use the information also exists.

There is agreement among the principal actors in this field that a coherent policy can be based only on a flexible approach that combines elements of all four groupings and uses them selectively in each situation. If there is one principle on which all "appropriate" technologists agree, it is that no two situations are alike. To be sure, there are some who tend to generalize on the

basis of experience with similar situations, but the more experienced see generalization -- and its frequent concomitant, over-simplification -- as an almost certain guarantee of failure.

AT Activities Aimed at Developing Countries

This study was not meant to result in the compilation of a directory of individuals and organizations involved in appropriate-technology activities. It was meant, instead, to identify the major actors in the field and to establish the context within which their activities are taking place, and any trends that can be identified. Obviously, a directory of sorts would be one of the by-products of any survey of this nature. However, it could not begin to compare in size or detail with those directories to which specific resources were dedicated. For example, the 1979 OECD publication by Jéquier (Appropriate Technology Directory)<sup>(1)</sup> was such a directory. It was compiled from the 388 responses received from 680 questionnaires sent out worldwide (Table 1).

Although an update of that directory would be extremely useful, because of the uncertainty in funding experienced by a large proportion of the organizations in this field, the present effort was confined, perforce, to information obtained from contacts with a few representative and knowledgeable individuals and available reports and other documents.

Activities in the U.S.

This effort included a look at appropriate technology in the United States and other industrialized countries. Involvement in AT activities in this milieu often serves as a source of experience and training for people interested in using these approaches to solving problems in developing countries. Nevertheless, we should not lose sight of the potential risks involved in transferring U.S. experience to developing countries. As expressed in a 1979 report to AID,

" . . . it is difficult to judge the potential for service to the Third World by U.S. residents active in AT. The American AT movement has a wealth of valuable technical capabilities, yet one must be aware of the limits to their application or relevance in other cultures or other ecologies."<sup>(2)</sup>

A survey of appropriate-technology activities in the United States was published by the National Science Foundation in 1977, a companion report to the proceedings of a workshop on this subject. The survey, "Appropriate Technology -- A Directory of Activities and Projects,"<sup>(3)</sup> covered 279 individuals, private organizations (both non-profit and business) and public agencies (federal, state, and local) involved in agriculture, housing design and construction, equipment manufacture, provision of services, and information exchange. The results of the survey were somewhat circumscribed by virtue of being confined to information from those individuals and groups who responded to a questionnaire. Nevertheless, the survey presented a reasonably accurate picture of the situation at the time. It showed a preponderance of activity in energy and housing -- almost 60% of the respondents -- with the remainder about evenly divided between bio-agricultural activities on the one hand and community organization and development of skills on the other. Included in these three groups was a small number of organizations (about 10% of the total) engaged in information exchange.

Some mention should be made of the role of U.S. universities, not so much for their past or present activities in appropriate applications of technology to development problems of the urban or rural poor in developing countries, but because of their activities in contributing to the academic science and technology base of universities in LDCs. With appropriate policy decisions and support at the national level, that base could serve as a source of indigenous technological expertise to encourage the development, adaptation, and evaluation of AT approaches in developing countries.<sup>(4)</sup>

One particular type of activity in the U.S. might be worth examining in more detail. There is a host of AT projects under way within the Native American community. In many cases, these projects, which tend to emphasize the use of renewable-energy technologies, are located in villages and communities with many of the physical characteristics -- climate, geology, agricultural conditions, water supply -- of villages in which AID is involved in Asia and Africa. The opportunity for AID project officers and contractors to learn from these experiences in the U.S. might be useful. For example, the experience gained by NASA in design, installation, and training for the operation of the photovoltaic village electrical-supply system in the Shuchuli Papago village in Arizona helped in AID's project in Tangaye, Upper Volta.

Most of the organizations, institutions, and individuals in the United States working on appropriate technology are concerned with applications in the U.S. The number working on appropriate technology for LDC applications is very small, with a marked dichotomy in size - they are either relatively small, operating on private funds, or very large, funded by AID.

Among the former are the Aprovecho Institute for Appropriate Technology in Eugene, Oregon, chiefly noted for its developmental and promotional work on the lorena mud stove, an improved wood-burning cook stove. Aprovecho is a private, volunteer organization with no paid staff, where activities are divided between domestic concerns and LDC problems. Most of its consultancies in LDCs are financed by AID. Its work on the lorena mud stove, originally developed in Guatemala, has proceeded to development and improvement of a sand-clay system of stove construction.

Volunteers in Asia (VIA) is another small private organization, concerned primarily with providing volunteer services to organizations in developing countries. It was organized originally in 1963 by undergraduates at Stanford University, and began as an AT program in 1975. An important part of its activity is the publication of a variety of compendia of technologies used in LDCs, chief among which is the Appropriate Technology Source Book. VIA's funds come from contributions and sales of its publications.

VITA - Volunteers in Technical Assistance - VITA is probably the oldest actor on the US scene in the field of providing assistance in small-scale appropriate technologies to developing countries. A non-profit organization, with major funding from AID, VITA functioned originally with an unpaid staff. It was formed in 1959 (as Volunteers for International Technical Assistance, Inc.) by a group of engineers at the General Electric Company in Schenectady, NY, who recognized the importance of technology in improving the quality of life of people in the developing world. These engineers applied their professional skills to the design and testing of various devices, the need for which was known as a result of visits some of their members had made to developing countries. In the course of time, the existence of this technical service became more and more widely

known, and VITA began receiving requests for technical assistance with specific problems, to which VITA responded by sending both information and advice, and volunteers. These engineers and scientists were true volunteers since they paid their own expenses and used their vacation time to travel to developing countries and work on these problems in the field.

The roster of active volunteers now contains slightly more than 4,000 names, and is growing at a net rate of about 300/year. The system for use of volunteers has changed over the years, however, as the organization has grown and its operations have expanded. The volunteers are no longer that, in the old sense of the word; they are people with skills and expertise in certain fields who are available for short- or long-term assignments overseas, with their travel and living expenses and an honorarium or consulting fee paid by VITA. The roster also enables VITA to respond to requests from AID for people with special skills to work on AID projects -- VITA serves as a source of suggestions.

In addition, the use of the volunteers to respond by mail to requests for information and advice has diminished. The staff, now numbering between 60 and 65 mostly full-time members, includes a number of people with technical skills who can answer most requests themselves.

VITA's Village Technology Handbook is one of its earliest publications. It is a collection of designs for implements, devices, and machines that can be constructed locally from local materials or junk parts of other machines and it is still well known in developing countries. Written at the request of AID in 1963, the handbook contains fifty articles in the fields of agriculture, water supply, sanitation and health, and housing and construction "prepared to assist village workers of developing countries in making useful tools and in acquiring helpful work techniques."<sup>(5)</sup>

Village Technology Handbook remains VITA's most popular publication, with total distribution well over 10,000 and now running at about 1,500/year. However, VITA's list of publications has grown to about 100 titles, about two-thirds of which are currently being distributed.

VITA's activities have covered the following fields:

- Food technology (crop processing, food processing, crop storage)
- Water resources (wells, pumps, sanitation)
- Low-cost housing
- Agricultural implements, machinery
- Renewable energy (woodstoves, solar water heaters, biogas, windmills)
- Enterprise development

There are now eight VITA specialists stationed in the field on a variety of projects. These include projects in:

- Djibouti (AID)
- Egypt (AID)\*
- Somalia (AID)
- Guinea (AID)
- Thailand (AID)
- Rwanda (AID)
- Monserrat (Carribean Development Bank)
- Upper Volta (AID)

The major project under way at the moment is the energy project, funded through AID's Office of Energy (ST/EY). This represents some \$5 million (for a period of about five years) for a variety of services in renewable energy. (The specialist in Thailand is supported by this project.)

AT International (ATI) - Like VITA, ATI is a major non-governmental US actor in the field of appropriate technology. It differs significantly, however, in its genesis, raison d'etre, and method of operation.

ATI was created in 1977 as a private, non-profit corporation, after lengthy discussions within AID and among AID and a host of representatives of other government agencies, private consulting groups, and individuals all concerned

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\*The specialist in Egypt is a VITA volunteer being paid a living allowance only.

35

with aspects of appropriate technology. Their discussions, and the eventual decision to create the organization, were stimulated primarily by an interest in the subject on the part of the Congress. In its legislation for FY76, AID was authorized to spend up to \$20 million over a period of years (since extended) for such activity. Thus, with the exception of a minor grant from Control Data Corporation, ATI's source of funding has been AID.

The organization divides its activities into four categories:

- Business and Technology Services
- AT Extension Services
- Policy and Communications Services
- Finance and Administration

In distinction to VITA, ATI is not itself involved in development of implements, devices, or mechanisms of any kind. Its function is rather to support organizations in their "effort to overcome the constraints or do away with the blockages to the development and spread of technologies that benefit lower-income people."<sup>(6)</sup> Thus, ATI places itself firmly in the third group described in the Discussion section (p. 6), viz., it operates on the principle that the problem is not the need to develop technologies, but to assist and encourage the use of those already developed. ("Technology" in this sense, refers principally to "software" technologies, that is, management, marketing, financing, commercialization techniques, rather than the hardware technologies.)

This is amply confirmed by the kinds of grants ATI has made. Although it is difficult to categorize some grants as "hardware-" or "software-" related from their titles alone, with most of them the intent is obvious. Thus, a perusal of the list of titles of all grants made shows about 86% - both in number and proportion of total grant funds - obviously deal with "software" technology, and there is some question about the remaining 14%. On the other hand, examination of a sample of 66 of the projects showed four, possibly five grants (6-8%) made to organizations that probably had some direct involvement with hardware development.

The types of activities undertaken by ATI are illustrated by the organizational chart illustrated in Figure 1.<sup>(6)</sup>

## Activities in Other Donor Countries

Without a greater investment of time and effort than was available, it was also not possible to identify -- and cull -- a comprehensive list of individuals, organizations, and agencies in the donor countries where development-assistance activities involve aspects of appropriate technology. Some agencies identify themselves as involved with AT. With others, as with AID, it is often necessary to infer the "appropriate" technological component in activities otherwise labelled.

Using information obtained from the World Bank, previously published AT directories, interviews with selected people, and other sources, we have tentatively identified approximately 200 organizations and agencies in Canada and Europe engaged in some form of AT activity.

This does not include multilateral organizations, such as the World Bank, OECD, or the UN agencies. Nor does it include the 167 sectarian organizations almost exclusively identified as based in the U.S., but certainly functioning from some of the other donor countries as well.

Needless to say, a thorough study of this list of organizations has not been possible, but some general conclusions will be presented from information available on a representative selection.

### Australia

Only two activities have been identified in Australia that have some function with developing countries. The first, the Appropriate Technology Development Group was organized in 1976 as a private consulting group with interest particularly aimed at Southeast Asia and the South Pacific. Its source of funds is not clear, but it has dealt with development of windmills, small-scale sugar plants, biogas plants, simple appliances for the handicapped, and credit and investment procedures for small businesses.

The second is the Intermediate Technology Development Group, ITDG, which is not to be confused with the organization in London. ITDG functions in much the same

way as VITA, in providing advice and information by its volunteer members. Areas of concentration are energy, agricultural tools and equipment, and promotion of small industry.

### Belgium

Although Belgium is a steady source of technical expertise for UN agencies that fund projects in developing countries, only two organizations could be identified as playing an organizational role in AT. The first is ATOL, Appropriate Technology for Developing Countries (Angepaaste Technologie voor Ontwikkelingslanden). A non-profit organization, it is financed mainly by donations, with support also from foundations and church groups. ATOL has provided technical advice on such things as:

- solar water heaters;
- biogas;
- improved wood stoves;
- water turbines;
- windmills; and
- brickmaking.

ATOL is also one of the organizations that participated in the formation of SATIS (see Netherlands).

The Post Graduate Centre of the University of Louvain (Leuven) has been working with a low-cost housing project (Rwanda) and stabilized earth blocks and other building materials (Tunisia). It functions in these countries through the universities (presumably through collaboration at the institutional level) and PVOs.

### Canada

Canada has long been in the forefront of appropriate technology applied to developing countries' problems chiefly through the work of the Brace Research Institute. Founded in 1961 as part of McGill University, Brace has been engaged in a large number of projects that include development of prototype equipment; field work in developing countries with construction, installation, and operation of devices designed by Brace; and providing technical advice. Its activities

have long centered on uses of solar energy, for which work Brace has become well known. Other fields of activity are agricultural tools, housing, crop processing, and water, although much of the work on all but the first is intimately involved with use of solar energy. Specific projects include:

- Solar stills;
- Solar steam cooker;
- Solar water heaters;
- Windmill pumpers;
- Solar crop dryers;
- Electrical systems for windmill generators;
- Improved wood stoves;
- Heat pipes;
- Refrigeration;
- Wood alcohol production;
- Briquetting of biomass residues;
- Greenhouses (controlled-environment agriculture);
- Underground heat storage for cooling and heating;
- Energy surveys; and
- More efficient agricultural digging implements.

With a staff that has varied between two and five full-time professionals (its current level) and a budget that has never exceeded a few hundred thousand dollars, Brace has had field projects in some 30 countries and, with its energy assessment and advisory activities, has worked in a total of 92 countries. Its activities have produced more than 400 publications over the years.

The Canadian Hunger Foundation is a non-profit organization formed in 1964 during FAO's Freedom from Hunger Campaign. It remains affiliated with FAO and its emphasis is on hunger problems in South America and the Caribbean, Africa, and the Indian subcontinent. Its main areas of interest are:

- nutrition, food technology;
- water resources, pumps;
- handicrafts;
- crop processing and conservation;
- agricultural tools and machinery;
- boat construction; and
- credit and lending systems.

These activities include projects conducted for the Canadian International Development Agency (CIDA).

The International Development Research Centre, IDRC was created by act of Parliament to encourage applications of science and technology to problems of development by supporting and strengthening capabilities in these areas within the developing countries. Its funds come from Parliament as a separate line item in CIDA's budget. In the more than ten years since formation, IDRC has emphasized agricultural research, health, information exchange, and the social dimensions of development.

The project budget for 1981 was approximately \$31 million, which was divided mainly among activities in agriculture, nutrition, health, information, and social sciences. Roughly half of the budget can be associated with field projects that involve direct applications of technology, while the remainder is devoted to a variety of studies and development of information-handling systems.

The portion associated with direct applications of technology can be summarized as follows:

● Agriculture, Food, and Nutrition Sciences - 39%

Under this category IDRC initiated activities in crop sciences, fisheries, animal sciences, and forestry. For example:

- A plant-breeding program in sorghum and pearl millet has been started in Zimbabwe to improve small-scale grain production.
- A project to increase use of millet as a protein supplement to a rice-based diet has been started in Bangladesh, along with a second project to upgrade local varieties of legumes. Other legume-improvement projects are under way in Egypt and Jordan.
- Development of appropriate crop-processing technologies in Panama, Peru, Thailand, Zambia, Philippines, Korea, Ghana, and Ethiopia is also under way. This includes solar dryers, mills, portable threshers, flour production from newly introduced grains, and new foods.
- Fish dryers are being developed in the Philippines.
- Social forestry projects, village woodlots, improvement of tree varieties, have been undertaken in Niger, Egypt, Peru, and India.

● Health Sciences - 14%

Projects in this category have included population, basic health services, tropical medicines, water supply and sanitation, occupational health. Examples include:

149

- Drinking-water system improvement projects are underway in Ecuador and Thailand.
- A simplified record-keeping system is being developed in the Philippines.
- A simplified method of determining vaccine potency is being developed, and simple oral-rehydration techniques are being promoted to combat diarrhea diseases.

These activities are designed to create a base for subsequent larger-scale development projects. IDRC is thus seen as a means of fertilizing the ground and planting the seed crops of future change.

CUSO - Originally somewhat of an analog to the Peace Corps CUSO was formed in 1967 as the Canadian University Service Overseas. It was originally based on the idea of volunteerism, and as a private organization, raised its own funds. CUSO started its overseas activities by filling middle-level positions in government services in LDCs, but has evolved beyond that now.

In 1964, it received its first government assistance - in the form of transportation by the Royal Canadian Air Force - but since then it has received regular support from CIDA. That support is now about \$1 million, to match which CUSO has raised about \$300,000 from other sources.

CUSO now functions as an implementing agency for CIDA projects. Far from its original style, these frequently are major projects involving sums of several hundred thousand dollars.

In evaluating proposals it will support, CUSO is guided by concerns for the appropriateness of the technological approach proposed.

AT activities include helping establish small-scale enterprises particularly aimed at assisting women to earn income.

France

The number of mechanisms for funding AT activities in French foreign-assistance programs has been "assez compliqué" for some time. As a result, a major reorganization has been under discussion by the present government. The planned

reorganization is designed to improve coordination, reduce the cost of monitoring projects, and improve the effectiveness of France's science and technology aid by increasing the amounts and targetting fewer countries.

For many years, government ODA funds have been channeled into a variety of projects through a wide range of organizations. These include non-governmental organizations funded exclusively by the government, non-governmental organizations linked to government-funded non-governmental organizations, and multiparticipant companies involving private manufacturers, R&D organizations, and government agencies. In addition, there are non-profit private organizations working on activities in LDCs with no direct government support, and private profit-making consulting firms paid directly by LDC governments, presumably with ODA funds.

An example of the non-profit organization supported wholly by private funds (donations and membership fees), is the French Committee for Inventions and Innovations Adapted to Developing Regions. As reported in the OECD directory, it was devoting several hundred thousand dollars annually to water supply, agriculture, energy, and small-scale industry, although more on a promotional basis than as a provider of technical (i.e., engineering) assistance.

A more important actor is CEEMAT - Centre d'Etudes et d'Expérimentation du Machinisme Agricole Tropical (Center for the Study and Experimentation on Tropical Agricultural Machinery). With funds provided by the Ministry of Cooperation through the Groupe d'Etudes et de Recherches d'Agronomie Tropicale (GERDAT), CEEMAT is engaged in R&D, equipment testing and evaluation, information exchange, and technical and feasibility studies in crop processing, agricultural tools and machinery, and cultivation techniques. It has cooperated with manufacturers of agricultural machinery in both France and LDCs in the development of "appropriate" equipment.

Funds provided by the French and other governments support the operation of the study and information-dissemination organization CIREN - Centre International de Recherches sur l'Environnement (International Research Center on Environment and Development). Founded in 1972, following the UN Conference on the Environment in

Stockholm, CIRED has been the source of many publications, including the "Ecodevelopment News," a periodical that includes information on AT activities worldwide.

SOFRETES (Société Française d'Etudes Thermiques et Solaires), a manufacturer of solar equipment, was organized with the participation of, among others, a private French manufacturer of Rankine engines and the atomic energy commission. Some years ago, the Renault company joined in with the hope that its world-wide distribution network would facilitate the sale of SOFRETES pumps. These systems are a complicated merger of piston pumps, Rankine engines, and flat-plate solar collectors, and their sale to Francophone countries in Africa -- and to Mexico -- for use in rural areas has long been identified with French rural development ODA. A new modification is the use of the heat (Rankine) engine and collector system to power an electric generator, in a project being mounted in Senegal. It will be interesting to follow the progress of this project in view of the fact that the vast majority of SOFRETES pumps installed have ceased to function because of lack of maintenance and difficulty in obtaining spare parts.

The SOFRETES pump is a controversial subject in considerations of appropriate technology. When it was first introduced, it caught the attention of many AT advocates because it provided a means of pumping water in remote areas using only the sun as an energy source. With renewable-energy technologies a major part of the interest in AT, many felt that in spite of its sophisticated engineering, the SOFRETES pump represented an appropriate technology. Its appropriateness has been called into question for some time, however, because of the difficulty in securing adequate maintenance for its complicated mechanism, and spare parts, in isolated areas where it is intended for use. Furthermore, the unit cost per installed kilowatt is higher than that of any other system -- even higher than photovoltaic systems -- and it is difficult to see how West African countries can rationalize the cost of these systems absent substantial subsidies from France.

Under the reorganization of French science and technology ODA, the coordinated approach requires concentration on specific issues:

- Clear articulation of how each local development project fits into the national and regional economy

- Thorough study of the agrarian system in areas of rural development
- Intensified research on development in the tropics
- Furthering uses of intensive horticulture
- Renewable energy
- The economics of energy in agriculture
- Small farmer development
- Agricultural and village mechanization
- Small local agricultural industries and local food processing
- Utilization of professional agricultural research organizations in rural agriculture
- Aid for further private and public sector investment in development activities." (6)

In addition, credit formerly restricted to former French colonies would be made available to targeted LDCs by shifting the Central Bank for Economic Cooperation (Caisse Centrale de la Cooperation Economique - CCCE) and the Ministry of Cooperation to the Ministry of Foreign Relations (Ministère des Relations Extérieures - MRE).

A further change would encourage innovation by permitting the Science and Technology Division of the MRE to initiate and support a project for one year before turning it over to the pertinent regional office of the MRE. The significance of this change becomes apparent from an examination of a third French mechanism for funding overseas LDC activity, the private non-profit organization funded by contracts from the MRE. The major organization in this category is the Groupe de Recherches et d'Echanges Technologiques, GRET (Group for Research and Technical Exchange). Examination of its activities is important not only because of their content, but also because the change in status of the Science and Technology Division of the MRE was the brainchild of the founder of GRET, who has recently become an advisor to the new Minister of Foreign Relations. Thus, GRET may play an even larger role in AT projects than it has heretofore.

GRET provides five major services. A "networking" service monitors national developments in appropriate technology, including those in its own research center. A documentation center is maintained to provide studies of national and international cases of applications of AT. An information service provides technical and statistical information for development of projects. An audio-visual service on AT applications is available, including films made by GRET. Finally, its publication service sells detailed studies in selected technical areas.

In its technical work, GRET operates through a system of "cells" that concentrate on five areas: low-cost housing, health, arid-zone agriculture, processing of agricultural products, and solar drying. Each cell is autonomous and maintains contact with specialized groups in both France and in the field. The cell structure permits organization of workshops on specialized topics. Examples of workshops that have been held are:

- Solar energy use in the Cape Verde Islands;
- Windmill pumpers;
- Solar energy for pasteurization; and
- Definition and integration of new technologies in agricultural-production systems in arid zones.

One particular aspect of GRET's activities is worth pointing out before concluding this discussion. As a result of the experience it has gained from its bilateral and French government contracts for AT activities, GRET has recognized the need for continuity in working with developing countries. Thus, GRET has assumed the responsibility of providing that continuity to projects after the original expert consultants and implementers have left.

There are several organizations that operate in cooperation with GRET, generally with similar funding mechanisms. One of them is CEPAZE, Centre d'Echanges et Promotion des Artisans en Zones à Equiper (Center for Appropriate Technology Exchange and Promotion of Village Industries in Developing Countries), which is concerned exclusively with developing village-level small-industries training centers. CEPAZE is supported by contracts with the French government and with

developing countries, supplemented by donations from its French artisan members. In addition to its bilateral activities, CEPAZE has engaged in several research projects on equipment development (hydraulic rams, solar cookers and dryers, animal-powered mills) and process development (oilseed processing, pipe manufacturing).

Well over 20 years ago a cooperative was formed by a group of small farmers who recognized that the survival of small and marginal farms depended on technological research. CINAM (Compagnie d'Etudes Industrielles et d'Aménagement du Territoire) has since extended its experience and operations to developing countries. Its activities are supported by its members and by contracts with the French government and with LDC governments. The World Bank reports that,

"Over the years, CINAM has made substantial contributions in: (1) production of small farm machinery and tools, small mechanical and animal traction and traction implements; (2) farmer vocational training; (3) women in agricultural mechanization and small enterprise development; and (4) energy for agricultural purposes."<sup>(7)</sup>

CINAM is currently engaged in manufacturing a tractor (the Yeti!), developed for use in hilly or mountainous plots. An integrated biomethanation system is being developed involving all aspects from livestock production to use of the gas for refrigeration and shaft power. CINAM is also working on the design and prototype construction of village-scale machinery powered by a small (four-horsepower) Citroen engine modified to operate with diesel fuel, gasohol, or gasified wood fuel.

A third organization that works with GRET is CICDA, Centre International de Coopération pour le Développement Agricole (International Center for Agricultural Development). Established about five years ago as a non-profit association by a group of development technical assistance and extension specialists, CICDA, like GRET and CEPAZE, obtains its operating funds from contracts from the French and LDC governments. CICDA has avoided rapid expansion and spreading itself too thin by confining its activities to three projects in Latin America. They provide services in public health, support local infrastructures, and provide information on appropriate technologies for use in agricultural mechanization, water supply, and small dairies.

25

Finally, at the beginning of 1982, a new organization, Association Bois de Feu, was formed, to be linked with GRET but devoted to problems of firewood. Liaison with GRET will be through the GRET-GERES cell (Groupement pour l'Exploitation Regionale de l'Energie Solaire) at the University of Provence. Bois de Feu will concern itself with information collection and dissemination; translating into French basic documents, publications, and audio-visual materials; sensitizing pertinent government organizations to the firewood problem, training at home and abroad; maintaining contacts with a proposed European coordinating network; preparing field projects with local collaboration and helping to expedite projects ready for implementation.

### Germany

The development assistance arm of the German government is the Gesellschaft fur Technische Zusammenarbeit, GTZ. GTZ has recently funded the establishment of GATE, German Appropriate Technology Exchange as a center for dissemination and promotion of appropriate technologies for developing countries. GATE is a section within GTZ and is wholly funded by the government. It provides free information (to development institutions) with concentration in energy, water supply and sanitation, agriculture, food technology, manufacturing and housing construction. GATE has an additional responsibility rather unusual for AT institutions - it evaluates developments in German R&D institutions and industry to identify new products or processes that might be applicable in developing countries. In this sense, it performs, on a government level, a function similar to that performed on a non-government level in the U.S. by the Advisory Committee on Technology Innovation (ACTI) of the National Academy of Sciences.\*

GATE has some funds for surveys of traditional technologies, publications, and information exchange, and it also designs projects. However, GATE has no field operational responsibilities.

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\*ACTI is a standing committee of the Board of Science and Technology for International Development.

The only other German institution concerned with developing or applying appropriate technology methods or devices to problems of developing countries that could be identified from the information available is IPAT, Interdisziplinäre Projektgruppe für Angepasste Technologie (Interdisciplinary Project Group for Appropriate Technology). It was formed in 1976 by a group of students within the Berlin Technical University, but is reported to receive most of its funds from the government.<sup>(2)</sup> (The relationship with GATE, if any, has not been ascertained.) As last reported in 1978, IPAT's activities covered a variety of interesting and useful technologies. These included:

- wind and solar pumping systems;
- greenhouse designs for semi-arid areas;
- a greenhouse/fish-pond complex;
- biomethanation systems using water hyacinth;
- alcohol production by fermentation of sugar by-products;
- composting methods;
- solar stills for desalination of brackish and salt water; and
- drip irrigation systems.

In addition, IPAT describes itself as involved with preventive medicine. Many of these activities have resulted in prototype systems or devices, similar to the work of ITDG's research center at Shinfield. (See United Kingdom) The Bank report notes, however, that the difference between the two is that "these prototypes have no ongoing corresponding indigenous research and development groups who will test and market the work."<sup>(7)</sup>

Of potential application to developing countries is the work on small wind-energy conversion systems (SWECS in DOE parlance) taking place at the University of Stuttgart. There, the FWE, Forschungsinstitut für Windenergietechnik (Research Institute for Wind Energy Techniques), whose work is financed by industry, consulting fees, and sale of its publications, has been working on a small ten-meter diameter turbine designed for an output of six kilowatts. Although reports indicate it will be based on sophisticated fabrication techniques, the final product might well be appropriate for some locations in developing countries.

Israel

Although not usually considered among the donor nations, Israel has been a source of technical assistance in the past, particularly in Asia and Africa. No information was available on its current LDC programs but some of its past activities are instructive in the types of appropriate technologies used. In addition, some domestic activities are of considerable interest in terms of potential for application in developing countries.

Two projects in Nepal illustrate how the success of rural development programs depends strongly on the use of appropriate technologies. In Nawalpur and Nepalgunj, in the Terai, farming settlements were started in 1965 with Israeli technical assistance. By 1975 when the Israeli experts withdrew, two successful farming communities had been established. The eventual success of the projects cannot be attributed to only a few selected activities, of course, but early in the period before bare wells and engines had been installed, survival and encouragement of the new settlers depended heavily on development and use of new agricultural implements (plows, sowing devices) introduction of composting techniques to provide needed fertilizer, and a simple expedient of substitution of buffaloes for oxen. This latter "appropriate technology" permitted improvement of the diet because religious proscriptions did not prevent the slaughter of buffaloes for food, and the buffalo also provided milk.<sup>(8)</sup>

The Applied Research Institute at the Ben Gurion University of the Negev evolved from the Negev Institute for Arid Zone Research. Supported by grants, industrial contracts, and the government, the Institute focuses on desalination techniques, salt-tolerant plants, and applications of wind and solar-energy conversion techniques.

Related activity is underway at the Institute of Desert Research, also attached to the Ben Gurion University. The IDR's activity is more closely identified with AT in that it focuses on development of technologies, and revival of ancient techniques, appropriate to desert environment. These include examination of:

- Traditional agricultural techniques;
- Solar ponds as sources of process heat or power;
- Domestication of desert wildlife; and
- Desert ecosystems.

### Italy

Not much AT activity could be identified for Italy, which is not, in any event, a major development-assistance donor. A small, non-profit organization, the Italian Center for Cooperation in the Building Development of Emerging Nations, with money from the government, donations, and membership fees, does research on Italian construction methods transferrable to LDCs.

Finally, the Lay Volunteers International Association, a Catholic group, is known to be involved in village projects in Senegal. No details are available, however.

### Netherlands

The Netherlands has been well known in the field of AT for a number of years through the work of university groups, other non-profit groups, and the government's receptivity to supporting AT work for application both domestically and in its development-assistance programs.

The Eindhoven University of Technology has had an interested group of faculty and student engineers working with "appropriate production systems" for over ten years. Five or six years ago it was formally organized into an Appropriate Technology Department. Besides conducting research in the Faculty of Industrial Engineering, it has carried out activities in Peru and Indonesia. Prototype devices have been developed -- windmills, family cookers, water pumps -- and applications of these devices has been incorporated in Dutch ODA projects.

Delft University has also been engaged in AT activities for about ten years. A Center for Appropriate Technology (CAT) has been formed that has a wider range of interest than the group at Eindhoven has. CAT lists six areas of concentration:

- refrigeration technology;
- process equipment;
- biochemical reactors;
- building methods and materials;
- appropriate management; and
- civil engineering.

The projects on which CAT has worked include:

- water pumps;
- solar cooling;
- small-scale sugar manufacturing;
- methane production;
- single-cell protein;
- cement substitutes;
- rural water supply;
- building methods;
- ferrocement construction;
- water purification;
- grain drying;
- training in metal working;
- fish harvesting; and
- small-scale extraction of pharmacologically active compounds of plant origin.

The list is impressive, and the last item is particularly interesting because it is a cooperative project with an AT group in Sri Lanka and another Dutch university. Nevertheless, the length of the list and the relatively small number of people involved (in 1978 there were 14 people, of whom two were full-time) indicate that it might be useful to take a closer look at this group to evaluate its effectiveness to determine not only the efficiency of staff use but the degree to which the results are being used by the government in its development-assistance projects.

A third university group deeply involved in AT applications in developing countries is the Committee for International Cooperation Activities (CICA) at Twente University of Technology. With a full-time staff of 15 (plus 40 volunteers!), CICA concentrates on projects in:

- solar energy (collectors, stills, cookers);
- windmills (water pumping, electricity generation);
- gasification;
- water resources; and
- small metal-working industry.

Detailed information on specific projects is not available, but it is known that several windmills have been constructed, for both water pumping and electricity generation, with some tested in India. A gasification unit has also been developed and tested in three African countries and promotion of small-scale metal working has taken place in Indonesia.

A fourth university-associated group in the Netherlands is the Medical Working Group for Developmental Cooperation (MWO - Medische Werkgroep Ontwikkelingssamenwerking). Through the medical faculty and student organization of the Catholic University of Nijmegen, the MWO responds to requests from developing countries by providing technical information and documents. Details on specific activities were not available.

The major non-profit group in the Netherlands working in the field of appropriate technology is Foundation TOOL (Stichting TOOL - Technische Ontwikkeling Ontwikkelingslanden). Since its inception in 1977, TOOL, with support chiefly from the Ministry for Development Cooperation and several universities, has functioned primarily as a documentation/coordinating center for appropriate technology information and activities. Its activities are similar to those of VITA in this sense, but the major difference between the two organizations is the membership structure. Whereas VITA is heavily dependent on individual volunteers for its technical services, TOOL is assisted by nine member organizations that include, besides universities and technical colleges, the staff association of an engineering consulting firm. It responds to something like 2,000 requests annually, publishes a number of books and pamphlets, and, through its member groups, has developed a number of technical devices. Among the more than 30 such projects are:

- solar ice maker;
- windmills;
- low-cost fishnet-weaving machine; and
- winnowing machine.

The most recent accomplishment of TOOL is the creation, in April of this year, of SATIS, Socially Appropriate Technology Information System, a major information-exchange network in this field. The system used by SATIS for classifying

92

information has been developed in cooperation with a number of other European AT organizations. The significant aspect of this system is that it was developed to permit a user of information to select pertinent documents easily from any reference center. Most other information-exchange systems have evolved primarily as a means of handling a rising flood of documents in a coherent way. The difference, therefore, is in the point of view. The usefulness of SATIS is becoming widely recognized and organizations in the U.S. such as VITA, ATI, and the World Bank are preparing to adopt it.

As a result of planned reductions in funding by the government, TOOL/SATIS is facing the possible move of SATIS to an agency in a developing country. (There is some indication that SATIS might be relocated in Senegal.) This would make it much more of an LDC service than an apparent documentation convenience for the developed countries.

Finally, another organization that has been functioning for at least seven years is DEMOTEC-1, Demonstration of Appropriate Technology Concepts. Originally operating with two volunteer engineers working and living in otherwise unused facilities of the Royal Tropical Institute in Amsterdam, DEMOTEC is now a research and development center in Utrecht, with a staff of five engineers. Funding is from a contract with NOVIB, (see below).

Over the years, DEMOTEC has developed equipment prototypes that include:

- cement and jute hydraulic rams;
- rope pumps;
- animal-powered pumps;
- animal-powered agricultural implements;
- hand-powered cement mixers; and
- cement and jute piping.

For each prototype a manual has been developed that illustrates design, construction, operation, maintenance, and evaluation of the device. What is not known is the success DEMOTEC has had in disseminating its developments.

47

NOVIB, Netherlands Organization for International Development Cooperation, is a membership group consisting of 62 labor, political, religious, and professional organizations. It engages in rural development projects with technical components (production and processing of food, stock breeding, drinking water supply), and in projects designed to provide managerial and credit assistance (for example, assisting non-governmental organizations in providing the local capital required for Dutch ODA projects).

### Sweden

The Swedish International Development Agency, SIDA, is the AID equivalent of Sweden. With the cooperation of the Swedish Agency for Research Cooperation (SAREC), it is responsible for the use of the 1% of Sweden's GNP that is devoted to development assistance.

[The Swedish system is significantly different from ours, and some explanation may be in order. Traditionally, the ministries are relatively small policy-making bodies. Operational responsibilities lie with independent boards whose funds come from parliament via applications through their cognizant ministries. This was characteristic of all ministries except the Ministry of Foreign Affairs, which had no board. When Sweden became concerned about development assistance, SIDA was created and placed under the MFA. Subsequently, when SAREC was formed in 1975, it too was placed under MFA, and the two effectively are the operating boards of that ministry.]

Together, SIDA and SAREC have the use of 60% of Sweden's ODA funds (i.e., 0.6% GNP) for their projects. They also have consultative status in determining the distribution of the remaining 40% (i.e., 0.4% GNP) through the UN system.

SIDA's projects are principally large construction projects, with a few exceptions. Two that are pertinent to this study are the Kenya Integrated Rural Development Project, and the Arusha (Tanzania) Appropriate Technology Project. The project in Kenya involves local production of machinery and implements and the Arusha project is concerned with the development and adaptation of machines

for local manufacture. The project in Tanzania, for which detailed information is available, is particularly interesting in that it has succeeded in doing what most development projects aim at - it has stimulated the formation of several local companies that are now providing needed services and manufacturing and selling needed equipment.

The AATP has been involved in the development and testing of biogas plants, soil-cement bricks, windmills, water pumps, and solar cookers and water heaters. As a result of its activities, the following commercial enterprises have been established:

- A company installs biogas plants. It digs and lines the pits, and makes and installs the steel drums.
- A company manufactures and sells windmills for pumping water, based on an AATP design.
- An AATP-designed water pump is now being manufactured by a village cooperative and sold to the Ministry of Water for use throughout Tanzania.

The AATP was founded on the principles of assessing the needs and then developing and/or adapting the technology with local participation.

SAREC was created in 1975 to encourage interchange between the science and technology community in Sweden and their colleagues in developing countries. In a sense, it is the Swedish equivalent of IDRC in that it supports research in LDCs. However, its grants generally go to universities and research councils. Thus, there is little AT orientation in SAREC's activities.

### Switzerland

In his study for OECD, Jéquier lists nine Swiss organizations dealing with appropriate technology. (There is no indication of the total number identified, but the overall response rate for Western Europe was 63.9%.) Of these, two are UN agencies (ILO, WHO), six are involved in one or more applications of appropriate technology in developing countries, and only one has a solely domestic agenda. (The ILO and WHO activities will be discussed under the section on international organizations.)

The Association for the Development of African Architecture and Urbanism (Association pour le Développement d'une Architecture et d'un Urbanisme Africains) is a non-profit organization whose activities are supported primarily by "governments and foreign aid programs."<sup>(6)</sup> In the eight or nine years of its existence, it has concentrated on house construction (methods and materials) promotion of small industry, and waste recycling. Projects have included:

- low-cost housing;
- production of earth-laterite bricks;
- application of earth-plaster compounds;
- manual presses, hydraulic presses;
- concrete mixers; and
- biogas systems.

As its name implies ADAUA has concentrated its efforts in Africa.

The Swiss Association for Technical Assistance (Helvetas - SATA) is another non-profit organization, financed by the government and some donations, devoted to appropriate technological assistance to developing countries. It has been functioning for more than 25 years, and has concentrated on rural water supplies, alternative energy sources, small-industry promotion, roads and transportation, and soil protection. Its projects have focused on local collaboration in design and planning, and local production with local materials. SATA has worked in Asia, Africa, and Latin America with projects in: Nepal, Bhutan, Sri Lanka, Cameroon, Ethiopia, Kenya, Mali, Lesotho, Guatemala, and Paraguay.

The project in Nepal is particularly interesting since it is described by SATA as similar to projects in the other countries, and it is one where personal observations are available for this survey. In Nepal, SATA has supported the establishment of a small industry (at Balaju Yantra Shala-BYS, outside Kathmandu) that manufactures cross-flow (Banki) water turbines, solar water heaters, biogas plants (i.e., metal gas holders of the Indian design), and water-purification devices. All labor is local, with training as needed by SATA personnel, and materials supplied from local sources or imported, at most, from India. The work with water turbines and solar water heaters, in particular, has had significant impact in Nepal.

SATA's efforts at BYS have resulted in the use, throughout the country, of more than 300 solar water heaters, some on large tourist hotels that as a result are no longer consuming large quantities of scarce firewood, or of electricity whose voltage and reliability are uncertain, to heat water.

The water turbines are used to provide shaft power for grain grinding or to generate electricity, the former to replace traditional wooden-blade turbines, and the latter to supply small amounts of electricity (0.5-5kW) in isolated areas. The turbine manufacture cleverly depends on no sophisticated casting techniques, and can be accomplished by simple cutting, welding, and hand filing. Even so, the design allows easy modification to change the power requirements without increasing the number or types of materials needed, or the basic design.

BYS has also developed a regulator for turbines used in microhydroelectric installations that is locally made and far less expensive than conventional regulators that must be imported.

SATA's accomplishments in Nepal have depended on a long-term commitment not only of funds but of technical personnel willing to devote many years to such an assignment.

Unique among the organizations dealing with applications of technology in rural areas of developing countries is the International Federation of Organic Agriculture Movements (IFOAM). IFOAM devotes its small (one person) staff to disseminating information on alternatives to energy-intensive agricultural techniques, with part of its operation aimed at developing countries.

The Latin American Institute, founded in 1961 as a business-oriented institute, began AT activities in 1975 when the Development Aid Division of the Foreign Ministry requested it to do a literature study and bibliography on AT, which has since been published. This activity seems to have been given over to SKAT, the Swiss Appropriate Technology Foundation.

The World Council of Churches, through its commission on the Churches' Participation in Development, has done some work in disseminating windmill pumper prototypes to developing countries. In recent years, however, it has confined itself to information exchange and feasibility studies.

Finally, the Swiss Association for Intermediate Technology (SVMT-Schweizerische Vereinigung für Mittlere Technologie), a small non-profit membership association, has played a small part in adding to the AT literature with a study on earthquake-resistant architecture in Guatemala and a manual on solar technologies for LDCs.

### United Kingdom

Appropriate technology activities of the United Kingdom have for many years been identified with the Intermediate Technology Development Group, based in London. With funding primarily from foundations and donations, but with support also from the Overseas Development Administration, the ITDG has been one of the major actors in this field. It was created in 1965 to give advice and information on appropriate technologies for developing countries, but has since expanded to provide a variety of other services. Recently, ITDG has formed a number of subsidiary and associated companies (Intermediate Technology Consultants, Ltd.; IT Transport, Ltd.; IT Power, Ltd.; Development Techniques, Ltd.; and a separate publications company). These companies provide services and materials that earn operating income for the group. In addition, with ODA funding, Intermediate Technology Industrial Services (ITIS) was established in 1977 to provide assistance in establishing small-scale employment-generating industries in developing countries. ITDG activities include agricultural training and machinery development, water supply (training and technical assistance in pump installation), development of improved wood stoves, small electricity-generating plants, development of new building materials, and management planning. ITIS has been involved in a number of industrial projects in textiles, forest products, mining, boat building, microhydroelectricity, and food processing.

Early in its history, ITDG distributed a catalogue of agricultural implements and machinery manufactured in the United Kingdom, aimed at LDC markets. ITDG has de-emphasized that approach, and the group now works with developing countries on projects to develop and manufacture such things locally.

The activities of the ITDG have moved over the years from an emphasis on the development of machinery and equipment to a mix of that plus providing advice on organization, administration, and management of small enterprises, and providing technical consultancy services (on specific technologies) to LDCs and UN agencies.

58

OXFAM is a PVO based in the United Kingdom that is a significant actor in the AT field. It emphasizes projects requiring socially and technically appropriate solutions to local problems. It functions by funding local community-development teams, AT centers, information dissemination, and providing technical back-up for its field operations. Its activities include public health, agriculture, handicrafts and small industries, housing, and organizational development.

The Overseas Development Administration supports appropriate technology projects in much the same way as AID, for the most part. That is, with the exception of a few specifically identified activities such as ITDG, its development-assistance projects may very well involve appropriate uses of technology but they are simply parts of projects otherwise designated. For example, a well administered long-term ODA project outside of the village of Lumle, Nepal, was identified as a project to provide employment and horticultural training for ex-Gurkha soldiers. Nevertheless, the project was based on horticultural and construction techniques adapted to local land, materials, and labor conditions, and involved experiments with a biogas installation -- in short, the kinds of activities usually identified as appropriate technology.

Specifically identified ODA-supported AT activities include, besides the ITIS project previously discussed under the ITDG, the well known Tropical Products Institute (TPI) and the less well known Energy Technology Support Unit of the Atomic Energy Research Establishment (AERE). TPI has long been active (since 1894) and has been a part of ODA since 1964. It is engaged in R&D, testing and evaluation of new equipment, and economic and technical feasibility studies primarily in post-harvest technologies (processing, storing, marketing) of tropical plant and animal products. Besides developing and promoting small-scale processes for processing fish, cereals, oilseeds, fruits, and animal by-products, it has been instrumental in promoting improved methods for production of essential oils and charcoal, dyeing vegetable fibers, and uses of cellulosic plant residues. While TPI would not characterize itself as an "appropriate technology" organization, Jequier points out that it "is one of the world's largest contributors to AT."<sup>(1)</sup>

The Energy Technology Support Unit of the AERE at Harwell has been dealing in small-scale energy technology development activities for almost ten years, with

much of the activity devoted to development of small heat engines. The unit is also the operating base for the Energy Advisor to the ODA.

### Multilateral Organizations

Among the multilateral organizations, significant appropriate-technology activities are under way in the World Bank, some of the United Nations agencies, and the Commonwealth Science Council.

World Bank - Some years ago the Bank created an Office of the Science and Technology Advisor recognizing, perhaps, that most of the projects it funds, (from which it hopes to recover the investment plus a bit more) are after all dependent in an important but not always easily identifiable way, on applications of science and technology. That office, which is the source of much of the information in this report, has been able to make itself recognized in the Bank system as a source of ideas and support for the incorporation of appropriate uses of technology in Bank projects, particularly in the planning stages. With a small staff and a budget that involves no field projects, the S&T office has amassed an impressive library of AT materials, and has become an important part of the worldwide AT network.

The office's contribution to Bank projects is accomplished by intervention in the planning stage to identify changes or additions that would improve the chances for success by the incorporation of appropriate technologies. It operates by either staff discussions or by using its funds to provide expert consultants on specific technologies to work with project planners.

In the past year, the S&T office has made some 100 such interventions in projects in the planning stage. An evaluation of the impact of these interventions, after the projects have been under way for a few years, would be most instructive.

UNICEF - Probably the oldest actor in this field in the UN system is UNICEF (United Nations Children's Fund), which, for many years, has had a policy for project support based on the principles of low costs, use of local materials and

skills, and community participation. Although many projects deal with hardware, UNICEF also deals with encouragement of small industry. UNICEF has also supported the construction and operation of the Karen Village Technology Development and Demonstration Unit, in a village outside Nairobi, where a variety of "AT" devices - windmills, solar dryers, biogas plants, grain mills, etc. - serve as demonstration units for visiting government officials and others from third-world countries who might not be familiar with these concepts. Field projects have included the following:

- Water storage tanks - A successful project in Kenya has resulted in not only local acceptance but local demand. UNICEF now supports the assistance of artisans who travel from village to village to help in construction.
- Water pumps - A project in Bangladesh has resulted in establishment of a manufacturing industry. This project began in 1971 with the introduction of some hand pumps that could be made locally for \$18-20. Since then, local production has been up graded, and although the pumps now cost about \$160, over 500 have been sold for community water supply and for crop irrigation.
- Sanitation - In collaboration with WHO and the World Bank, UNICEF has supported the dissemination and use of water-seal latrines.
- Health - The local production of oral rehydration salts has been encouraged and supported.
- Energy -
  - Woodlots have been started in Nepal, Mali, and Mauritania.
  - Biogas plant have been installed in Nepal, Peru, Turkey, Sudan, Mali, The Gambia, Guatemala, El Salvador, and elsewhere.
  - Improved wood-stove projects have been started in Africa and Asia.
  - A solar still with a 5000-liter/day capacity has been installed in a fishing village in Somalia. Without the fresh water provided by this still, there would no village.
- Grain storage - Ferrocement silos in Rwanda and basket-reinforced cement jars in Burundi have been built.
- Agricultural machinery - Manually-operated but community-scale corn and groundnut shellers have been built.

UNICEF has traditionally been concerned with the role of women in development and maintains an office that deals with this issue specifically. UNICEF is also currently engaged in developing policy guidelines to define its role in ameliorating the household fuel crisis.

UNIDO - The United Nations Industrial Development Organization is, as its name implies, primarily interested in industrial development based on "modern" technology. Nevertheless, it has released several publications dealing with small industry based on locally available materials. In 1978, UNIDO held a conference in New Delhi on "Appropriate Industrial Technology" that dealt with the issues of scale and appropriateness. Although the Ministerial Meeting did not produce emphatic recommendations dealing with "appropriate technology," the issue was more thoroughly discussed in the technical panels that preceded the Ministerial session. The energy panel in particular dealt with the introduction of woodfuel-conserving stoves, small-scale hydroelectric installations, the use of solar devices, and the importance of income-producing employment for women otherwise displaced from income-producing occupations by the advent of village industries controlled by men.

Current projects of UNIDO seem centered on "high" technology, e.g., the forthcoming (December, 1982) meeting to discuss an international center on biotechnology and genetic engineering.

Center for Science and Technology for Development. Formerly the Office of Science and Technology, the Center was organized as an outgrowth of the UN Conference on Science and Technology for Development. As such it is represented on various UN committees dealing with this issue, and is a source of information on S&T activities within the UN system.

One of the activities for which the Center is responsible is the Advisory Committee on Science and Technology for Development, ACSTD. (This, too, is a reorganized version of a former group, stimulated by the UN Conference.) ACSTD has formed several panels, one of which will be meeting in December at the International Rice Research Institute to discuss the Integrated Application of Emerging and Traditional Technologies. This conference is aimed at encouraging the use of both traditional (= "appropriate") and modern technologies, in circumstances where each is indeed appropriate.

The Interim Fund for Science and Technology was started with great fanfare after the UN Conference in Vienna. Unfortunately, some of the industrialized countries whose contributions were counted on to give it vigor - especially the U.S. -

62

failed to follow through on their pledges of support. As a result, the Fund has been able to fund only a fraction of the projects that have been proposed. Of the 64 projects that have been funded, 13 can be identified as involving appropriate applications of technology. These are:

● Africa

- Kenya - Rift Valley Institute of Science and Technology - to support training of technicians in dealing with mechanisms to be used in rural areas.
- Lesotho - University Training in Solar Energy and Biogas - construction and testing of solar water heaters and community biogas plant.
- Mauritius - Wind Power Evaluation and Training.
- Seychelles - Energy Project (undefined).
- Somalia - Support to Appropriate Technology Development - agricultural techniques and water supply for refugee settlement.
- Regional, West Africa - Woodstoves in the Sahel - based in Ouagadougou, in cooperation with CILSS.

● Middle East

- Jordan - Use of Local Building Materials.

● Asia

- Bangladesh - Support for the Institute of Natural Drugs Research and Development.
- Indonesia - Appropriate Technology for Rural Communities (apparently at the AID-supported Development Technology Center, Bandung)
- Nepal - Applications of Science and Technology in Nepal.
- Korea - Pilot Plant for Waste Recycling.

● Latin America

- Honduras - Wood for Energy (gasification).
- Guatemala - (ICAITI) Ex-Ferm Process of Fermentation for Ethanol Production.

FAO - The Food and Agriculture Organization of the United Nations has long been engaged in projects that involve the adaptation and improvement of traditional agricultural and food-processing technologies in developing countries. Their

activities are probably sufficiently familiar to AID to avoid the necessity of a detailed listing here. Suffice it to say that FAO has supported field projects involving production and processing of probably every crop of significance in the third world - including aquaculture and fish drying and smoking - and has conducted numerous studies on the use of agricultural residues. It has forestry programs in many countries that depend for their success on training of local people in nursery techniques and the use of new species of trees especially suited to given regions. It is one of the few agencies that, by virtue of its mandate, incorporates an integrated approach in its projects, recognizing the interdependence of forestry, agriculture, biomass-waste management, and watershed management. In recent years, it has become involved in projects specifically identified as "appropriate technology," - as in a project in Guinea, currently awaiting a decision, on applications of appropriate technology to small farms.

The Commonwealth Science Council (CSC), a part of the Commonwealth Secretariat, is primarily concerned with organizing the scientific and technical resources of the developed nations for application to problems of developing countries. Operating from a central office in London, the CSC meets regularly, on a rotating basis, in each of its LDC member countries. It funds a variety of studies and projects, all aimed at improving agricultural productivity, housing, water supply, food preservation, and introducing manufacture of new products from waste or previously unused materials. Among its projects are the following:

- Manufacture of paper and cardboard from water hyacinth. A pilot plant has been set up in Bangladesh that has produced a variety of papers and boards from this plant whose major function heretofore has been to clog waterways.
- Development and promotion of biogas plants in Asia, Africa, and the Caribbean.
- Design, testing, and manufacture of small internal-combustion engines for use of diesel and other alternative fuels.
- Solar crop dryers, cookers, water beaters.
- Improve charcoal production.
- Improved wood/charcoal stoves.
- Extraction of stabilized rice-bran oil.
- Local manufacture of irrigation equipment.

- Utilization of crop residues.
- Improvement of milk production and marketing.
- Improvement of traditional fishing technologies.
- Development of low-cost housing.
- Development of herbal medicinal plants.

These are some examples of "hardware" technologies being supported by the CSC. In addition, the CSC holds seminars and workshops to disseminate AT information, distributes publications, and support training in a variety of appropriate technologies.

CSC projects are funded by a combination of sources. The Secretariat has a small budget for organizing meetings, workshops, and for publications and training. The major part of project funds is provided by the participating Commonwealth countries.

### Conclusion

The survey has shown a wide diversity of activities that have been included under the rubric of appropriate technology. It is apparent from much of the literature and many of the respondents that a major obstacle in the way of making the benefits of technology available to the developing countries is the pejorative nature of the term "appropriate technology." Too many people respond to inquiries about uses of appropriate technology in development assistance projects with poorly disguised disdain for the idea, without realizing that they are actually dealing in such technologies. In a way, it is reminiscent of Moliere's Bourgeois Gentilhomme who did not realize that he had been speaking prose all his life. Perhaps the best service that could be rendered to the third world - and to many communities in the industrialized world - is for the major donors to adopt the term "applied technology" instead. An Office of Applied Technology is likely to receive less conscious or subconscious resistance to its interventions than any office with "appropriate technology" in its title.

Nevertheless, one should not lose sight of the fact that there is a serious problem with a fixed view of the benefit of technology to those less fortunate than we. In a discussion of technology transfer to the LDCs prior to the UN Conference on Science and Technology, Roger Revelle concluded that we have very little technology to transfer to LDCs. He noted that, "Much Western technology is energy gobbling, capital intensive, and labor-saving. It's designed to be labor-saving. When this kind of technology is applied or adapted in a developing country, it often exacerbates inequities of income, creates injustice, and tends to lead to serious social disruption. Other technology of the rich countries is simply irrelevant, for example, fancy medical equipment, beautifully streamlined x-ray machines, and kidney dialysers -- what place do they have in a poor country which has perhaps one doctor for six or seven thousand people?"<sup>(9)</sup>

Ideally, one should not focus on technology as a solution to specific problems because of the interlinkages among problems and the indirect but often serious impact that technological solutions to specific problems frequently have on others. This issue was discussed in a Congressional hearing in 1977.

"There is no 'energy problem,' or 'health problem,' or 'food problem,' or 'population problem' that can be examined and solved as a separate issue. We certainly cannot attach these problems all at once, but we should not attach any one in isolation.

"What is needed is a major study of the linkages among energy, agriculture, food supply and processing, nutrition, housing, education, transportation, mineral resources, industrialization, water supply, and public health, to name a few that come immediately to mind. I think it is only through an understanding of such interdependence that we will approach a realistic solution to the poverty, disease, deprivation, and unhappiness that afflict mankind. Technology developed on the basis of that understanding -- 'as if people mattered' -- will then be appropriate technology."<sup>10</sup>

There is an urgent need for the kind of technology that is appropriate to the needs, resources, and circumstances of developing communities, and AID's concern for this issue is well-founded.

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APPENDIX 7

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15

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76

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