# CAPITAL-SAVING TECHNOLOGY:

# A REVIEW OF AID PROJECT EVALUATIONS

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## PREFACE

This evaluation was performed by Associates in Rural Development, Inc. (ARD) of Burlington, Vermont for the Agency for International Development's Office of Evaluation (PPC/E/PES). Key personnel on the ARD team were Mr. Richard Donovan, Dr. George Burrill and Mr. Paul Dorvel.

The study reflects our review of evaluations, audits and abstracts of projects in AID's capital-saving technology portfolio. The views presented are the sole responsibility of the authors and do not represent those of the Agency for International Development. We would like to acknowledge the constructive comments of Ms. Molly Hageboeck of AID's Office of Evaluation on the preparation of this report.

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# I -- EXECUTIVE SUMMARY

The Agency for International Development (AID) is undertaking a review of capital-saving technology (CST) projects funded by the agency over the past decade. The product of this review will be an AID report which will give agency administrators and Congress an overview of the effectiveness of the CST portfolio and assist in efforts to determine how a program for evaluating their impact might proceed.

As part of the overall review of the CST portfolio, Associates in Rural Development, Inc. (ARD) was contracted by AID's Office of Evaluation (PPC/E/PES) to review evaluation abstracts and selected evaluation documents. ARD was to identify patterns of project "success" and "failure" to the degree that such a document review permits, compare the performance of AID-funded projects with similar projects in the United States and identify gaps in AID evaluation data that need to be addressed by the agency.

A number of important conclusions emerge from ARD's review of the performance of AID CST projects. These conclusions are based on a review of evaluation and audit abstracts for 59 CST projects, further in-depth analysis of 10 project evaluation documents and ARD's experience gained from evaluating similar appropriate technology projects in the United States.

- Congressional questions about the performance and impact of AID's CST projects, when taken alone, suggest that AID's primary focus is the delivery of capital-

saving technologies directly to the poor. In practice, this is rarely the case. For AID's projects to be successful on a long-term basis, it is necessary to identify some organization or institution which will carry on the work after AID's "seed project" is completed. Most projects in the CST portfolio contain such an "institution-building" component. Thus, the evaluation of CST programs should not be limited to the "success" or "failure" of certain technologies. Rather Congress and AID should be concerned with the actual impacts of all project activities, with a continued emphasis on building up long-term host-country capabilities.

- Technology replication on a self-sustaining basis has not, by and large, taken place on a wide scale, though some CST projects show signs of this. Project time frames have been too short to allow for the often complex, protracted process of technology introduction and diffusion, especially where institution-building is a component. Time frames under five years appear on average, insufficient to realize the kind of self-sustaining and self-financing effect that Congress has envisioned.

- From ARD's review of project evaluations and abstracts, no universally applicable effective mechanism for technology diffusion is apparent. However, critical elements for successful projects seem to be: 1) technology selection based on a thorough examination of the intended users' needs and situations, 2) a clear, yet limited, focus on a few technologies, 3) reliance on established and experienced private contractors, private voluntary organizations (PVOs) or research and development institutions for project implementation, and 4) private sector involvement with a strong emphasis on extension.

- CST projects attempt to address some key constraints to increased income and employment. However, it could not be determined from ARD's review of evaluations whether the constraints addressed are the most important impediments to increased income and employment in developing countries. This question can only be answered through a critical analysis of project impacts and improved AID evaluation practice.

- Evaluations of CST projects seem to concentrate on project inputs/outputs without relating them to actual project effects on income and employment. This is due in part to the paucity of baseline data and also the

complexity of the evaluation task. Gaps in AID evaluation information that should be filled include: 1) the question of unanticipated effects (e.g., placement of trained personnel, outside funding attracted, unexpected linkages, etc.), 2) step-by-step analysis of project design assumptions, and 3) actual costs/benefits of selected project technologies or processes.

- Almost all CST projects are, or have been, plagued by planning and/or implementation problems, most notably:
  --unrealistic time frames,
  --bureaucratic/procedural delays (host agency and AID),
  --inability of host cooperating agencies to deliver support,
  --untimely funding, and
  --under-qualified/insufficient staff.
  "Successful" projects have succeeded in spite of such obstacles only because of highly skilled project implementers and committed host-country organizations.

- A comparison of AID CST projects and similar domestic programs funded by the Community Services Administration (CSA) indicated that there is a great deal of common ground, especially regarding: 1) the importance of supporting committed individuals and/or groups, 2) the significance of unplanned effects in project performance, 3) the conclusion that technology diffusion among low-income groups has not taken place on a wide scale and is an inherently lengthy process, 4) the lack of hard income and employment data in evaluations, and 5) the obstructive effect of sluggish bureaucratic procedures on project implementation.

- AID's CST projects compare quite favorably with appropriate technology projects in the United States. Basically, this is because AID has not focused just on technologies, but rather on processes and the integration into project designs of various activities, including tools, methods and information-sharing. Domestic programs, such as those funded by CSA have all too often focused on technologies beyond the financial grasp of low-income populations.

To improve both the performance and current store of knowledge on CST project performance, AID should implement a cross-project impact evaluation that employs comparable

measures of project success/failure. Such a comparison would allow AID to assess the cost-effectiveness and technical performance of specific technologies in different settings. In this way, a more accurate analysis of the lessons learned in past projects can be achieved. Projects to be included in the cross-project impact evaluation should offer comparisons on the effectiveness of:

1) private- versus public-sector involvement,

2) institution-building versus technology-delivery projects (and combinations thereof),

3) tools versus methods versus information (and combinations thereof), and

4) short versus long project time frames for "successful" projects (those where evaluations have already identified positive income and/or employment effects).

Of critical importance is the analysis of project design assumptions and their validation/invalidation during project implementation.

## II -- INTRODUCTION

AID is currently undertaking a review of CST projects funded by the agency over the past decade. The product of this review will be an agency report which will provide agency administrators and Congress with an overview of the effectiveness of the CST portfolio and assist in efforts to determine how a program for evaluating their impact might proceed.

Briefly, capital-saving technologies are technologies which:

- economize on capital without wasting or displacing labor;
- require a small capital investment per worker;
- are modest in scale, simple to install and durable in operation;
- are not dependent on a highly centralized infrastructure for production, maintenance or repair, and are thus manageable by small entrepreneurs;
- make efficient use of renewable resources and minimize costs by combining factors of production according to their relative prices and scarcities;
- meet the needs of local communities and enhance the self-reliance and local control of such communities; and
- create a process of capital self-generation and self-liquidation so as not to become continually dependent on outside resources for financing.*

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*From Report #96-273, Congressman Long from the House Committee on Appropriations to the House of Representatives, U. S. Congress, June 14, 1979. Appendix B contains a more detailed definition of capital-saving technologies agreed upon by Congress and AID in April, 1980.

AID's CST project portfolio was developed in response to concerns voiced by Congress and agency staff that, prior to 1975, technologies transferred to developing countries were "expensive to buy or maintain, difficult for unskilled and illiterate workers to repair, and have displaced workers from farms and villages..." As of March, 1982, there were 303 projects in the CST portfolio.

As part of the overall review of the CST portfolio, ARD was contracted by AID's Office of Evaluation (PPC/E/PES) to review evaluation abstracts and selection evaluation documents. ARD was to identify patterns of project "success" and "failure" to the degree that such a document review permits.
In addition, ARD was asked to:

- compare the performance of AID-funded projects overseas with similar technology projects undertaken within the United States during roughly the same period, such as those funded by the Community Services Administration;
- assess the relative progress and effectiveness of overseas and domestic low-cost appropriate technology programs, based on existing evaluative information; and
- identify gaps in AID evaluation data that need to be addressed to fully understand the impact of the agency's efforts in the area.

This report is one of a series of studies being performed which PPC/E/PES will integrate to create an overall agency report. Another major study is AID's evaluation of Appropriate Technology International (ATI).

Methodology

During the course of its analysis, ARD completed a three-stage review of abstracts of evaluation and audit documents. This review included 59 out of 303 CST projects. These 59 represent all CST projects which AID's automated data base* reported had been audited or evaluated as of January 27, 1982, using a set of scoring conventions previously tested by PPC/E/PES on other types of AID projects.

A comparison of data on AID projects revealed patterns in project "success" or "failure"--the performance of CST projects in terms of their goals, and how they compared with appropriate technology projects in the United States was also undertaken. In the course of our review of the abstracts, we identified critical needs for future project evaluations which have not been consistently addressed in past project evaluations.

After completing the review of evaluation and audit abstracts, ARD forwarded the coded overview data to PPC/E/PES for its analysis of the CST portfolio and selected 10 projects for further analysis.** In a final stage of the evaluation

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*From AID's Office of Development Information and Utilization (DIU).

**The 10 projects were selected on the basis of suggestions by AID's Office of Evaluation and, after our review of abstracts, clear evidence that a project evaluation document referred specifically to actual changes in income and employment achieved through a CST project. This analysis involved reviewing evaluation and audit documents, not abstracts, for evidence of positive or negative effect of the CST portfolio.

review, ARD selected three projects for in-depth analysis and to present short project synopses. The projects selected were:

- International Rice Research Institute's (IRRI) Small-Scale Agricultural Equipment Extension Project in Asia,
- Appropriate Technology Project in Haiti, and
- Rural Technologies Project in Honduras.

Upon completion of ARD's three-stage evaluation document review, ARD was able to identify important factors in CST program implementation, give an up-to-date report on the progress of CST projects as reported by project evaluators, and offer AID's Office of Evaluation guidance for the continuing evaluation of the CST portfolio and assessment of program impact.

## Organization of the Report

Based on the scope of work developed by AID's Office of Evaluation, ARD presents its findings from this review in the following three chapters:

- Chapter III discusses the performance of CST projects in terms of key factors, i.e., effective mechanisms for technology diffusion, project "success" or "failure," whether or not key constraints to increased income and employment are addressed by AID CST projects, how they affect the poor, the unanticipated effects of CST projects, and how well evaluations and audits substantiate the hypothesis that CST projects positively affect income and employment.
- Chapter IV presents ARD's comparison of domestic and AID CST programs. Common goals, project issues and the evaluation of program impacts are discussed, as well as our conclusions concerning the relative successes of AID and domestic CST programs.

- Chapter V reflects on the way the CST projects have been monitored and evaluated. Critical areas for future evaluations to focus on are pinpointed, and suggestions are made regarding the selection of projects for future impact evaluations.

The body of the review is followed by three appendices:

- Appendix A is a listing of all projects reviewed by ARD.

- Appendix B contains Congress' official definition of CST projects as adopted in April, 1980.

- Appendix C is made up of three short synopses of the following projects, based on ARD's review of evaluation documents:

  1) IRRI's Small-Scale Agricultural Equipment Extension Project in Asia,
  2) Appropriate Technology Project in Haiti, and
  3) Rural Technologies Project in Honduras.

  Though representing a very small part of ARD's overall review, they offer valuable lessons for the implementation of CST projects.



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## III -- PERFORMANCE OF AID'S CAPITAL-SAVING TECHNOLOGY PROJECTS

A basic hypothesis of the CST project initiative is that the implementation of these projects and the ensuing development and adoption of capital-saving technologies will lead to increased income and employment in developing countries. To accomplish this, CST projects are expected to focus on direct assistance to the poor, and generate self-sustaining and self-financed economic growth in developing countries.

In Congress' 1980 discussion of the CST portfolio, three major questions were posed:

- does a clear relationship exist between individual CST projects and increases in income and employment;
- have capital-saving technologies been selected on the basis of a step-by-step process addressing the key constraints to increased income and employment faced by small producers, as opposed to being simply the result of pursuing "targets of opportunity;" and
- have these technologies been delivered to a large number of poor people?

Throughout ARD's review of evaluation and audit abstracts and documents, an attempt was made to be conclusive about the ability of the CST portfolio to deliver the desired results. Early on, it became clear that either the CST portfolio is still a relatively new set of projects such that, given the long-term nature of technology transfer, it is too soon to be able to measure the "success" or "failure" of the portfolio, or portfolio evaluations are not adequately addressing important evaluation issues.

This chapter begins by reviewing what is known at this time about the CST portfolio from ARD's review of abstracts and documents. It concludes by addressing successful mechanisms for technology diffusion that have been reported in evaluations and audits, and reflecting on the time-frame limitations and lack of evaluative data which characterize evaluation of the CST portfolio.

## Key Factors in CST Project "Success" or "Failure"

During this review of evaluation and audit abstracts, ARD searched for key factors which are commonly associated with project performance. The key factors examined were ones that PPC/E/PES has found useful/pertinent in the course of its review of similar materials for other sets of AID projects. These factors are planning, staffing, funding, coordination, management, policy and performance.*

Given the small number of reportedly "unequivocally successful" projects in the CST portfolio and the lack of documented CST project benefits to recipients, key factors were most often described in a negative tone in the abstracts. The most common and serious problem areas were planning, funding, management, staffing and coordination. The following percentages show how each key factor affected CST projects, on

*The same factors were included in AID's 1981 examination of its institution-building projects and several other sets of agency projects.

which there was enough data to permit scoring, as described in evaluation and audit abstracts:

| | Positive | Negative | Neutral | Unknown |
|---|---|---|---|---|
| Planning | 5% | 39% | 14% | 42% |
| Funding | 3% | 44% | 10% | 43% |
| Management | 19% | 51% | 17% | 13% |
| Staffing | 17% | 44% | 10% | 29% |
| Coordination | 8% | 36% | 17% | 39% |
| Policy | 3% | 14% | 3% | 80% |

Though discussions of each of these six key factors are predominantly negative in nature, it was also clear that project evaluators felt that CST projects, on the whole, are performing quite well. In spite of the negative comments regarding other key factors, 34 percent of the project evaluations described overall performance favorably while only 15 percent were scored negatively. Despite this favorable review of many CST projects, which will be discussed later, ARD was unable to find substantiation of any increases in income or employment in the vast majority of CST projects (only 6 of 59 or 10 percent of the CST portfolio document positive changes in income and employment). It is also important to note that 50 percent of the CST project abstracts reviewed are inconclusive regarding project performance.

Planning and design is clearly a critical phase of all CST projects. Good planning, explicitly noted in only three project abstracts, was clearly associated with positive performance. Obviously, bad planning, as stated in evaluation abstracts, correlated directly with negative performance and problems in other areas, such as staffing, coordination and

project management. In other words, the quality of planning related directly to the overall performance of CST projects. Among the major problems which plagued the planning and design phase are:

- inadequate analysis of host-country interest and commitment, and inadequate involvement of cooperating agencies in pre-project planning; for example:

  --the evaluation of the Tivoane Women's Project in Senegal reported that, "The project plan did not allow for adequate involvement of women in the initial design phases. All inputs were decided on and brought into field sites without participant consultation causing inappropriate choices to be made [eucalyptus trees]...and hindering local innovation."

  --the evaluation of Peru's Appropriate Rural Technology Project reported that "ITINTEC's [implementing government agency] current BOD [board of directors] is industrially oriented and does not understand the rationale for the types of projects proposed; and its approval authority over all prefeasibility studies is hindering the review and approval process."

- poor assessments of end-user needs, local production capability, host institution-building requirements, socioeconomic factors and market conditions; and

- significant time lag between project paper and implementation (contract for implementation) plus no reexamination of the continuing validity of the project design prior to implementation.

Management, defined as the delivery of project inputs, such as equipment, vehicles or timely contract awards, was seen by evaluators as deficient, in some way, in 30 out of 59 projects. The types of management problems which occurred often were:

- host government and AID bureaucratic delays which affected timely payment of vouchers, staff recruitment, procurement, loan or grant processing,



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and facility construction--AID accounting procedures were often misunderstood;

- lack of clear lines of authority, task responsibilities and scopes of work among host agencies, contractor and AID; and

- inability (or unwillingness) of the host government to come through with promised support (for instance, the evaluation of the Radio Education Teacher Training Project in Nepal stated that, the "most critical implementation problem is the failure of the Government of Nepal...to meet its obligations.").

These management problems do not appear specific to any particular kind of project. Where new or weak host-country institutions are expected to be built or strengthened, commitment on the part of the host government and proper project development are critical issues. It seems to be accepted that all projects will start two years after completion of the project papers. Given the other uncertainties that plague the development process, AID should continue to pay specific attention to monitoring management deficiencies which are mainly "in-house" problems.

Staffing has proven problematic for many projects, especially contractor project teams and consultants, and host-agency counterpart personnel. Our review of abstracts and evaluations found that the technical input of contractors and poorly qualified/committed host-country counterparts were noted as deficient in many projects. Some of the most frequent staffing problems were:

- under-qualified or incompetent contractor staff;

- late recruitment of contractor staff;

- failure of host governments to provide counterparts or qualified candidates for training;
- poorly designed training programs; and
- lack of clear planning for the integration of host-country staff who attended participant training programs outside the country into the project management process.

Funding problems affected not only procurement but staff recruitment and planning as well. Typical problems included work stoppages due to a contractor not being paid or a host-country accounting system not performing up to the expectations of an AID mission. The most frequent funding failure was a host government's inability to come through with promised funding support. AID funding was seldom inadequate, but procedural delays often held up disbursement.

Coordination problems were usually the result of poor communication between host-country institutions and project contractors, which often seems to be due to poor initial project design (unclear task responsibilities and poor assessment of host-country commitment) and then aggravated by inefficient AID management practices. In other words, poor project coordination is primarily the end product of poor planning, funding, management and staffing.

## Are Key Constraints to Increased Income and Employment Addressed by AID CST Projects?

The vast majority of projects reviewed did attempt to address constraints which project evaluators felt were

important for increasing income and employment, notably in the areas of credit extension, small enterprise development, and information collection and exchange. The limited information on actual project impacts at this time prohibits concluding that the projects have, in fact, addressed these key constraints successfully. Further analysis of CST project impacts on recipients in developing countries may allow evaluators to determine which are the most important constraints addressed by CST projects. ARD's review of abstracts and evaluations consistently identified five constraints/problems faced by CST projects:

- inadequate manufacturing and distribution systems,
- weak extension and information linkages,
- poor coordination between project implementers and other host-country human and technical resources,
- limited availability of inexpensive credit, and
- lack of management expertise in government agencies.

Have CST Project Designers or Implementers Pursued "Targets of Opportunity"?*

Little evidence was found that would suggest that capital-saving technologies or processes which project designers or implementers suggested were opportunistic, i.e., available but not suited to the situation. This is perhaps best explained by the example of a project design which seeks to include technologies or processes which, instead of responding to real

*See Appendix B.

needs in developing countries, are selected because of a vested interest. For instance, a project designer includes wind power because he/she is the preeminent expert in that area, or an AID project focuses on a technology which is of no value to project recipients, but in the United States, there is good equipment to be purchased or expertise to be acquired.

During our review, it became clear that in a few specific cases, contractors attempted to guide projects toward their area(s) of expertise. In Indonesia, the IRRI attempted to focus on its Philippine-designed threshers and tillers, even though sociological conditions indicated that non-labor displacing technologies (e.g., sprayers) might be more appropriate. In Senegal, AID procurement policy forced the installation of U. S.-made, and very inappropriate, water pumps for a women's vegetable-growing project. Overall, only three out of 59 evaluations or abstracts suggested that CST projects were guilty of opportunistic project design or implementation.

Do AID CST Projects Affect Large Numbers of Poor?

Project evaluation and abstract information is inconclusive on this point. There are some figures cited in several cases about beneficiaries. For instance, in the Ghana Farmers' Association and Agribusiness Development (FAAD) project evaluation, it is stated that "activities have directly benefitted 40,000 low-income villagers." In Honduras, "direct benefits [of waterwheel introduction] accrued to...105 people

and 313 people indirectly." IRRI's threshers are a "hot item with total sales reaching over 2,400 per year in 1978"-- the income/employment ramifications of this are not stated, but may be substantial in both the manufacturing and agricultural sectors. In Upper Volta, the Partnership for Productivity (PfP) Pilot Rural Enterprises Development Project made over 100 loans averaging $625 each to individuals totally outside the established credit channels and had a high repayment rate.

Two major issues here are what is meant by "large" and "poor." Clearly, from our review, most projects target low-income persons and small-scale entrepreneurs in a direct or indirect way. Some, such as the Radio Education Teacher Training Project in Nepal, do not discriminate regarding their target population. Some successful projects (e.g., IRRI, Honduras Rural Technologies, Ghana FAAD) are reportedly affecting the poor in substantial numbers relative to project objectives. However, the replication or adoption of technologies/processes developed by AID CST project implementers during or after a project has seldom been documented, and the positive or negative effect(s) on large numbers of poor people is unknown at this time.

Unanticipated Effects of CST Projects

AID projects are evaluated on the basis of expected outputs, even though AID's guidance also calls for an examination of unanticipated effects. However, evaluators have



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not tended to focus on unanticipated effects of CST projects. The few cases that have been cited are instructive.

The IRRI project in the Philippines attracted funding from the World Bank and Canadian International Development Authority (CIDA) for follow-up activities. This occurred upon recognition of IRRI's success in developing farming equipment appropriate to the needs of Filipino farmers. The FAAD project in Ghana forged a productive alliance of private voluntary organizations which, since project completion, have officially formed an association called the Ghanaian Association of Private Voluntary Organizations in Development (GAPVOD). Through this association, they cooperate and exchange experiences as well as network with technology-oriented development groups all over the world.

Among the negative unanticipated effects of CST projects, the evaluation of the Philippines' Small Farmer System Project notes that the project is working with a double-cropping farming system that allows intensive cultivation of small plots of land, yet also requires an increased labor input which limits the degree to which farmers can become involved in lucrative off-farm employment. In the PfP Rural Enterprises Development Pilot Project in Upper Volta, a successful low-income credit program has been developed outside government structures which is helping to develop small enterprises in agriculture, crafts and transportation. However, its competition with a government-sponsored program for the credit-

worthy may weaken PfP's chances of getting government approval for future funding requests.

These few examples of projects with unexpected effects point to the need for AID designers and evaluators to carefully consider all possible results of project activities. Deeper analysis might show that some secondary results, such as the ability to attract concurrent funding or the demand for former project staff in the labor market, are relevant to project success or failure and, therefore, important to measure. Indeed, as will be discussed in Chapter IV, the most beneficial impact of some appropriate technology programs in the United States were secondary and unanticipated project outputs.

## Effective Mechanisms for Technology Diffusion

From our review of the CST portfolio, very few have unequivocally attained the objective of introducing a technology or process that is now disseminated on a self-sustaining basis. Thus, this discussion of effective mechanisms for technology diffusion focuses on those "successful" projects as identified in abstracts and evaluations. The group of project "successes" from which to draw is small, but nonetheless offers valuable examples.

As of March, 1982, "successful" projects have focused primarily on small farm technologies. They appear to offer immediate potential for technology diffusion, and evaluations of these projects point to positive employment and possibly

income impacts. The IRRI's Small-Scale Agricultural Equipment Extension Project, begun in 1975, is one example. (See Appendix C for a fuller discussion of this project.) IRRI sees its basic functions as supplying research and development directly to a nascent agricultural equipment manufacturing sector and establishing solid linkages between research and development, manufacturing and farmers. Dissemination is designed to be carried by the host government. IRRI's methodology includes:

- a multidisciplinary team approach to canvassing farmers' priorities/needs;
- selection of a priority technology and study of existing designs;
- prototype development, testing and modification according to IRRI design specifications; and
- licensing a limited number of manufacturers willing to agree to IRRI's conditions regarding quality control and servicing, and continuing linkages with manufacturers and users/buyers for feedback and impact monitoring.

However, the evaluation of the IRRI project in Asia also contains an important note of caution. IRRI could not rigidly apply the same methodology in Pakistan and Indonesia--the lack of manufacturing and counterpart research and design facilities required that IRRI address each of these problems and demanded a different approach. This demonstrates an important lesson in technology transfer: physical, economic and social conditions in each country are so specific that any effort to directly transfer a process or technology from one country to another

can be frustrated and may defeat project implementers.

It is important to recognize that specific project objectives and circumstances will determine the most effective diffusion mechanism. In particular, they will determine whether a particular level and kind of aid intervention (i.e., implementation model) will be effective. For instance, in the case of IRRI, AID supported a long-established research and design facility against a background of relatively well-developed and eager agricultural and manufacturing sectors where market demands were well articulated. In the Honduras Rural Technologies Project (detailed in Appendix C), a group of government-affiliated institutions, with AID coordination, are providing information, management assistance, training and enterprise development assessment in addition to research and design, and extension to PVOs and private-sector entrepreneurs. This mix of activities and organizations was reviewed favorably by evaluators who documented technology replication and employment gains. The FAAD project in Ghana included AID support for seven established PVOs working in rural development, who later formed a close working "consortium." Coordination and exchange is excellent, and direct income and employment benefits have been reported--the project was deemed "highly replicable" by project evaluators. In Upper Volta, PfP (a PVO) has implemented a reportedly very successful revolving-fund, pilot credit program for individuals and groups unable to obtain credit through existing government channels, thus

providing assistance and stimulation to the existing entrepreneurial class. Evaluators report that the project is succeeding because of direct contact with loan recipients and private-sector involvement.

We can note several points in common between "successful" or promising CST projects:

- active private-sector involvement;
- reliance on established and experienced PVOs, research and development institutions, and consulting firms as intermediaries to implement projects;
- direct and frequent contact with technology recipients;
- careful selection of and focus on a limited number of technologies; and
- a level of project assistance which is linked with organizations that address key constraints to technology diffusion, e.g., research and development--IRRI, credit--PfP, mixed--Ghana and Honduras.

Overall, projects which start with well-considered, attainable objectives and allow enough time for the development of needed linkages and institutions have a good chance for success. The adaptation and diffusion of a new technology is a complex matter: institutions must be developed to handle research and design, information networking and business support; extension teams must be trained and organized; and a manufacturing sector, if appropriate, must be mobilized. As a precept to effective technology diffusion, it is our judgment that project durations of less than five years do not appear adequate in most cases to ensure self-sustaining capital-saving technologies.

Our review did not identify, and we cannot prescribe, a universally effective technology transfer mechanism. As a rule, however, no technology will be replicated unless it is marketable. This implies a user or buyer who perceives it as responding in a cost-effective way to a priority need. Moreover, greater social and economic benefit(s) can be gained if the technology is replicated using local production and maintenance capabilities. Effective mechanisms for delivering CSTs (which fit Congress' definition), will then:

- select, focus on and develop a marketable technology that responds to a priority need of the end-user; and
- seek to mobilize local capabilities and resources to produce, disseminate and maintain the technology.

Past AID Evaluations and Audits and the Degree to Which They Substantiate CST Hypotheses

During the course of this review, we searched evaluation and audit documents for patterns and indicators suggesting that the implementation of the CST portfolio has, in fact, had a clear relationship to increases in income and employment or the generation of capital savings in developing countries. Congress has hoped that AID, by implementing CST projects, would stimulate a rise in employment and income in developing countries. Although there are a few indications that these results have been achieved in some AID projects, ARD was not able to establish a clear post facto relationship between CST projects and increased employment or income.

Evaluation and audit documents allude to positive results.

In some projects, results are cited such as increased farmer productivity or number of CST units placed in the field. But, the actual effects on recipients in terms of employment and income are unclear. For example, in the Honduras Rural Technologies Project, over 70 waterwheels were "distributed" to farm families, but there is no indication of how, at what cost or with what results. Superficial description, in terms of project outputs, is a common shortcoming of the project evaluation documents we reviewed. The overall documentation of project impacts in those evaluations is so scarce that if there are positive results from these projects, we were unable to pinpoint them or reach conclusions on the actual effect on income and employment of the CST portfolio. The inability to link CST projects with actual effects may also be attributable to two other factors.

First, it may be too early to expect that the real benefits of the CST portfolio are evident. The long lead time required between technology development, widespread adoption of the technology or process, and ultimate impact is apparent. For most projects in the portfolio, lack of adequate data and the significant length of time which is required for technology transfer prevented ARD, and may prevent AID field evaluation teams, from either conclusively refuting or validating (at this time) the hypothesis that "CST projects yield improved income and employment" at this time for most projects in the portfolio. However, project evaluations and audits allude to

enough successes to warrant AID undertaking more specific impact evaluations of some CST projects.

Second, too little emphasis is being given to measuring what project participants do after they have received training or orientation during project implementation. This and other unanticipated effects of projects, such as attracting other donor funds (e.g., the World Bank), have been given too little attention. AID project designers and evaluators seem to be overly concerned with numbers of units installed rather than other beneficial spin-offs of projects. Past mission project evaluations have not been properly focused on measuring specific results (e.g., extent of distribution, income effects, etc.) which are self-sustaining and self-financing. A number of projects appear to have accomplished some of these aims, but passing judgment on the complete portfolio would be premature until consistent evaluation indicators, which focus on the measurement of impact, have been established or evaluators consistently address/measure the impact of these projects.

## IV -- COMPARISON OF DOMESTIC AND INTERNATIONAL CAPITAL-SAVING TECHNOLOGY PROJECTS

One question that is reasonable for an organization like AID to ask about the performance of any set of projects, particularly a relatively new set, is "How much progress/impact should we expect at a given point in time?" In many instances, there is no relevant comparison AID can make to determine whether its projects appear to be proceeding and producing results at a reasonable pace. Sometimes, however, the development projects of other organizations present an opportunity for comparison. In a few situations, domestic experience offers a relevant point of comparison. In the case of capital-saving technology projects, the efforts undertaken in the United States, over the period covered by AID's overseas projects and based on much the same congressional initiative, provide a unique opportunity for AID to examine the progress of its projects relative to a fairly comparable set of domestic projects. Within the framework of this contract, AID asked ARD to compare the progress and performance of AID CST projects, as reported by evaluations and audits, with domestic experiences.

During the last three years, ARD undertook a series of evaluations in the United States of "appropriate" and energy technology projects funded by the Community Services Administration (CSA). CSA was given a mandate to assist low-income groups in achieving greater economic self-sufficiency. CSA-funded projects focused on activities ranging from urban

redevelopment to rural renewable energy technologies. Despite the broad range of projects, CSA's priority throughout was the development of technologies or methods directly responsive to the needs of low-income people. ARD performed in-depth field evaluations of four CSA-funded projects:

- National Center for Appropriate Technology's (NCAT) Small Grants Program,
- Energy Task Force, Inc. in New York City,
- Bronx Frontier Development Corporation, and
- Small Farm Energy Project at the Center for Rural Affairs in Hartington, Nebraska.

As a group, they offer a fairly complete picture of the critical issues involved in technology-oriented assistance programs which target low-income groups in the United States. This experience, coupled with ongoing and past work with AID missions overseas, affords ARD a unique perspective on the relative performance of these domestic and international assistance programs. For this particular comparative analysis of AID projects, the most relevant CSA-funded project is the NCAT Small Grants Program. Given NCAT's broad geographic focus, range of technologies, and similarity in goals and objectives, there are a number of significant areas for comparison with AID's CST portfolio.

## Comparison of Goals and Objectives of NCAT and AID

The goal of CST projects has been to assist in the production of goods and services within the financial and

physical constraints of small producers and the poor, which then induces positive changes in income and employment. NCAT's program has focused on energy conservation strategies and technologies for low-income groups as well as increased local food production. In both cases, issues such as simplicity of maintenance, design and installation of technologies, and small capital requirements must be addressed in project design and implementation. Though NCAT has substantial technical resources, the purpose of the Small Grants Program has been to address the funding of local projects in the same way that AID directs its financial resources to support host-country projects.* In both cases, funds serve as "seed money," and it is hoped that those responsible for implementing projects will carry on the activities when the project ends. The NCAT evaluation also examined program impact. It asked, whether NCAT's program delivered technologies/methodologies to low-income groups that actually produced jobs, saved energy or increased productivity.

Although the scale of operations and geographical focus of NCAT and AID are quite different, ARD did find that many technology transfer issues are similar and, further, that there <u>are</u> effective strategies which work on both domestic and

*ARD's task during the NCAT evaluation was to: determine whether NCAT's Small Grants Program allocation was a feasible strategy for technology transfer to low-income populations; determine what implementation strategies appeared most successful for adopting technologies; and make recommendations for future appropriate technology projects.

international fronts, as well as stumbling blocks that impede both kinds of assistance programs.

## Comparison of Critical Issues in CST Projects and the NCAT Small Grants Program

In this section a number of project experiences (both similar and different) relating to NCAT and AID field projects are discussed. Note that in our review process, the evaluation of AID projects' performance was the first activity on our agenda, followed by looking for patterns and similarities common to both programs. The results of our comparison are summarized below.

The lack of baseline data: In both the NCAT program and most AID projects, too little effort was put into the compilation of baseline data during project design to allow the quantification of changes in, for example, energy consumption, or increases in agricultural production or income. AID project evaluations show little hard data on changes in income or employment; NCAT project implementers were unable to document the positive or negative effects of technologies they introduced. The documentation of project effects provides a clearer perspective on the efficacy of a specific strategy for achieving CST projects' objectives. Data-gathering can be a costly and time-consuming process, but simple cost-effective methods do exist, and can afford evaluators and decision-makers tangible evidence of project "success" or "failure."

The ability of CST projects to address key constraints on income and employment: The lack of baseline data for both NCAT and AID projects prevents a conclusive assessment of actual project results. However, in both cases, there is evidence that people have been trained and obtained related jobs in which that training could be applied, separate from project-related activities. It is not apparent, nor has it been documented, that changes in income in AID projects have occurred. At NCAT and in other CSA projects, the training programs placed trainees in relevant private-sector jobs (e.g., the Energy Task Force in New York), and significant changes in income and employment resulted.

The time frame for CST projects: A common thread in the evaluation of NCAT and review of AID evaluations is that project planners underestimate the time needed for technology transfer. The process of adapting a technology design, testing it under research and field conditions, and then extending it to the target population is usually lengthy. In both cases, the transfer of "proven" technologies requires adapting a previously developed technology for local conditions. For example, solar greenhouses and mud stoves both require design changes depending on climate and material resources. IRRI's experience, described starting on page III-12, is another example.

Besides specific technical problems, ongoing project delays often occur while waiting for an expenditure approval or

testing equipment shipped from or within the United States. Hence, by lengthening project time frames, more time would be available for completing and monitoring all project activities, including the specific impact of project outputs on target populations.

The importance of the committed individual and/or organization: The ability of NCAT or AID to link with an effective individual or organization with a proven commitment to technology transfer is an important factor in successful project implementation. Conversely, lack of commitment to seeing a technology or process through to completion is often cited as a reason for failure. In AID projects, an example might be a local PVO or entrepreneur who, when provided with a suitable design, demonstrates an ability to follow up with extension or dissemination activities. Clearly, the lack of host-country commitment and AID's inability to link with established organizations has been critical in some project failures.

The danger of pursuing "targets of opportunity": The degree to which project designers fall prey to pursuing the opportunistic application of existing technologies was difficult to assess in reviewing AID project documents. There is, however, a danger that this could happen, especially when project designs include a wide range of technologies and the technology selection process is managed by a contractor with a particular technical strength. The AID requirements for host-

country commitment may preclude opportunism, but not eliminate the temptation. From our review of evaluations, we could not conclude that AID has been guilty of pursuing this type of "target of opportunity." However, with tools-oriented projects that adopt existing technologies, this will continue to be a potential issue.

At NCAT, ARD found the appeal of many technologies to be so strong that the agency did indulge in selecting technologies on the basis of design ease or interest, rather than their ability to produce real energy savings for their low-income users. Moreover, not only did many technologies fail to produce the expected results, the financial resources needed to make them operational were beyond the grasp of low-income populations.

Technology projects producing unanticipated effects: Upon completion of the NCAT and other CSA evaluations, unanticipated, yet important effects of these technology transfer projects became clear. For example, many of the specific technologies chosen by the Energy Task Force were unworkable, yet people trained by the project formed a cadre of professionals who went on to successfully deliver energy conservation services to low-income groups, spurring activity on the local level throughout New York City and in other parts of the United States. At AID, unanticipated project results have included greater local cooperation between agencies and the attraction of funds from other organizations for

continuation of project activities. The important fact is that in both CSA and AID technology-oriented projects, there have been worthwhile, though unexpected, beneficial spin-off effects for low-income recipient populations.

In the course of our review of AID's CST projects and evaluation of NCAT, it became clear that management as well as technical and client concerns must be considered in determining program performance. Two such concerns often common to both international and domestic programs are particularly important.

1) The effectiveness of the grants strategy: ARD's NCAT evaluation uncovered a number of deficiencies in its small grants process, such as the need for more active monitoring. However, the strategy of using a grants program to support technology transfer was judged favorably. Why? Because at NCAT, though many of the technologies were ill-suited to low-income needs, the grant applicants were able to adapt a technology or use grant funds to develop a process or program that was responsive to local needs.

Similar results have occurred in some AID projects through grants programs. For example, the FAAD project in Ghana tied in AID funding with local PVOs who used the money to improve poultry production techniques and set up trade associations for small producers, such as farmers and craftspeople. The Honduras Rural Technologies project is using a grants process to foster creation of small industries. Although it is still in progress, AID evaluators have reacted favorably to the

initial response of the Honduran private sector to the grants process. In general, grants programs are a challenge to set up and manage. Nonetheless, when the review panel can find recipients who have shown that they can deliver results, grants programs can be very successful.

2) Responsiveness of NCAT and AID bureaucracies to criticism of management structure: A number of different recommendations to NCAT have been made over the past three years for improving its responsiveness to low-income people and organizations providing assistance to the poor (e.g., community action agencies and nonprofits). Improvements have been requested in the areas of technical assistance, funding procedures, required paperwork and turnaround time on decisions for grant awards, among others. NCAT has attempted to address these failings by streamlining their grants process and reducing the turnaround time on award decisions and funding questions.

AID's ability to respond to complaints about funding and contracting procedures, turnaround time on decisions and short project time frames is important. Given the common occurrence of management problems that affect the outcome of projects, AID should note this as an area for improvement. Delays in the arrival of a contractor or operating funds have affected the success or failure of both NCAT and AID projects. At the least, delays cause cost inefficiencies which render contracted

project designs unworkable. Since management is primarily an internal matter, AID should address this problem directly.

## The Bottom Line on Relative Performance of AID- and CSA-Funded Programs

Over the last five years, both NCAT and AID appear to be learning from experience and improving the capacity of CST projects to generate increased employment and income. The major benefit of CSA-funded programs, such as NCAT and the Energy Task Force, was found to be trained personnel who have either sought further training or become involved in both public- and private-sector activities concerned with capital-saving technologies. The major problem has been reliance on technologies that have not always produced the desired results for low-income people. If they are to be effective, many of these technologies (e.g., solar greenhouses, solar hot water heaters and trombe walls) require front-end capital input and technical resources that many poor people do not have.

Less data are available on the results of AID's CST portfolio. However, according to evaluation abstracts reviewed by ARD, AID does not appear to have tried to place an existing technology in situations where it does not fit or to replicate widely technologies with a very limited impact on the poor. The overall performance of AID projects, according to our review of evaluation and audit documents, compares very favorably with domestic CSA-funded activities. The emphasis

put on the overall technology transfer process, rather than just specific technologies, should pay substantial dividends in the future. By developing a more consistent evaluation process and capitalizing on experience gained, AID should be able to improve the performance of the CST portfolio.

## V -- EVALUATION OF CAPITAL-SAVING TECHNOLOGY PROJECTS

The review of 59 evaluation and audit abstracts and 10 evaluation documents during the course of this analysis offered ARD a chance to reflect on the overall evaluation process implemented by AID for these projects. This chapter discusses the effectiveness of current AID evaluation practice and what changes might be made to improve it. A complete in-depth analysis of AID evaluation practice is not within the scope of this review. However, there are a number of areas that require attention by AID if the effects of CST projects are to be accurately assessed.

The major issue to arise from ARD's analysis is that no comparative or consistent data are yielded by the audit or evaluation design/methodology AID has been using. This makes it extremely difficult to generalize on specific issues across projects. General project issues are usually dealt with, but at a finer level (e.g., why specific technologies were not maintained or were not durable) comparable quantitative and qualitative data do not yet exist across the complete range of CST audits and evaluations. The most common format for organizing an evaluation is to analyze performance to date in terms of the project's logical framework. This provides a very good basis for assessing the progress of a single project or technology (e.g., number of units installed) toward stated goals, but is an inadequate basis for examining many of the other issues and questions which are critical for AID's long-

term decision-making process. These issues cannot be addressed without analyzing performance levels of technologies in terms of their cost, impact and mode of project intervention, and comparing them with other alternatives.

In addition, the natural tendency of evaluators is to address those issues unique to a specific project or verbalized by staff and others as the most pressing. Although important, this usually results in a lack of comparable data across important generic issues that AID should be assessing in its CST projects. The three most important of these issues are discussed below.

1) Many of the technologies employed by CST projects must be adapted to local conditions, and many such projects are primarily pilot projects. This makes it all the more important to generate evaluative data on a set of very specific issues* so as to permit comparison. Audits and evaluations reviewed by ARD showed a continuing absence of data in the following areas:

- technical performance of technologies is usually covered only briefly and not adequately for either definitive conclusions or comparative purposes;
- durability and maintenance of technologies is usually inadequately addressed;

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*An evaluation model for pilot or "learning laboratory" projects, such as AID's CST projects, can be found in "The Role of Evaluations for Renewable Energy Projects in Africa," by George Burrill, in ENERGY FOR AFRICA, SELECTED READINGS, AID, Washington, DC, September, 1980. The general model presented there can be applied in areas besides energy and is appropriate for use with a range of pilot projects.

- costs associated with technologies and strategies are dealt with usually in terms of broad conclusions reached by the project, but with inadequate detail to judge the assumptions used or for comparative purposes;

- the relationship of capital inputs to job creation is rarely addressed;

- the social adaptiveness of technologies is referred to most often when a major problem arose that couldn't be solved, rather than a more uniform treatment of the technology's adaptive process to the social situation;

- evaluations all too often refer to successful outputs (e.g., "over 70 waterwheels installed"), but do not qualify the way in which those outputs were delivered or give a correlation between the mode of delivery and success; aside from an administrative perspective, the identification of effective delivery mechanisms (e.g., extension services) is consistently given inadequate attention in audits and evaluations; and

- every project involving the transfer of a technology or technological process will face certain key constraints to adoption, but rarely are those addressed by the project critically compared to other important impediments to technology transfer in general.

2) Impact evaluations are needed. Yet, it is not the case that a series of disconnected impact evaluations of individual projects will provide AID with the knowledge it needs about its CST projects. What is needed instead is a cross-project impact evaluation that uses the same methodology to examine CST project outcomes (employment and income), comparable measures of technologies applied in different settings, and methods that allow AID to compare delivery mechanisms and associate particular techniques with patterns of positive/negative outcomes, etc. These important issues are further complicated by the newness and short duration of many CST projects/ technologies--a factor that inhibits worthwhile impact

evaluations now, but should not deter AID from developing an adequate impact evaluation design for cross-project use.

3) The final major factor of critical importance is the consistent lack of evaluative attention to assumptions and hypotheses upon which any CST project rests. Assumptions may or may not be indicated in a project's logical framework. Few attempts were found in audits or evaluations to review whether any assumptions were left unstated in project designs or whether stated assumptions were valid.

Of even greater importance is the lack of hypothesis-testing in AID's evaluations. Any development project has a set of linked hypotheses which form a causal rationale for the project. The opportunity to critically examine these hypotheses and determine their validity is almost always missed and, consequently, so is the opportunity to learn more about what may or may not be true concerning development theories and approaches. ARD fully recognizes the difficulty of validating project hypotheses in a project context, particularly when the validation issue is approached from a positive causal connection perspective, i.e., an effort to demonstrate that "x" will cause "y". Only rarely has AID seriously attempted to set up this type of hypothesis test, as the basis for it simply does not exist in AID's ongoing CST projects. On the other hand, AID has many opportunities to examine hypotheses from the opposite perspective and, at times, even has the requisite data. <u>If AID approaches its hypothesis-testing tasks in</u>

evaluation with the intent of learning what works by finding out and eliminating what does not work, it can learn more than is gained from present AID evaluations. Thus, even within the existing stock of AID CST evaluations, it is possible to ask the research question: Is it possible to demonstrate that "x" does not cause "y"?

Using examples discussed in this report, it is possible to prove that AID can examine project hypotheses in this manner. For example, the IRRI project hypothesized that "if technologies which have been proven effective in the Philippines are provided to farmers in other parts of Asia and the subcontinent, similar effects/outcomes will be realized." The hypothesis, as demonstrated by the IRRI evaluation was invalid as initially posed. In this case, IRRI not only had to provide technologies, it also had to adapt them and provide institutional support, a requirement the project designers did not anticipate. Other examples from the cases examined demonstrate, by negative reasoning, that several other hypotheses in CST projects are also invalid or likely to be so if examined closely. Proving what doesn't work and building a store of "lessons" by this inversion of the textbook approach to hypothesis-testing through evaluation is a perfectly valid way to proceed to learn, and it is an hypothesis-testing method that is well within AID's reach.

The set of projects that AID selects to be part of the cross-project impact evaluation should include a mixture of

projects that:

- have tools/methods/information components and all major combinations thereof (e.g., tools and methods, methods and information, etc.);
- do or do not have an institution-building component;
- have private sector, public sector and PVO involvement of differing levels and emphasis (e.g., a mixture of these or possibly a heavy focus on PVOs or the private sector);
- have received some previous evaluation and either positive/negative changes in income and employment have been measured, critical constraints common to CST projects addressed, or a replicable diffusion strategy has been fully tested.

In the evaluation of CST projects, key gaps in recent evaluations that AID must address are:

- initial project design hypothesis-testing;
- actual income/employment gains;
- technical and cost analyses of the specific technologies/processes chosen and the impact on recipients (including durability of the technology);
- what happened to host-country project personnel after project completion; and
- any self-sustained replication of technologies or processes.

The end result of evaluations that include a particular focus on these issues, and others that we have pointed out as missing in most evaluations, will be a clearer perception of effective and ineffective strategies in the diffusion of capital-saving technologies.

APPENDIX A -- PROJECTS REVIEWED

| Project Number | Project Name |
|---|---|
| 2790019 | Poultry Development (Yemen) |
| 2790065 | Tihama Primary Health Care (Yemen) |
| 3670114 | Integrated Cereals (Nepal) |
| 3670123 | Radio Education Teacher Training (Nepal) |
| 3880017 | Food for Work (Bangladesh) |
| 3910417 | Village-Level Food Processing (Pakistan) |
| 4920277 | Population Planning II (Philippines) |
| 4920301 | Small Farmer System I (Philippines) |
| 4970198 | Agricultural Research (Indonesia) |
| 4970264 | Provincial Area Development I (Indonesia) |
| 4970270 | Family Planning Development (Indonesia) |
| 4980265 | Industrial Extension of Small-Scale Agricultural Equipment (Asia) |
| 5040031 | Special Development Activities (Guyana) |
| 5110451 | Basic Foods Production and Marketing (Bolivia) |
| 5110452 | Small Farmer Organizations (Bolivia) |
| 5110464 | Exploratory Research on Plant Systems (Bolivia) |
| 5110472 | Rural Enterprises and Agribusiness (Bolivia) |
| 5110499 | Village Development (Bolivia) |
| 5170130 | Rural Roads Maintenance and Rehabilitation (Dominican Republic) |
| 5180004 | Special Development Activities (Ecuador) |
| 5190197 | Small Enterprise Development PVO-OPG (El Salvador) |
| 5210074 | Agricultural Feeder Roads (Haiti) |
| 5210091 | Rural Health Delivery Systems (Haiti) |
| 5210095 | Appropriate Technology (Haiti) |
| 5220123 | Small Farmers Technologies (Honduras) |
| 5220130 | Integrated Rural Health Services (Honduras) |
| 5220139 | Agricultural Research (Honduras) |
| 5220157 | Rural Technologies Project (Honduras) |
| 5270162 | Appropriate Rural Technologies (Peru) |
| 5270176 | Rural Enterprise II (Peru) |
| 5271070 | On-Farm Water Management (Peru) |
| 5320046 | Integrated Regional Rural Development (Jamaica) |
| 5380005 | Special Development Activities (West Indies-Eastern Caribbean Region) |
| 5380030 | Basic Human Needs Employment Sector (Caribbean) |
| 5980572 | Science and Technology Information Transfer (Latin America/Caribbean) |
| 5980574 | Educational Media for Women (Latin America/Caribbean) |
| 6080158 | Cidera School Grant-Farm Development (Morocco) |
| 6210117 | Agricultural Credit (Tanzania) |
| 6210138 | Hanang District Village Health (Tanzania) |
| 6250928 | Regional Food Crop Production (Sahel) |
| 6310009 | Practical Training in Health Education (Cameroon) |
| 6410067 | Managed Input and Agricultural Services (Ghana) |

410072 Farmers Association and Agribusiness Development-FAAD (Ghana)
500019 Primary Health Care Program (Sudan)
600059 North Shaba Maize Production (Zaire)
640293 Livestock Feed Production Project (Tunisia)
640302 Small Farmer Supervised Credit (Tunisia)
850201 Cereals Production I (Senegal)
850210 Rural Health Services Development (Senegal)
850235 Cereals Production II (Senegal)
860201 Integrated Rural Development (Upper Volta)
860219 Rural Enterprise Development (Upper Volta)
980388 African Women in Development (Africa)
980410 Guinea-Bissau Rice Production (Africa)
120006 Foundation for Cooperative Housing (Science and Technology)
120007 Integrated Improvement Program-Urban Poor (Science and Technology)
310569 Application of Radio to Teaching of Math (Science and Technology)
311114 Science and Technology Information Transfer (Science and Technology)
311191 Off-Farm Employment (Science and Technology)
320076 Opportunities for Industrial Centers International-OICI (Science and Technology)
320091 Development Program Grant-ACPO (Science and Technology)
380145 Technoserve, Inc., Matching Grant (Science and Technology)

## APPENDIX B -- DEFINITION OF CAPITAL-SAVING TECHNOLOGIES*

### Definition

The "official" definition of capital-saving technology was adopted in April, 1980. Under this new definition, a number of projects in agriculture, industry, construction, nontraditional or renewable energy, population, health, and education and human resources can be properly classified as capital-saving technology projects. The new definition consist of four parts:

1. Capital-saving technology in the production of manufactured and agricultural goods and services in developing countries combines labor and capital in accordance with their relative prices and scarcities; involves the local community in adopting new technologies and in participating in cooperative credit, savings and loan, and extension services; is physically accessible to the poor since it is modest in scale, simple to install and durable in operation; is financially accessible by means of small per capita investments which reach small producers; and is locally maintainable, that is to say, capital-saving technology can generate self-sustaining and self-financing growth in the low-income sector.

2. Capital-saving technology in the provision of roads, dams, water systems and other components of physical infrastructure uses light equipment and is related to the employment, production, and welfare needs of poor persons and small firms.

3. Capital-saving technology in the provision of services for health, education and management requires low financial outlay and provides services that are accessible both physically and financially to low-income persons.

4. Capital-saving technology usually entails a small amount of capital investment per job created on an order of magnitude equivalent in poor countries to the cost per worker of economically efficient technologies financially and socially accessible to those employed in the rural and informal urban sectors.

By emphasizing the effort to generate self-sustaining and self-financing growth in the low-income sector, the new definition of capital-saving technology raises issues not thoroughly aired

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*From AID's Progress Report to Congress on Capital-Saving Technology, July, 1981.

in earlier, "first-generation" discussions.* First-generation discussions were preoccupied with definitions. The discussions focused on the effort to include social, political, cultural and environmental costs in a proper evaluation of technology suitable for use in developing countries. "Second-generation" discussions usually begin by accepting the notion that technology is not socially neutral. The adoption of any technology, especially an imported, sophisticated one, may have unintended adverse side effects. Second-generation discussions focus on the effort to implement the concept of capital-saving technology.**

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*The closely related "appropriate technology" movement, having passed through a first generation, also in a second-generation phase. See Nicholas Jequier's "Appropriate Technology: Some Criteria," in A. S. Bhalla's Towards Global Action for Appropriate Technology, Oxford, Pergamon Press, 1979, and Frances Stewart's "A note on Project Appraisal and Appropriate Technology -- Some Suggestions for Further Work," mimeo, 1980.

**AID is attempting to forge an agency-wide understanding of the issues raised in connection with the effort to implement the concept of capital-saving technology.

## APPENDIX C -- SYNOPSES OF THREE CST PROJECTS

In this section, we present synopses of evaluations for three projects from AID's CST portfolio. The projects chosen exhibit most of those aspects we think are critical to evaluating the success or failure of this type of project. The selection criteria for a synopsis were quality of evaluations, performance of project and important aspects of CST project implementation.

### IRRI Small-Scale Agricultural Equipment Extension Project*

Building on the International Rice Research Institute's long-established presence in Asia as a crop research facility, the IRRI Small-Scale Agricultural Equipment Extension Project was begun in 1975 with its purpose being "to establish continuing capability in the agricultural equipment manufacturing sub-sector (of selected countries)...based on IRRI designs..." This project is particularly instructive in the context of this review because:

- its unique method for developing and introducing a technology focuses on providing the private sector with research and development support based largely on expressed needs and priorities, and using a multidisciplinary team approach;
- an IRRI outreach program extends the project to three other target countries in Asia--Thailand, Pakistan and Indonesia--each with a very different set of social, economic and agricultural circumstances; and

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*This discussion is based on the February, 1980 evaluation of this project, Argento et al, AID, Bureau for Asia.

it has, on balance, succeeded admirably at the difficult task of technology dissemination.

IRRI's success has occurred in spite of many obstacles and failings. Its outreach program was poorly planned and managed. In extending its project, IRRI failed to take account of the "need to institute some of the managerial tools like sector appraisals, project agreements and implementation schedules which define objectives and obtain counterpart commitment." IRRI had to adapt its level of intervention to each country--Thailand and, to a lesser extent, the Philippines essentially needed only research and development support, while Indonesia and Pakistan required much more manufacturing and institutional sector development, which was unanticipated. Prototypes designed for the Philippines were found unsuitable for use in other countries without modification (e.g., the axial flow thresher in Pakistan). In Indonesia, IRRI's focus on thresher and tillage technologies, where they might not have been sociologically appropriate, raised questions of an "opportunistic" approach. (In defense of IRRI's focus, the 1980 evaluation notes that Indonesian farmers wanted to mechanize these tasks--where import threats were greatest--raising the issue of "whether it is appropriate for an outside aid-giver to cater to the prevailing demand in a national market, which, due to distortions, may not reflect national interests.") Moreoever, AID obstructed this inherently long-term project with deficient monitoring and erratic, short-term

funding, which made planning and recruitment difficult.

The success of the IRRI project, as described by project evaluators, rests on these key factors:

- IRRI's measured, multidisciplinary team approach to product development and dissemination considered farmer needs and priorities as well as manufacturing capability in prototype design;
- IRRI saw as its main goal to establish linkages between research and development (IRRI role), manufacturers and farmers;
- IRRI was careful to focus on a few priority technologies and license only a few manufacturers willing to submit to IRRI terms regarding quality control and servicing;
- IRRI staff and private-sector participants were energetic, motivated and resourceful individuals; and
- well-developed, eager manufacturing and agricultural sectors presented a ready market for an appropriately designed technology.

The 1980 evaluation of the IRRI mechanization project makes it abundantly clear that a favorable agricultural/ manufacturing milieu, capable and dedicated individuals, IRRI's product development methodology and private-sector involvement compensated for poor management and planning, and erratic funding procedures.

## Appropriate Technology in Haiti*

The Denver Research Institute's Appropriate Technology (AT) Project in Haiti exemplifies an ill-planned and poorly

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*Discussion based on the October, 1981 evaluation of this project by Louis Berger International, Inc.

executed CST project. To begin with, over two years elapsed between the issue of the project paper (1978) and signing the technical assistance contract (1980). This hiatus took a toll on Government of Haiti (GOH) commitment and project momentum. No review of the project paper was made prior to implementation. Moreover, the project design was deficient in several respects:

- decisions on specific technologies were unstudied in large part, and social soundness, economic and environmental assessments were of questionable depth and quality; there was no focus on a limited number of priority technologies;
- several major functions of an AT organization were omitted from the scope of work (e.g., information-gathering, networking with other existing AT groups in Haiti and a measured approach to AT diffusion);
- project's focus was on applied technology research to the exclusion of dissemination issues;
- implementation schedule was optimistic given the lack of technology focus and fact that no GOH cooperating entity existed before 1979; and
- initiative for the project came from AID, making GOH commitment tenuous.

Project execution was fraught with entanglements, including a power play by the subcontractor who circumvented the contractor with an amended scope of work submitted directly to the GOH cooperating agency. There was a chronic GOH funding problem (unpredictable flow of funds) which prevented the timely fielding of counterparts. The contractor was unable to supply any of the staff it proposed. Skills of the staff recruited were not matched to the technologies selected, and no

staff were truly effective in leadership or research and development. There was insufficient emphasis placed on coordination with parallel PVO and GOH appropriate technology activities and linking with existing AT expertise in Haiti.

Some AT prototypes were built, but these few stand little chance of dissemination under this project. In spite of all the management fiascos, two Haitian organizations, the Bureau National de Technologie (BNT) and the Centre National de Technologie (CNT), were left behind and have "shown themselves capable of carrying on the development of some appropriate technologies." This is due, more than anything else, to the motivation of some Haitian counterparts, who found the enthusiasm and energy of one technically "mismatched" consultant infectious.

Rural Technologies Project in Honduras*

The Rural Technologies Project, begun in 1979, was designed to accomplish three major objectives, namely, to increase:

- small farms' effective utilization of labor and land through the use of improved light-capital farm implements and structures;
- small-scale rural industrial productivity and employment through introduction of improved production and management systems in existing small enterprises, and establishment of new pilot enterprises; and

*This discussion based on the June, 1981 evaluation by de Beausset et al, AID.

utilization by the rural poor of low-cost appropriate technologies or products designed to improve living conditions in rural households.

The Rural Technologies Project is somewhat unique in the absence of an AID contractor. Instead, several Honduran government institutions (Center for Industrial Development, Development and Adaptation Unit, Ministry of Natural Resources, et al) bear the responsibility for project implementation with AID financing and coordination. Peace Corps, PVO and private-sector participation are also important elements in project implementation.

The project was hampered by numerous difficulties associated principally with new institution-building by the Government of Honduras (GOH), which was unable to provide counterpart financing, recruit extensionists or technical assistance, or facilitate procurement in a timely fashion. An inopportune change of government in mid-project brought in host-country staff unfamiliar with either GOH or AID procedures. The project was also delayed by an unrealistic implementation time frame and the need to devote extensive time to the selection of priority technologies for development.

These growing pains are being addressed, according to the evaluators, and significant progress has already been made toward project goals. Components which are doing well include information-gathering, industry studies, training of farmers and small industrialists (e.g., blacksmiths, seamstresses), small business management assistance and farm implement



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diffusion. Demonstrable positive effects on farm income (e.g., the introduction of waterwheels which double the growing season) and rural enterprise employment are cited. Moreover, the rooting of the "development process" in individual attitudes is clearly an output of this project as shown in the case of a new metalworking shop: "not only was a new business established, employing five people, but also it began to make carts, plows, and other implements. These were...tested and modified by...farmers and the shop owners until the implements were acceptable to the farmer." The success of this project to date is documented as attributable to:

- involvement of GOH institutions and cooperating agencies in the design phase and as prime project implementers;
- careful review and study of technological intervention with the major criterion being impact on earnings--this means prioritization and focus;
- reliance on nongovernmental institutions and private-sector entrepreneurs to assume, to a large extent, the tasks of idea generation, product development and sub-project execution;
- emphasis on extension work, information-gathering, networking and coordination; and
- motivated individuals.

The effective mechanism for technology transfer and enterprise development then emerges as an information, management, funding and technical assistance support system for a willing and motivated private sector.