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APPROPRIATE TECHNOLOGY AS A STRATEGY FOR DEVELOPMENT

Report of Appropriate Technology International for the Year 1984

Appropriate Technology International
Washington, D.C.

MAKING CASSAVA CAKES IN HAITI...With ATI technical and financial assistance, SAVACAMPE established a pilot, small-scale cassava or manioc processing plant to produce flour in Camp Perrin, Haiti. Cassava flour is mixed with wheat flour to increase its nutritional value. To meet the market demand created by the plant, rural farmers are growing cassava tubers on marginal lands; as a result, their incomes have increased by approximately 20%.

ATI implements its mission with public funds made available by the U.S. Congress through the Agency for International Development (AID). ATI's program is carried out in cooperation with the Employment and Small Enterprise Division of the Office of Rural and Institutional Development within the Bureau of Science and Technology of AID.

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Letter from the Chair of the Board of Trustees

AT

A century and a half ago, Alexis de Tocqueville found during his stay in the United States that "the equality of condition is the fundamental fact from which all other themes seem to be derived."

And later, in his famous book *"Democracy in America,"* he wrote: "What most astonishes me in the United States, is not so much the marvelous grandeur of some undertakings, as the innumerable multitude of small ones. Almost all the farmers of the United States combine some trade with agriculture. Most of them make agriculture itself a trade."

The reader of this ATI report, I think, will find these thoughts echoed in the sections that follow, both as to strategy and to style of operations. ATI is fortunate to have as its Executive Director, Ton de Wilde, holder of a Ph.D. from the University of Sri Jayawardenapura in Sri Lanka, who reflects de Tocqueville in his section of this report entitled "Growth Through Equity." Later articles move from strategy to such specifics as lime kiln design, commercial viability of small-scale cassava processing, and small-scale brick production.

ATI's long term strategy, which is a central theme of this document, was developed in 1984. Those who have followed the ATI story since its establishment in 1978 (a story which has some of the qualities of the Perils of Pauline), will realize that in earlier years ATI followed all too successfully its instructions to take risks. The Board of ATI is confident that it is now on the right track, and is deeply grateful to Mr. de Wilde and his associates, and to the patience and wisdom of the authorities of AID, whose collaboration made this development possible.

We believe that appropriate technology, as defined and put to work in this fashion, can have high impact on developing countries and that the modest role of ATI is now clear.

The next step, of course, is to be sure that projects are well chosen and evaluated, and if successful, are replicated where appropriate. ATI has its work cut out for it — work which will contribute to the betterment of the "innumerable multitude of small" undertakings in *today's* developing countries.

Francis Keppel

Francis Keppel
Chair
Board of Trustees

Appropriate Technology as a Strategy for Development

ATI's 1984 ANNUAL REPORT

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Introduction

Appropriate Technology International (ATI) is a private, not-for-profit, development assistance corporation based in Washington, D.C., which operates in Africa, Asia, Latin America and the Caribbean. In developing countries, ATI works with local enterprises and organizations to identify, adapt and disseminate technologies appropriate to the needs and resources of the rural and semi-urban poor. ATI's major objective is to get productive technologies into the hands of the rura' poor in developing countries in order to increase their incomes and improve the quality of their lives.

This Annual Report, which reviews ATI activities in calendar year 1984, is divided into two sections. The first part describes the philosophy underlying ATI's development strategy; the second part describes the actual projects implemented during 1984.

The principal elements of ATI's program are:

Building Technical Capacity Among the Poor

Sustained growth of the world economy depends on sustained economic growth of the people who form its core: the rural poor in developing countries. The program of Appropriate Technology International experiments with cost-effective approaches to set up productive activities in rural areas that add value to local resources and that can be maintained and improved locally. By linking technical and scientific research organizations in the developing countries, ATI acts as a catalyst in the appropriate technology process. In professionally designed and carefully monitored projects, which incorporate innovative high-risk technologies and strategies which promise a high pay-off potential, ATI tests applications of technical and scientific knowledge relevant to the needs and capabilities of the rural and semi-urban poor.

Promoting Private Sector Strategies for Development

ATI uses public money to explore areas of opportunity for private capital. The investment in productive activities in rural areas is largely unexplored and, therefore, is a high-risk proposition. Motivation, innovation, and creativity — inherent factors in high-risk ventures — are unlikely to be found in government organizations. This explains why most of ATI's project partners —the implementing organizations — are businesses and other private sector organizations which share ATI's commitment to the commercial, non-subsidized application of technologies which satisfy the demands of the market place and, at the same time, increase the productivity and employment of the poor.

Strengthening Local Institutions

Sustained development requires that local institutions provide a favorable environment for establishing and maintaining rural and semi-urban enterprises. Access to markets, to financial resources, and to training and maintenance services are examples of crucial institutional support systems. It is not enough to wire rural areas for electricity if people remain in the dark as to its use. Purchasing new machinery, in and of itself, does not contribute toward sustained development. Although ATI's resources are too limited to provide all institutional support requirements, ATI's program and project design consider these factors. Institutional support is either provided in the project itself or through contacts with outside institutions.

Building a Body of Knowledge About Appropriate Technology

In recognition of the fact that any seed germinates best under favorable environmental conditions, ATI works with recognized authorities in the development field to help identify policies which foster the use of appropriate technology. But studying policy, both positive and negative, is only one aspect of building a knowledge bank of successful appropriate technology development strategies. The entire process of project development — selection criteria, analyses, appraisal, review, monitoring, evaluation — provides an opportunity for ATI to increase its expertise in a variety of development strategies. Learning what does not work, in the long run, may prove as important as verifying what does work.

Program Implementation

The true test of any develop strategy depends upon its implem tion in the field. To analyze the ge principles underlying the succe failure of development strategies staff members document each st the selection, approval, implem tion, monitoring and evalu processes.

ATI's rigorous project selectior cess formally begins with a Co Review Meeting. Here the Proje ficers present ideas for possible pr these are screened not only fo soundness of the technology choic for potential commercial vial economic sustainability, widespread use beyond the or project locale. Once a concept is ap ed, the Project Officer returns t field to work hand-in-hand wit proposed project partner to form a project plan, which includes, a other factors, market analyses, tec appraisals, and assumptions of factors necessary for success. Follc severe in-house scrutiny, the p plan is then presented to the P Review and Advisory Committee (P composed of outside experts fror international development and scie communities. Based on their advic proved plans may be modified b they are presented by the Exec Director to the Board of Trustee 1984, 25 concept papers were prese 17 completed plans were submitt the PRAC for review, and 16 pr were approved for implementati the field. In addition, 16 Project Of made 46 field visits.

Once a project is formally appr and funds are committed, ATI members provide management technical assistance on a regular to implement and monitor the During their visits several times a ATI Project Officers observe, discuss with the project partners, gress and problems. If further spec ed assistance is necessary, ATI upon its Technology and Enter Development Group. This team proach to project selection and dev ment is an integral part of knowledge-building and knowl sharing ATI advocates.

Growth Through Equity

Ton de Wilde
Executive Director

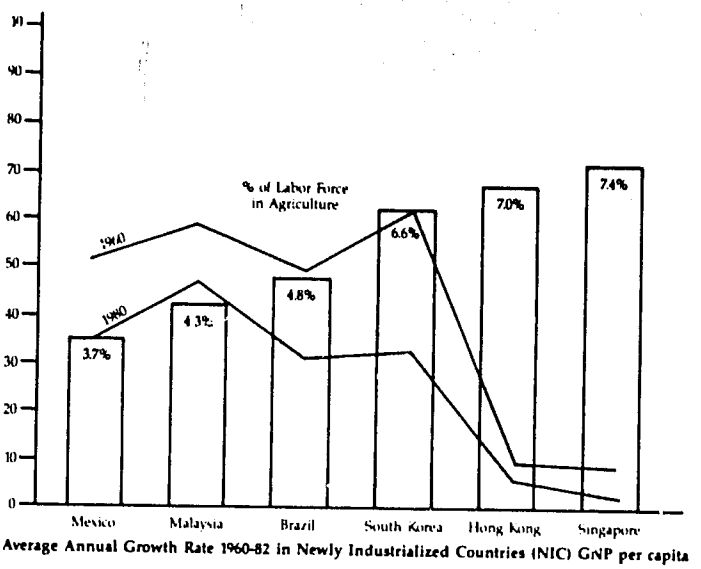
"Which workers increased productivity most in 1984?" This was the question on the front page of *The Economist* of February 2, 1985. The answer was not any of the 11 obvious candidates, ranging from a Japanese steelworker to a worker on a Detroit car-assembly line. The answer was: The Chinese Peasant. The editorial commented:

> "The World's largest and poorest industry is suddenly the one in which productivity can increase fastest. . . . The poor countries' new successes explode the old conventional wisdom that big dams, big irrigation systems, big farms, big everything are the way to agricultural growth. The heroes of these farming revolutions in China, Punjab, and other parts of the Third World are smallholders . . . Agricultural miracles start when countries stop favoring large-scale, equipment-intensive and capital-intensive farming."

The May 27, 1985 issue of *Business Week* had on its front page "Small is Beautiful," to call attention to its special report on the importance of small business to the economy of the United States: more than 50% of the new jobs created in 1984 were in small business.

What these two articles have in common is a clear recognition that something has happened to the economies of scale. Technological development over the last ten years has made it possible that "Small" can not only be "Beautiful," as E.F. Schumacher wrote ten years ago, but also "Powerful." As authors and corporate advisors Hawken and Shannon point out: The development of technology has drastically changed over the last ten years. Due to the higher price of energy, technology development has moved away from transformation of matter towards the transformation of information.

An excellent example in agriculture is the shift in emphasis from agricultural mechanization toward development of high-yielding seed varieties — a transformation of genetic information. The computerization of garment-cutting techniques serves as an excellent example in industry. Ten years ago, technology development was focused on faster and easier-to-handle cutting and sewing machines. Today, developments make it possible for six



Average Annual Growth Rate 1960-82 in Newly Industrialized Countries (NIC) GNP per capita

people operating a computer-controlled machine to cut more pieces from the same amount of cloth than 200 workers were able to cut previously.

This new trend in the development of technology has made the use of technology more scale neutral. When small is as efficient economically as large, small has an added advantage: small groups and small enterprises stimulate innovation, motivation, and creativity.

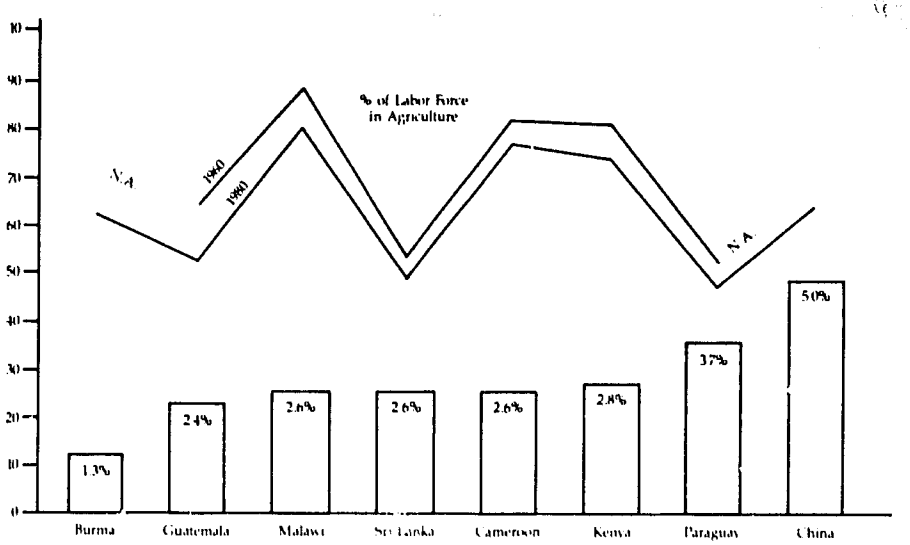
This change in focus of the development of technology presents a challenge and an opportunity for Third World development. The comparative advantage some developing countries had in the form of cheap unskilled and semi-skilled labor will decrease. The use of micro-electronics in production will replace thousands of jobs. On the other hand, the productivity of the millions of small farmers, small entrepreneurs, and workers in the informal sector can significantly increase, as demonstrated in the case cited in *The Economist*.

Important successes have been achieved by development strategies which seek ***growth with equity:*** large-scale projects mainly concentrated in urban or semi-urban areas, using sophisticated capital-intensive technologies, the benefits of which were to trickle down on the intended beneficiaries. However, the development strategy which ATI advocates is ***growth through equity:*** large and small-scale projects using technologies, simple and complex, adapted to the resource endowment and local situation of the millions of poor people living in the rural and semi-urban areas of LDCs. The hypothesis ATI is offering is that policies and programs which consciously promote socio-economic development at the micro-level can produce growth at the macro-level equal to or sometimes greater than large-scale capital-intensive national development efforts.

While the "Small is Beautiful" issue of *Business Week* demonstrates the validity of this thesis for the USA, we still need convincing evidence to support this thesis in Third World countries. On the other hand, development analysts are starting to question the model of industrialization followed by the industrialized countries, and until recently, also followed by a small group of countries well advertised as Newly Industrialized Countries (NICs).

Following the analysis in *The Economist* quoted above, Nicholas D. Kristof uses similar arguments in his *New York Times* article of July 28, "The Third World: Back to the Farm." ". . . Farmers, not industrial tycoons are seen now as the pivotal figures who can help pull their countries from the mire of indigence."

While the impressive national growth statistics of the "NICs" — Mexico, Malaysia, Brazil, South Korea, Hong Kong and Singapore—are being analyzed further, attention might focus on the experience of those Third World countries whose policies have been more



Average Annual Growth Rate 1960-82 in Revitalized Agricultural Countries (RAC) GNP per capita

supportive of the small farmer and the small rural entrepreneurs. These countries, which might be called the Revitalized Agricultural Countries or (RACs), have a modest growth in GDP (not as high as that of the NICs but higher than average for their income group as classified by the World Bank), and have shown respectable and, in some cases, very high rates of agricultural growth. Most important, the RACs retained a large proportion of their labor force in agriculture.

These RACs include Burma, Guatemala, Malawi, Sri Lanka, Cameroon, Kenya, Paraguay, and China. They cover a wide range of the economic/political spectrum, from centrally-planned to market-place economies, and from democratic to autocratic rule. The connecting thread among these countries appears to be a successful nurturing of small-scale or household production.

The accompanying figures compare Average Annual Growth in GNP between the NICs and the RACs from 1960-1982. The lines indicate the percentage of the work force in agriculture in 1960 and 1980 respectively. Further study of general trends in the distribution of the labor force in country groups shows that in the industrialized countries, the labor force in agriculture is tiny, the labor force in industry is high but falling, and new jobs are being created in the service sector. By contrast, in the NICs, industrial employment is still rising rapidly, while service sector employment is steady or falling, and agricultural employment is falling fast. The RACs still show predominant employment in agriculture and few jobs in services and industry but there are indications that their industrial employment is rising while agriculture remains buoyant.

The RACs appear to have achieved both a successful national output record and a successful record of distribution. In other words, the RACs appear to have found that elusive "Nirvana" of development economics, ***growth through equity***. I would argue that this is not an accident: by nurturing their small farmers, the RACs are easing the labor pains of industrialization and fostering economic growth at the same time.

Given the vagaries of labor statistics, and the inherent complexities of the social, economic, and political forces that underly national accounts, I do not want to try to put too fine a point on the example of the RACs. The experience of the RACs provides a first indication of proof for the thesis that policies and programs which consciously promote socio-economic development at the micro-level can produce growth at the macro-level equal to or sometimes greater than large-scale capital-intensive development.

The 20 or more years of development in the RACs indicate that small can be powerful and sustainable. While development analysts, economists and planners turn their attention increasingly toward rediscovering small-scale agriculture, there also emerges a strong need and market for more and more efficient technologies for the small farmer — for instance technologies for the handling and processing of the increased agricultural produce, more efficient tools and equipment for use on the small farm, and bio-technological applications. Not only has the farmer a need for technologies that increase productivity on the farm, but to sustain these on-farm productivity increases, there is a need and a market for non-farm technologies. Better access to markets to sell produce, access to more and improved farm inputs, better transport, larger and better storage facilities are all needed.

As demonstrated by the project descriptions on pages 21-31, Appropriate Technology International has a program in place which, if successful, will contribute to knowledge about how to achieve increases in productivity and create employment in small enterprises and on small farms to respond to this growing demand.

References

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Shannon, (Dian Cohen & Kristin Shannon) *The Next Canadian Economy*, Eden Press, Montreal, Canada, 1984

Appropriate Technology: Potential for High Impact

John L. Rigby
Director, Planning & Policy

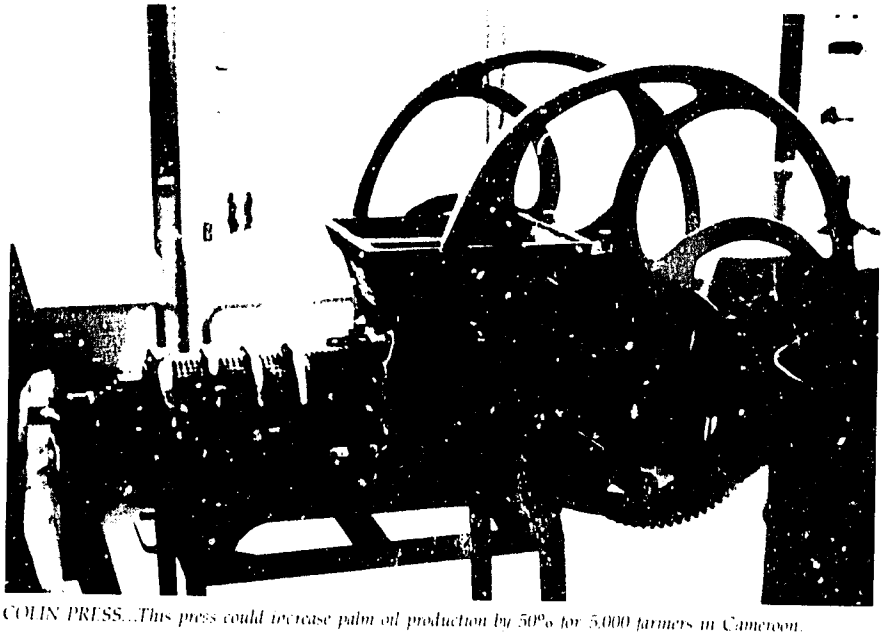
- Can an "appropriate technology" increase soybean production of 16,000 small farmers in Thailand, yielding annual net gains of some $3,000,000 in the farmers' incomes?
- Can an "appropriate technology" generate small-scale village manufacturing operations in Indonesia, increasing annual incomes for some 24,000 poor families by 20% (or $4,000,000) annually?
- Can an "appropriate technology" increase palm oil production for 5,000 farmers in Cameroon by 50%, with 50% - 70% reduction in processing time, yielding annual income increases of upwards of one million U.S. dollars?
- Can an "appropriate technology" increase the annual income of 2,000 small-scale swine producers in the Dominican Republic by at least $300,000 per year?

Obviously, these are meant as loaded questions — to suggest that the types of demonstration projects in which ATI participates have a potential for observable impact to a degree which is too seldom associated with the strategy *qua* phenomenon described as "appropriate technology."

Demonstration projects for which ATI provided technical, financial, and managerial assistance in 1984 are testing hypotheses which would yield affirmative answers to the questions posed above. Moreover, replication of the innovative elements of these particular projects — whether the replication is achieved through promotional efforts by ATI, through positive intervention by other private sector or public sector institutions, or even spontaneously — can yield benefits measured in multiples of the initial demonstration project objectives.

During 1984, ATI worked with more than 100 organizations to develop new projects with an expected impact similar to the examples cited above.

In December 1984, ATI staff concluded a Working Paper entitled *High Impact Appropriate Technology Case Studies*. This document (available on request) is being circulated to the development community in the Third World and in the North in support of the proposition, as stated in the paper's preface, that "important answers to problems in development can be found in small, commercially viable, and economically sustainable productive activities that have the potential to benefit masses of people without major capital investments."



COLIN PRESS...This press could increase palm oil production by 50% for 5,000 farmers in Cameroon.

High Impact Case Studies is a first effort to identify general principles underlying the success of cost-effective development strategies that use appropriate technology. The *Studies* review eight examples of appropriate technologies which have been widely disseminated — some even globally. The examples are:

1. *The Mark II Handpump of India.* Safe drinking water is being provided to an estimated 120-150 million villagers in India by these handpumps.
2. *Oral Rehydration Therapy (ORT).* The private and public sectors produce worldwide some 100 million packets of a glucose-electrolyte mixture to combat diarrhea.
3. *Water Pumping Windmill Industry In Argentina.* Over the past two decades, approximately 60,000 water-pumping windmills have been produced by the private sector. Everyday 300,000 people receive water for their cattle, other livestock, and even home use.
4. *Bamboo-Reinforced Concrete Rainwater Storage Tanks In Thailand.* Drinking water catchment tanks disseminated by an ATI partner organization with ATI assistance serve approximately 50,000 rural people.
5. *Labor-Intensive Rural Access Roads Programme In Kenya.* An appropriate technology approach to the civil construction functions of earthworks, production of aggregates, and surfacing, has produced over 7,000 kilometers of new roads, almost 50% of which are graveled.
6. *Bamboo Tubewells In India.* The low-cost bamboo technology for irrigation tubewells has, since its introduction 18 years ago, been adopted on a massive scale. Estimates are that more than 100,000 now are being used in the states of Bihar and Uttar Pradesh.
7. *Rural Small Farm Implements Components Manufacture In Tanzania.* With ATI assistance, a project partner has sponsored establishment of two private sector production and distribution operations which in the first two years of operation have produced and sold more than 2,000 ox carts and 2,500 toolbar-plows.
8. *Women's Pappad Processing Cooperative Enterprises In India.* Twenty-five years ago, seven women invested 80 rupees in a very low-cost nutritional snack food venture. Today this business generates sales in excess of 30 million Rupees ($3.75 million), and income for more than 6,000 cooperative members.

Two of these Case Studies — the India Mark II Handpumps, and the Bamboo-Reinforced Concrete Rainwater Storage Tanks in Thailand — are summarized on the next pages.

Mark II Handpumps In India

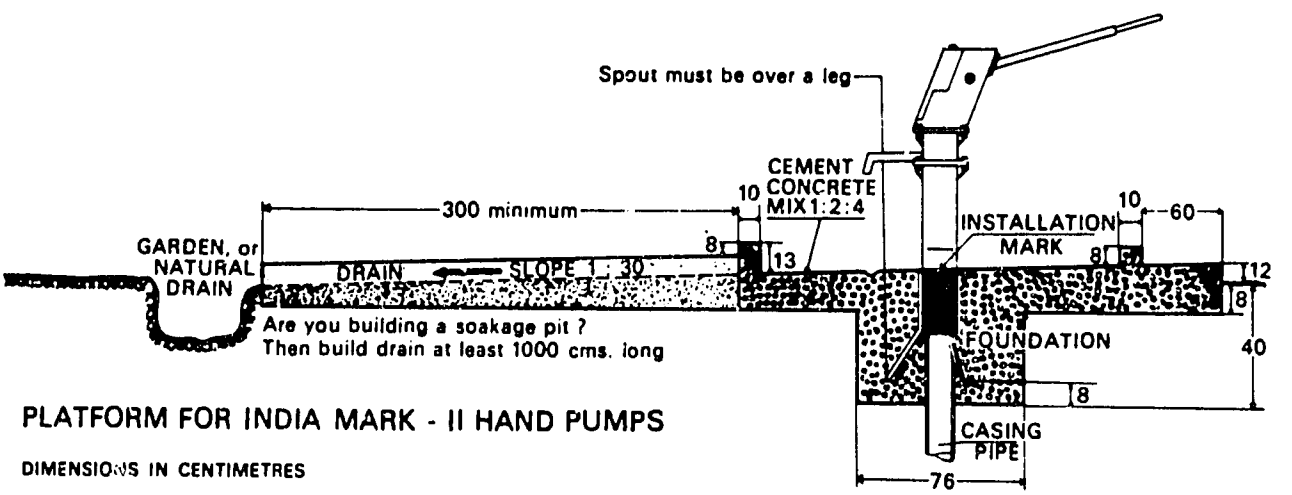
The Mark II pump design resulted from efforts by private agencies in Northern India during the late 1960s and early 1970s to combine effective deep well drilling technology with a durable pump design. Initially, an Indian private voluntary agency in Jalna, Maharashtra, introduced new and imported rotary drilling rigs for community wells to tap groundwater sources otherwise inaccessible to villages. In 1967, after cast-iron pumps failed repeatedly, a new, sturdier, all-steel handpump, called the Jalna pump, was developed. In the early 1970s, Maharastra modified the design of the Jalna pump, which became known as the Sholpur pump. This improved design was more professionally engineered and accurately manufactured for uniformity and incorporated features now found in the Mark II pump (i.e., roller chain, a new pivot mechanism, and a pedestal to fit over the well casing pump). UNICEF assisted in further technical modifications and test dissemination projects.

The Mark II handpump design is unpatented and remains freely accessible to the public. A number of Indian industries, both private and parastatal, now manufacture and sell the Mark II pump. As of December 1984, 38 firms ranging from very small to medium-scale were engaged in pump manufacture, and estimated total production capacity was quoted at 13,000 handpumps per month. Thus:

- The private sector now produces 156,000 Mark II handpumps per year;
- Approximately 8,500 people now constitute the labor force involved in the production of the pumps;
- At any one time in India now some 50,000 individuals are drilling new wells and/or supervising and maintaining existing installations;
- As of December 1984, more than 600,000 Indian Mark II handpumps had been installed in Indian villages, towns and cities. An average of 200-250 persons are served per installation. This means that in India today, 120-150 million villagers benefit from the Mark II handpump technology;
- In the past five years, Indian manufacturers have exported an estimated 15,000 - 20,000 Mark II pumps to more than thirty developing countries.

ATI analysis of the Mark II experience suggests that the principal reasons for its initial and sustained success include the following:

- Constant field use proves the pump's capacity to deliver adequate volumes of water to substantial numbers of people;
- The design is well suited to decentralized manufacture at medium-scale workshops with rudimentary equipment;
- The delivery and maintenance system is highly effective and well organized (use of semi-sophisticated drilling equipment; relatively simple labor-intensive installation; and a three-tiered maintenance system at village, subdistrict, and district levels);
- To assure uniform design and interchangeable parts, the Indian Standards Institute has made national standard design specifications available at no cost to all potential manufacturers;
- The pump users actively participate in each critical step of installation, operation, and maintenance;
- UNICEF and competent and respected engineering inspection firms exercise sufficient control over manufacture and delivery to maintain high standards of quality and reputation.

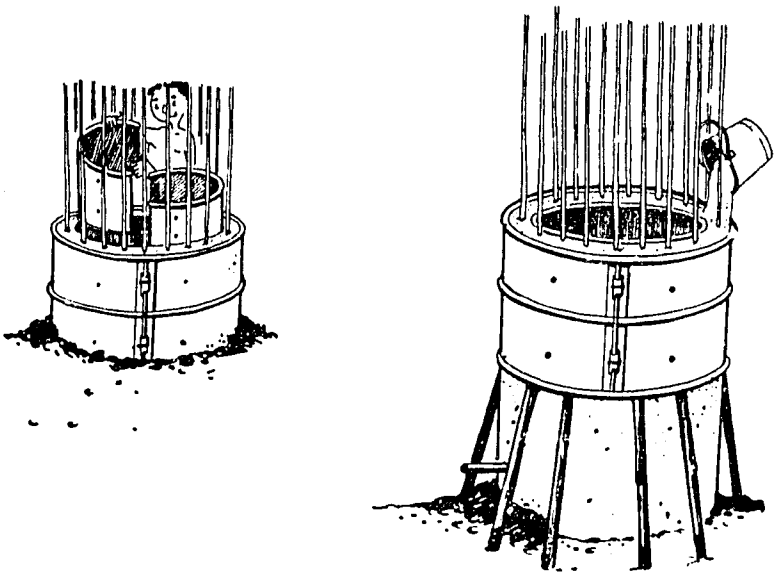


PLATFORM FOR INDIA MARK - II HAND PUMPS

DIMENSIONS IN CENTIMETRES

Courtesy of Industrial & Allied Sales Private Ltd., New Delhi

Bamboo Reinforced Concrete Water Tanks Project



BUILDING BAMBOO-REINFORCED CONCRETE WATER TANKS...PDA Thailand uses illustrations like these to provide step-by-step building instructions to villagers.

The Community-Based Appropriate Technology and Development Services (CBATDS) is an affiliate of Thailand's largest private voluntary organization, the Population and Community Development Association (PDA). PDA created CBATDS in 1979 with financial and technical support by ATI, to diversify its services. Once in place, CBATDS began generating rural development projects to improve the income and quality of life for rural Thais. In fact, many of the CBATDS programs in water resource development, cottage industries, agricultural extension, etc., are predicated on the participation of the expansive PDA network of family planning acceptors, volunteers, and growing staff active in approximately 16,000 villages throughout Thailand.

Eighty percent of Thailand's population, or 48.5 million people live in 51,000 Thai villages. PDA and CBATDS concentrate their efforts in Northeastern Thailand, the poorest and least developed region of the country. One-third of the population of Thailand lives in the Northeast; and their income is one-third that of the national average.

Shortly after its inception, CBATDS began promoting the dissemination of a low cost water storage tank or cistern (or "Tungnam" in Thai). The technology involves a bamboo-reinforced concrete cylindrical tank which receives (and stores) rainwater from the sloping metal roofs common in Northeastern Thailand. A woven mesh formed from untreated bamboo increases the tensile strength of the concrete used in tank construction and reduces the loop and bending stresses on the base and walls of the tanks. The basic design now employed by CBATDS has a capacity of 11,300 liters and is adapted from designs previously developed by Khon Kaen University with support by the Thai Division of Sanitation and UNICEF.

By the end of 1984, CBATDS had mobilized technical, organizational, and financial assistance to construct more than 7,000 bamboo-reinforced concrete rainwater collection and storage tanks for individual households. The participants in the program contribute their own labor and repay all material costs, plus a small surcharge, into a revolving loan fund.

CBATDS estimates that between 30,000 - 50,000 rural people currently receive direct benefits from the CBATDS Tungnam program. CBATDS believes that a total of between 7,500 and 10,000 additional tanks will be purchased by villagers in Northeastern Thailand over the period 1985-1987. Projections to 1990 indicate that the program will provide sanitary drinking water to up to 200,000 people.

ATI analysis indicates that the primary reasons for the continuing success of the CBATDS water tank program include the following:

- CBATDS' parent organization, PDA, is a well-known entity which has been involved at the village level in family planning and community service activities for many years. Therefore, villagers have confidence in PDA and are willing to participate in the project;
- By providing credit, technical, logistical and organizational packages, CBATDS helps villagers overcome the obstacles they would face in trying to build the water storage tanks on their own;
- The technology chosen was familiar to enough people in the project area to generate a viable threshhold of support among opinion-makers and eventual participants;
- A comprehensive and participatory needs assessment and technology choice and adaptation process in the early stages of the project paved the way for a solid technology financing and dissemination scheme and effective project management structure.

ATI's Agenda for the Coming Years

In 1984, following several months of discussion between AID (ATI's major source of funding) and ATI, ATI adopted its Long Term Strategy as a program guide for the next five years. This document serves as the framework for ATI's Annual Work Plan, prepared each fiscal year in conjunction with an operating budget.

This Long Term Strategy is not etched in stone; it is reviewed and adjusted regularly. As this Annual Report goes to press, ATI is discussing with AID specifications of a section on the follow-up and replication, in other areas/regions of the world, of technologies tested in ATI's demonstration projects. The Annual Report for 1985 will report on this Replication Addendum.

A portion of The Long Term Strategy follows:

"The fundamental objective of ATI is to implement programs that demonstrate the utility and cost-effectiveness of development strategies directed towards rural and semi-urban areas which disseminate commercially viable and economically sustainable technologies adapted to the resource endowment of the rural and semi-urban poor, and to facilitate the use of these development strategies by other organizations on a wider scale.

"Due to its limited resources, ATI has selected specific areas in which to focus its energies in order to effectively pursue its objective.

1: ATI directs its program toward bringing benefits to the poor in rural and semi-urban areas of developing countries. Although individual projects often have several groups of intended beneficiaries, ATI's primary target group remains the rural and semi-urban poor;
2: ATI focuses its activities within three technical areas: agricultural products processing and utilization of agricultural wastes; local mineral resource technologies; and equipment and support for small farms;
3: ATI emphasizes that the development and dissemination of appropriate technology require a multidisciplinary approach; however, within this approach, ATI will have a "hard" technology at the core of its programs and projects.

"ATI's field program is based upon a close, cooperative partnership with local institutions, predicated upon the assumption that the achievement of meaningful, sustainable growth and improvement in a particular region must directly involve local people in all stages of the development process. ATI's relationship with these local organizations involves an extensive amount of communication and planning in identifying local needs and priorities, and their relation to and interaction with project design, development, and implementation. ATI project holders are characterized by a significant outreach capacity, a capacity to manage project funds, to implement a specific project within a specified time frame, and to monitor and evaluate the project.

WOMEN CARRY COMPOST TO THEIR SMALL RICE PLOTS. Compost, used to fertilize and condition land, is an agricultural input. One aspect of ATI's program involves increasing the efficiency of agricultural inputs; this will lead to greater agricultural productivity, especially on the small farm.

"In the process of working with subproject implementing organizations, ATI will continue to direct its energies toward the development of strategies which help to integrate and, when necessary, augment the talents of existing local institutions, particularly:

- private organizations with strong links to the poor that can identity opportunities and provide services to rural small-scale industries;
- science and technology institutions which can provide innovative technology and guidance in adapting technology to conditions of the people in the project areas;
- private entrepreneurs investing in small industries with strong backward linkages to the poor through the purchase of raw materials from the poor;
- government extension efforts which have potential for dissemination of technologies that can be used by the poor; and
- financing institutions which have potential for dissemination of technologies that can be used by the poor.

"In conjunction with ATI's emphasis on facilitating productive activities that provide long term benefits to the poor, ATI stresses that technologies and products introduced must prove to be commercially viable and economically sustainable. In other words, production systems introduced in a project must prove to be viable by conventional standards of business analysis. ATI also takes into account the benefits that accrue to the intended beneficiaries through forward and backward linkages. For example, ATI might support a productive activity which promises only a marginal rate of return if the added income to suppliers of raw materials to the enterprise is significant. In addition to proving that technologies are commercially viable, ATI emphasizes that technologies and productive activities introduced must prove to be sustainable in the long run.

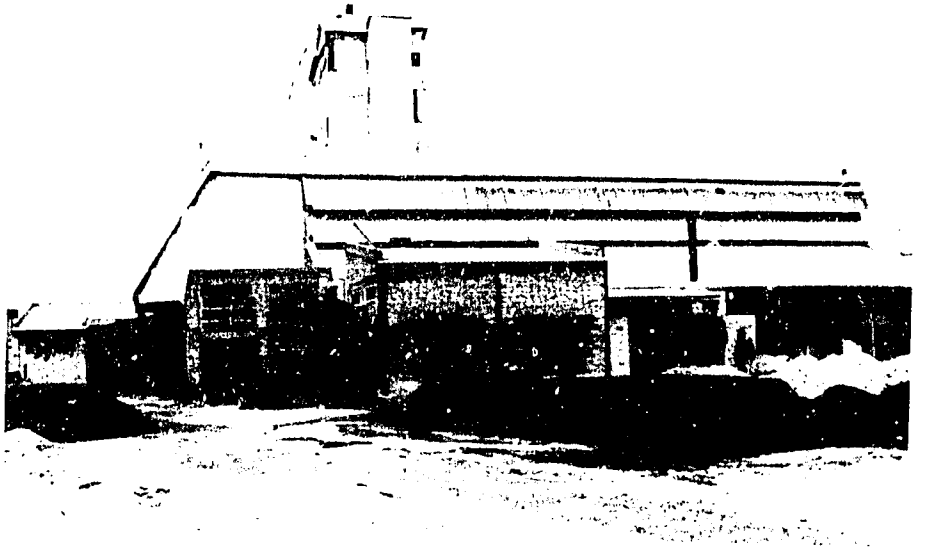
"Innovative elements relating to 'hardware' might be achieved through upgrading traditional technologies, adapting technologies utilized in other

geographical areas, adapting and/or down-scaling modern technologies, introducing technologies developed in R&D laboratories, or a combination of the above examples. Innovative elements relating to the 'software' or support systems might be achieved through adaptation of organizational, management, accounting, or financial systems, marketing efforts, financing mechanisms (such as adapting franchise or lease/purchase arrangement to rural situations), or training programs (such as training paratechnicians).

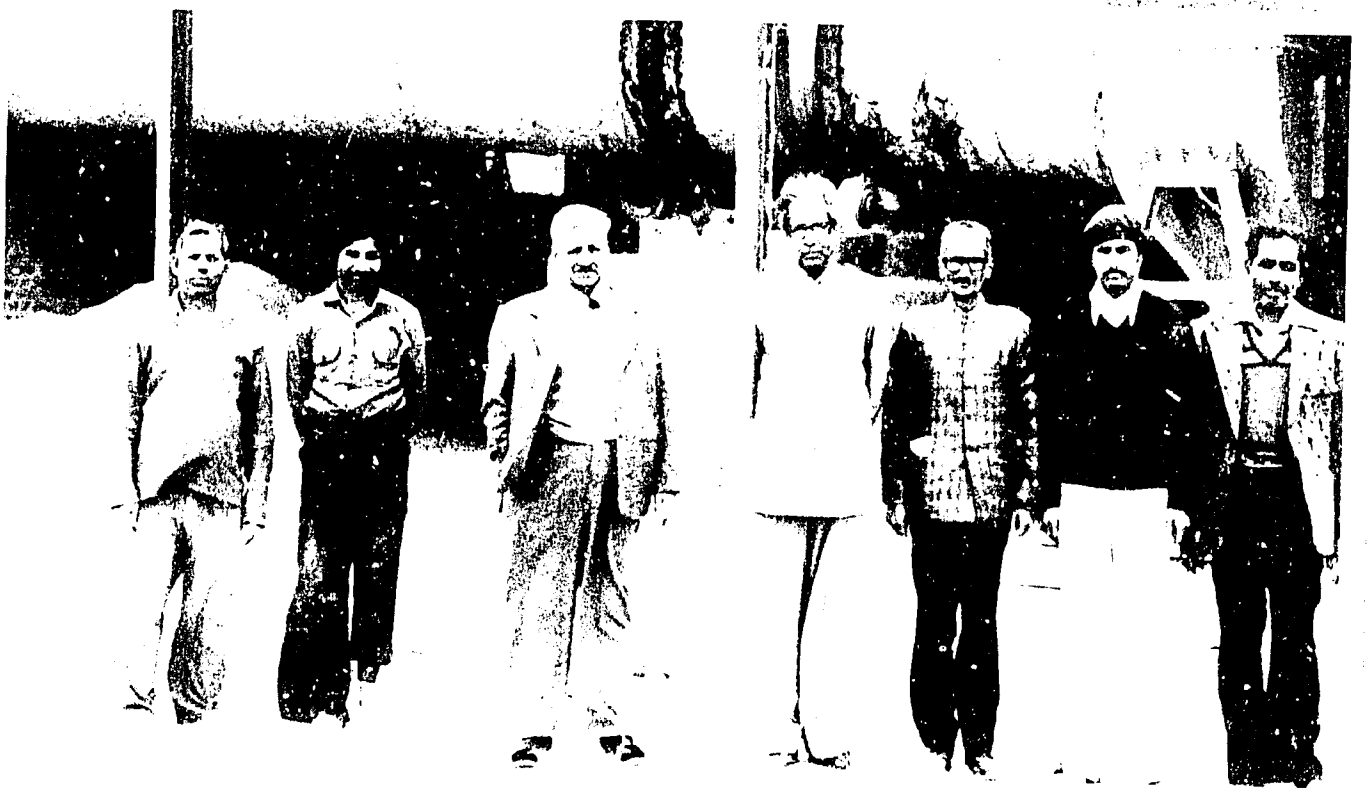
"All technologies must be accompanied by an equally important support system aimed at adapting and integrating the particular technology to the unique physical and cultural environment of each region or village in which it is introduced. The necessity of ensuring the availability of required support systems underlines the importance of integrating the talents of local organizations, as discussed above. When integrated, the varied talents of these organizations can complement each other in providing a complete package of necessary support systems.

"For a project to be considered successful, the innovative element(s) involved must not only be disseminated on a wide or significant scale but must also be disseminated in a cost-effective manner. In addition, the technologies or products introduced must prove to be commercially viable and economically sustainable.

"When a project has proven to be successful in the field, its innovative elements are considered for replication outside the purview of the original project."



MINI-CEMENT PLANT...AIDA India developed a mini-cement plant with a capacity of 25 tons per day of Portland quality cement. This technology is being considered for replication, pending final technical assessment.

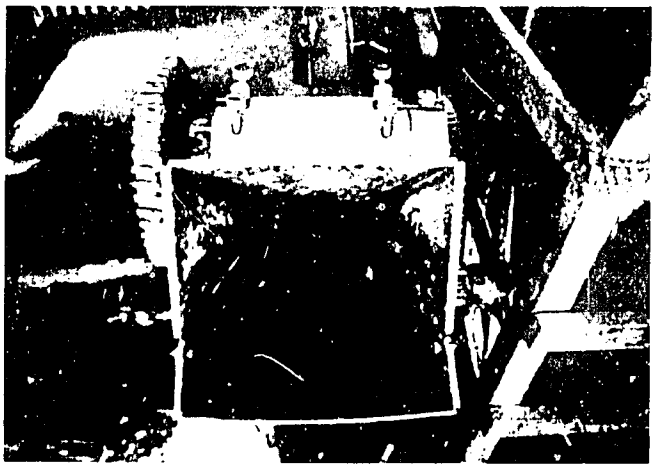


DEVELOPER OF MINI-CEMENT TECHNOLOGY The late M.K. Garg (3rd from left) spent most of his life developing appropriate industrial technologies. Mr. Garg is shown with his team in spring, 1984.

Macro-Policies for Appropriate Technology

Dr. Frances Stewart
Institute of Commonwealth Studies, Oxford University

EDITOR'S NOTE: Advocacy of appropriate technology as a development strategy requires active participation in a policy dialogue with Governments and influential institutions both in the Third World and developed nations. ATI has contracted with Francis Stewart of the Institute of Commonwealth Studies, Oxford, England, to examine the relationship between government policies and appropriate technologies in developing countries. This article by Dr. Stewart describes the policy studies being conducted by eight experts which she is supervising. These studies, preceded by an overview in which Dr. Stewart presents her major conclusions, are expected to be published by ATI in autumn, 1985.



SUGAR CANE CRUSHER Macro-policies and their effects on technology choice in the sugar processing industry is the subject of a study conducted by Raphael Kaplinsky.

This project is designed to identify the set of general government policies which would be conducive to the introduction of appropriate technology on a wide scale. In addition, the project hopes to contribute to our understanding of how political circumstances condition policies.

The general presumption behind the project is that the widespread dissemination of appropriate technology in developing countries requires a favorable policy environment. Without such an environment, particular AT projects are likely to be of limited use, with their effects often confined to the project itself, and with little probability of replication on any scale.

The project consists of eight studies in a number of developing countries. Each study covers different aspects of the question of government policies for appropriate technology.

Four of the studies are completed. Ashok Rudra has surveyed policies towards Indian agricultural technology over the last few decades. He shows that in the last twenty years, government policies have tended to favor inappropriate technologies — mainly tractorization and chemical fertilizers. The study identifies a more appropriate set of policies, and analyzes the political interests responsible for past policy choices.

Raphael Kaplinsky examines choice of technique in sugar processing in India and Kenya, identifying the policies, in each country, which led to the particular technological choices. Many of these choices involved inappropriate technology (capital-intensive and large-scale). One major influence on choice of technique in this case was the price of sugar cane. Decisions were made without consideration for the implication for choice of technique in processing; another influence was the size of the farms producing sugar cane. The study identifies the major interest groups affected by various policies, and how their power over policy-making led to the particular outcome in each country. The study is particularly relevant to the AT movement, which has been successful in improving the efficiency of small-scale techniques in this industry. Therefore, policies to encourage the widespread adoption of the appropriate technology are now required to secure the dissemination of the improved technology, and to ensure that the research and development effort has results in terms of the technology in use in the industry.

Jeffrey James has reviewed technology choice in parastatals in Kenya and Tanzania. He finds that despite the many differences between the two countries, choices have been generally inappropriate, in terms of scale, capital-intensity and product. The motivations of decision-makers within the parastatals, interacting with the economic environment, are found to be responsible for this outcome. One important influence is the priority given to maximizing output, at almost any cost. In the prevailing environment of acute shortage of foreign exchange, this led to the adoption of technologies supplied on credit from abroad, irrespective of the appropriateness. In addition, the objective of maintaining "high" (i.e., advanced country) product standards was also responsible for capital-intensive choices, especially in Kenya. The study identifies changes in economic environment and in the structure of the parastatals which would lead to more appropriate choices.

Gustav Ranis and Frances Stewart investigated rural industrialization, comparing the Philippines and Taiwan, focusing especially on the linkages between agriculture and rural industry and services. Both countries have had a good performance in agriculture and both have experienced sustained expansion in rural industrial activities linked to agriculture, but the expansion in rural industry has been much more rapid in Taiwan than in the Philippines. The study traces the factors responsible for this difference. These include the nature of agricultural development, notably crop composition and the rate of mechanization, organizational choices in processing agricultural products, and the extent and distribution of rural infrastructure. The study identifies policies which would strengthen rural linkages, thereby generating more rapid growth in rural industry, which in turn would promote agricultural development.

Other studies still in process include an investigation of improved cooking stoves in Nepal and manual irrigation pumps in Bangladesh. One study examines the effects of government standards in raising productivity in machine tools in Japan (historically) and in contemporary China. An investigation into technical change in industry in Latin America will elucidate policies likely to produce an appropriate direction in indigenous technical change.

Upgrading Traditional Rural Technologies*

Jeffrey James
Boston University

Slightly more than a decade has passed since the publication of Schumacher's *Small Is Beautiful*. Judging by the subsequent prominence of the appropriate technology concept in the development literature, one might conclude that Schumacher's central message has been at least thoroughly examined, if not widely accepted. However, close inspection of the literature shows that such a conclusion is not warranted. What Schumacher advocated was a redirection of development efforts in favor of the non-modern sector, and in particular, the application of "intermediate technology" to improve the standard of living of this sector. In contrast, most of the literature has focused on the modern sector, addressing the technological problems posed by international transfers of technology, multinationals, factor price distortions, etc. With few exceptions, the corresponding problems of the non-modern sector have been neglected. The purpose of my paper, *Upgrading Traditional Rural Technologies*, is to begin to redress this imbalance and to argue for renewed interest in Schumacher's original concern with the non-modern sector as the primary focus of policies for appropriate technology.

The most common perspective of those who have focused on the non-modern sector is that the solution to the technology problem is to make more productive alternatives available to the poor. This view is inadequate for several reasons. First, it begs the question of whether alternative techniques should comprise improved versions of traditional methods, downgraded variations of modern methods, or entirely new alternatives. Second, focusing exclusively on that part of the non-modern sector in which the poor are located, leads to neglect of the dynamic linkages with other parts of the economy on which the ultimate success of policy often hinges. And finally, by making the adoption of appropriate technology the end result, the issue of the efficiency with which the adopted techniques are used over time is ignored.

Upgrading Traditional Rural Technologies advocates a more dynamic and "holistic" approach to the technological problems of the non-modern sector. We begin by making the case for upgrading widely-used traditional techniques, as opposed to a policy of down-scaling modern technology or generating entirely new alternatives. Thereafter, we argue that an adequate upgrading framework must take into account that the adoption of improved technology is only one link in a dynamic process, that what occurs in the non-modern sector is dependent on the relationship of this sector to others and that heterogeneous poverty groups are affected in diverse ways by the particular form of the upgrading process.

SHAPING CERAMIC POTS. These technologies, if upgraded, can bring significant economic growth, states Jeffrey James.

The point of departure of *Upgrading Traditional Rural Technologies* is the view that because there are vast numbers of rural poor who are dependent upon traditional technologies in farm and non-farm activities, considerable scope exists for alleviating mass poverty through upgrading the productivity of these technologies. So far, the predominant response has been to focus on the technical (engineering) problems of generating improved technologies and, to a lesser degree, on the problem of disseminating information about the new technologies. This response is too narrow in that it ignores economic issues that are critical in determining the outcome of upgrading efforts. We advocate a broader concept that locates upgrading in a context of heterogeneous poverty groups and complex intersectoral linkages and in which the adoption of improved technology is only a necessary condition of a successful outcome.

The import of this expanded focus is to shift policy emphasis towards consideration of those factors that determine the sustainability of a *process* of *continued* improvements. This requires those concerned with policy to consider the nature of the interdependencies between traditional producers and other economic agents. (Economists refer to this as a "general equilibrium" approach). The analysis of these interdependencies must be conducted within the framework of a dynamic, as well as a static methodology.

Within the framework of the broadened approach, the following constitute

*Condensed from Working Paper Prepared for ATI in 1984

UPGRADED SISAL SPINNING. Upgraded technology made sisal spinning profitable.

the specific factors on which policy ought to focus:

a) *Dissemination:* There are several characteristics of traditional technologies that give rise to alternative ways in which new technologies should be promoted. Among the most important are differences between technologies for production or consumption; differences between those that can be disseminated on an individual basis and those requiring a communal form of organization; and differences between those that are located on the farm and those associated with non-farm activities. However, whatever the combination of characteristics comprised by a particular technology, it is the ability to determine user requirements that primarily determines the success or failure of policies for dissemination. What is less clear is how to achieve the close involvement of users at the design stage in environments where interpersonal relationships between groups are highly unfavorable.

b) *Heterogeneity:* The poor are often highly heterogeneous, occupationally and spatially, and new technologies are likely to have a different impact on these groups. Research should focus not only on the impact of upgrading on the heterogeneous groups comprising the poor in each particular case, but should also examine the effects on specific categories of poor people (e.g., women) *within* the groups. A matrix approach may be a useful basis on which such empirical work could be initiated.

c) *Efficiency in use:* The impact of upgrading on the poor depends on the use that is made of new technologies *after* they have been adopted. However, empirical evidence on the extent of inefficiencies is scant. What data are available suggest that these inefficiencies can be substantial and that they can be avoided or reduced if a high degree of involvement of local users is elicited in the design and implementation of the new technology.

d) *Products:* Most case studies refer to improvements in processes and pay relatively little attention to products. But in the non-farm component of the rural sector, traditional producers must frequently compete with the products of the modern sector, and the *simultaneous* upgrading of products and processes seems often to be necessary. The competitive relationships between sectors also give rise to further necessary conditions for the viability of upgrading that are described below.

e) *Linkages:* Technologies improved by upgrading must be viable in the long term if they are to have any real effect on the alleviation of poverty. Thus, the potential of upgrading must be judged against intertemporal criterion as well as for immediate economic impact. The long-term condition will be met neither by a merely once-and-for-all improvement nor by one whose viability over time depends on continual subsidization.

The requirement that technologies be competitive over time at market prices means that traditional producers must compete with the products of the technologically dynamic modern sector (or with imports). The outcome of upgrading then depends not only on the *intrinsic* characteristics of the improved technology but also on policies that determine the context (e.g., prices) in which the competition takes place. It further depends on the nature of the backward linkages that are established with a dispersed rural capital goods sector, since these linkages influence possibilities for innovation in the continuity of the upgrading process.

The evidence points to the role of the overall rural development strategy in determining the extent to which the relationships described in the previous paragraph are conducive to the long-term viability of upgrading. Where a "bimodal" strategy is followed (i.e., one that is based on a dualist size structure of farm and non-farm units), policies and resources are geared to large-scale units and the resulting economic environment "chokes off" evolution of the upgrading process. In contrast, where a "unimodal" strategy is pursued (i.e., one that emphasizes the progressive modernization of the entire rural sector), the macro-environment is far more favorable to the long-term viability of improvements in traditional technology. One may conclude, therefore, that the potential for innovation of an upgrading approach depends less on any *intrinsic* aspects of the approach than on the overall policy context in which it is attempted (and the manner of its implementation.)

The Technologies Involved in ATI's Program

ATI focuses its activities within three technical areas: (a) agricultural products processing and use of agricultural wastes, (b) local mineral resource technologies, and (c) equipment and support for small farms.

Examples of technologies encompassed in ATI projects within the three priority technical fields include:

A. *Agricultural Products Processing and Use of Agricultural Wastes*

- Small-scale pressing and extraction of edible oils such as palm and sunflower;
- Processing of cereals and staple foods such as the milling of millet and sorghum;
- Production of animal feed from agricultural wastes;
- Processing of fruits and vegetables;
- Upgrading of traditional wool and cotton spinning and weaving techniques.

B. *Local Mineral Resource Technologies*

- Small-scale production of cement and cementitious material such as lime pozzolana mixtures;
- Ferro-cement applications such as water tanks;
- Small-scale production and use of lime;
- Production of clay products such as ceramics, bricks, and tiles as well as the improvement of production methods such as ovens and kilns;
- Production and use of stabilized earth blocks;
- Production of adobe based building materials.

C. *Equipment and Support for Small Farms*

- Small-scale application of biotechnologies such as Rhizobium inoculants and processing of cassava into high protein animal feed;
- Manufacture of hand tools;
- Production and marketing of rural transport equipment such as ox carts and other animal-drawn implements;
- Water catchment, storage and delivery systems such as the dissemination of small-scale rainwater catchment tanks;
- Production and marketing of small farm implements developed by international research centers for soil conditioning and water lifting.

LINARES PUMP...This cost-effective irrigation technique improves agricultural productivity on small farms.

In the design, planning, implementation, and evaluation of ATI's dissemination projects, both "hard" and "soft" issues need to be addressed with respect to the appropriateness of a particular technology for a particular situation and setting. Among the principal conditions and issues are the following:

"Hard" Technology Conditions and Issues

The range of technical options should be reviewed and the most cost-effective technology should be identified.

Technology must have passed the research and development stage, and the results should be known.

The technology must be fundamentally suited to the physical infrastructure where it will be used. Local conditions (e.g., available energy sources, transportation and communication systems, etc.) which constrain technology choices in each region or area must be carefully considered.

Equipment and machinery must be maintained and should be capable of being repaired by local technicians. Spare parts should be available and, preferably, manufactured locally to avoid delays, dependency on sole source suppliers, and the risk that the government will not always allocate scarce foreign exchange to purchase spare parts overseas.

Many failures in establishing commercially viable and sustainable productive activities are due to the lack of adequate and consistent quality of the product. It is essential to establish reliable means to provide cost-efficient quality control for rural and semi-urban small-scale industries projects.

The technology should be carefully evaluated.

The choice of technology needs to be matched with the skills and educational level of the people who will use the technology.

"Soft" Technology Conditions and Issues

The poor's lack of capital and inadequate access to credit are serious barriers to development in rural and semi-urban areas, and to their mastery of productive technologies. Lacking the cash to purchase equipment and supplies outright and the collateral and security required for conventional financing, complicated

yet cost-effective financial arrangements must often be devised to support even relatively small investments.

Producers in rural areas often encounter serious barriers to getting their products to market. Marketing arrangements must be adapted to specific local conditions and trade practices to compensate for inadequate transportation and communication systems.

The labor displacement characteristics of the technology should be considered, especially with respect to women.

Whether "simple" or "sophisticated" technologies are chosen, the operation, management, maintenance and repair requirements need to fit the skills and education of the people who will use the technology. In most cases, however, a certain amount of training and education is necessary before a technology can be successfully introduced into rural and semi-urban areas. Due to turnover of labor and changes in the technology, this aspect needs constant attention. Local institutions which are available to cater to these educational and training needs should be geared to the specific needs of the rural and semi-urban poor.

Beginning in the last quarter of 1983 and through calendar year 1984, ATI commenced 22 new field projects under the priority technical fields outlined above. Each of these projects has a balance between the "hard technology"—the technical component—and the "soft" techology—the systems through which people can utilize the technology.

The technical components which form the basis of the field projects undertaken by ATI in 1984 are detailed separately on pages 21-31. For illustrative purposes, more specific descriptions of the technologies and technical issues involved in ATI projects follow.

ACHIOTE TREE...In 1985, ATI helped to establish a rural-based achiote processing plant in Peru. The seeds in the pods of this small tree, when processed, yield annatto, a food colorant used primarily in the dairy industry.

Rhizobium Inoculant Technology, Thailand

The technology in this project centers on rhizobium inoculant—a low-cost method for increasing soybean production. The purpose of the project is to make rhizobium inoculant available to small soybean farmers at a low cost, to increase soybean production, and eventually, to alleviate the burden of importing this edible oil seed and animal feed.

Rhizobium is a genus of bacteria which are able to live symbiotically with leguminous plants by infecting the roots of the plants, while at the same time providing the plants with an essential, limited nutrient, soluble nitrogen. Rhizobia are able to "fix" nitrogen gas from the atmosphere and convert this inert gas into a chemically active soluble nutrient which the plant uses for synthesis of its own tissues and for storage in the seed as proteins. The inoculant is dusted or applied to the seed at planting time, and as the roots sprout, the bacteria form a nodule and live in symbiosis with the plant tissue.

Because the bacteria must be living at the time of inoculation, and because they die at temperatures above 35-40 degrees C., storage and transport in tropical zones are difficult. In addition, the rhizobium inoculant is needed only at planting time—at most twice annually. The common practice in industrialized countries, namely, centralized manufacture and refrigerated storage and transport, is too costly except for subsidized agricultural projects.

ATI's project in Thailand seeks to develop a way to decentralize the production and packaging process in order to obviate the need for cold storage and transport. Production of the inoculant is essentially a fermentation process on sucrose and other nutrients, then the live bacteria is spread on peat moss or other organic carriers upon which the bacterial population will be sustained.

Scientists in Thailand recognized the need for developing a rhizobium inoculant industry as an addendum to the need for expanding soybean production. Soybean production has increased as much as 50% in test plots, and yield increases of 10-20% are not unusual. It is possible to reduce input of nitrogenous fertilizers by as much as 60%, if the rhizobium inoculant performs well. Work at the Nitrogen Fixation in Tropical Agricultural Legumes (NIFTAL) research center at the University of Hawaii has shown that a small-scale process of direct inoculation of robustly growing cultures of rhizobium onto sterilized peat moss results in a tenfold increase of live bacteria. This process, now being tested in Thailand, may enable the soybean inoculant to be produced and transported more cheaply than was possible heretofore. Decentralized plants will be set up to produce sufficient quantities of inoculant to be used in marketing trials during the following planting season.

Lime Kiln Technology, Costa Rica

The technology in this project centers on improving traditional lime production by using a design which allows continuous production instead of traditional batch production.

The manufacture of lime products requires three principal processes: limestone preparation, calcination, and hydration.

The process begins in the mines, where the limestone is mined by hand with pick axes, chisels, and dynamite.

At present the kilns are wood fired. This creates environmental problems and lowers the quality of the lime because wood ashes mix with the final lime product. Heat escapes through the open top of the kiln and through the front part. Once the calcining process is completed, the supporting rocks are knocked down and the lime is extracted through the fire hole. This process endangers the workers, who sometimes suffer temperatures up to 60 degrees Celsius.

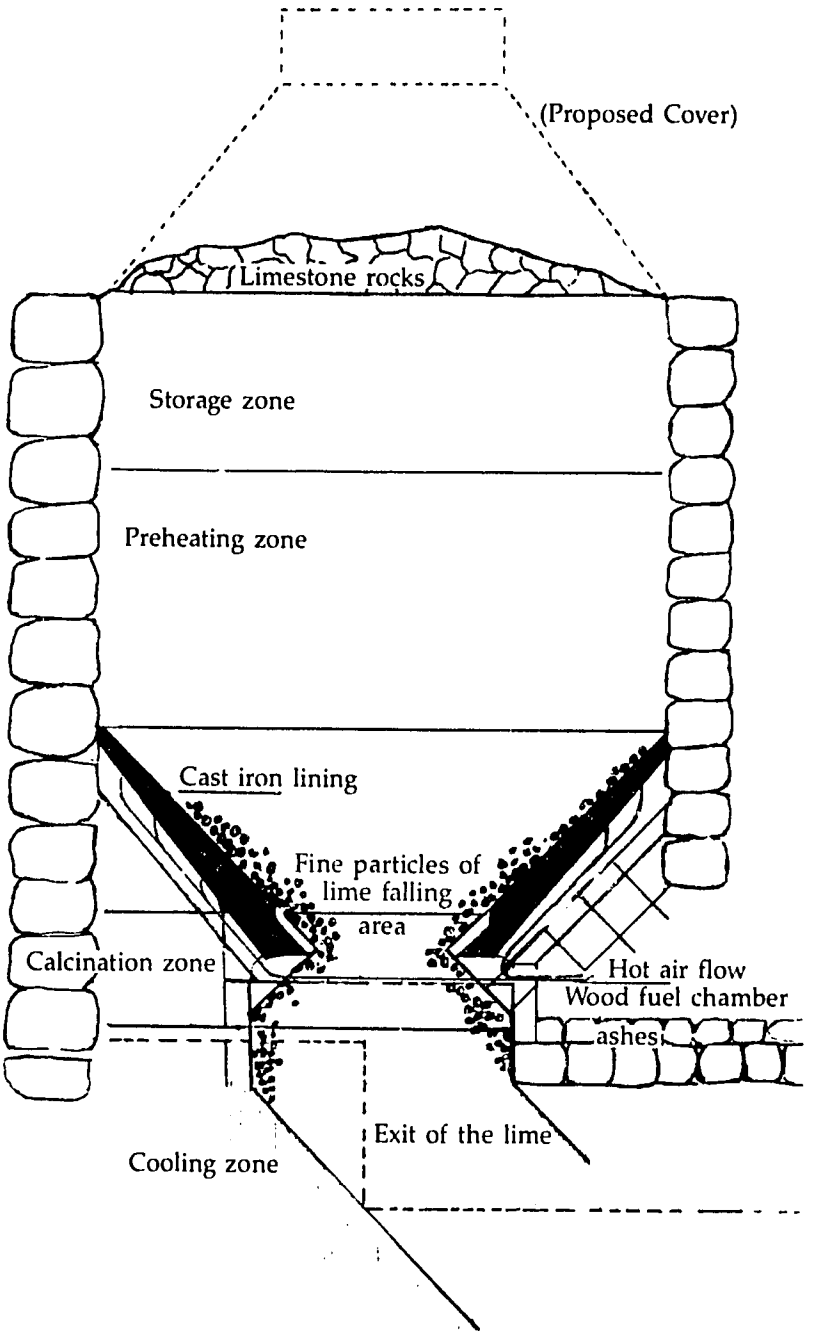
The basic problems in the existing lime kiln technology in the Caribbean and Central American region include the following:

- Because the walls of the kilns are not adequately insulated, fuel is wasted;
- Because of the batch process, the kiln cannot be loaded until it cools and must be fired from a cold condition, this wastes more fuel;
- Lack of uniform size limestone causes some rocks to be over-heated and the largest rocks to be inadequately calcined;
- The open top of the presently used design allows valuable heat to escape; this wastes additional fuel.

In this project, the Instituto Tecnologico de Costa Rica (ITCR) will provide technical staff and facilities to improve the lime kiln designs and the production process, including steps to assure a more uniform quality of limestone. Some of the changes proposed for the basic kiln design include:

(a) changes in the firing funnel;
(b) construction of a sliding ramp to facilitate the continuous discharge process;
(c) construction of a combustion chamber;
(d) introduction of heat circulation system;
(e) introduction of wood feeding tunnel.

Major Components of an Improved Lime Kiln



Brick Production, Botswana

The purpose of this project is to demonstrate that commercially viable, small-scale brickyards can be established to produce a high quality brick which is one-half the price of imported brick from South Africa.

The project will introduce new brickmaking technologies to the area.

Present brickmaking technologies available in Botswana do not lend themselves to medium or small-scale production which can both compete effectively with imported bricks (in terms of quality) yet can also be available at low cost to poorer families. The principal production problems encountered by medium and small-scale brickyards which this project will address are defects in the brick firing process, and low tensile and compressive brick strength.

The technological innovations to be introduced in the project include:

1. *A Permanent Kiln:* Prior to this project, only clamps (also called Field Kilns) had been used by ATI's Project Partner, the Minerals Holding Trust (MHT). While the capital costs of the Field Kiln are virtually nil, there are many disadvantages, such as poor heat distribution, inefficient fuel consumption, and high labor costs. As a result, a large percentage of bricks was below even minimum quality standards. To meet these problems, a scaled-down and redesigned version of a Hoffman-type kiln has been developed around double chambers, permitting primary air flowing into the kiln from outside to cool already fired bricks and simultaneously be heated to a high temperature before reaching the combustion zone. Exhaust gases leaving the heat zone preheat unfired bricks before passing into the flues leading to the chimneys.

2. *Improved Drying Processes:* A succession of technological innovations will be introduced to solve the problems of low tensile and compressive brick strength.

To raise the compressive strength of the bricks to building code standards, three steps will be taken:

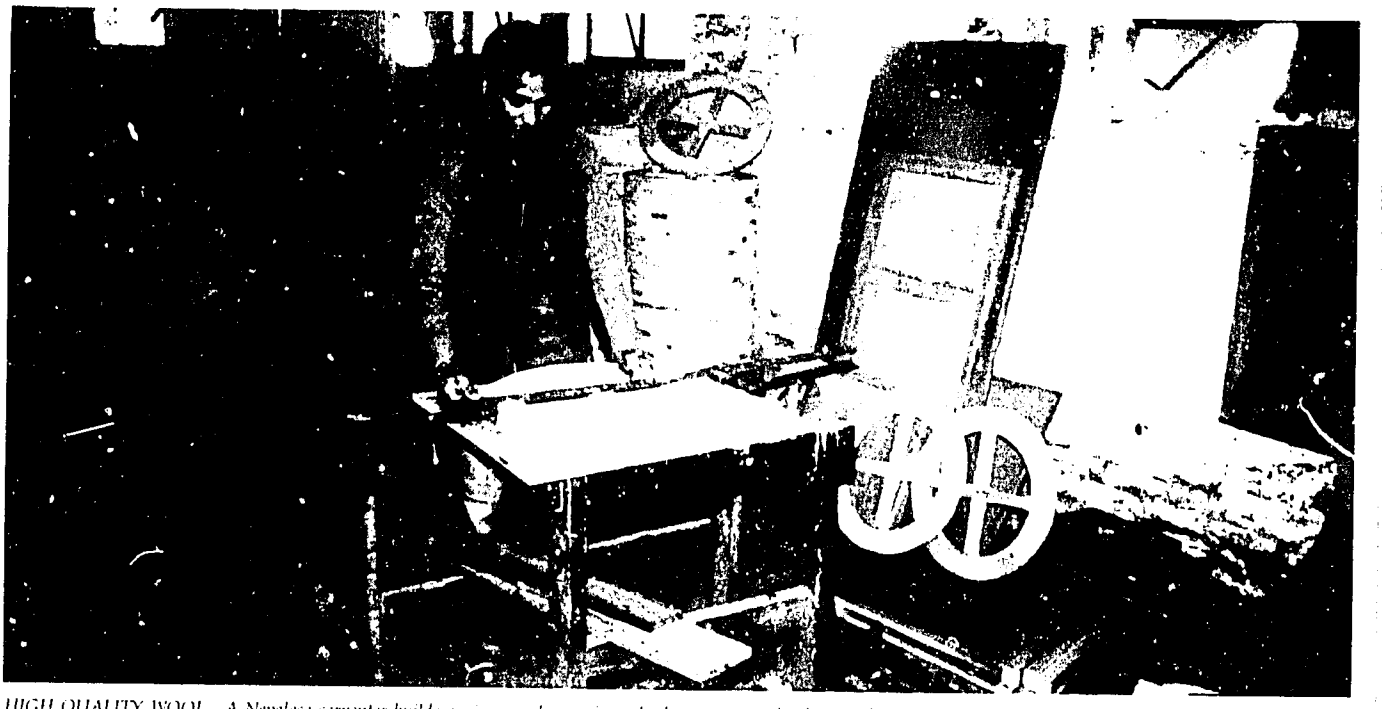
The proportions of clay ingredients will be changed. Tests will be conducted to determine a balance between costs of the bricks, quality, and strength.

Low moisture brick technologies will be introduced. Low moisture brick production requires that the clay be crushed into very fine material prior to mixing and pressing. In addition, a Belgian designed hand-operated brick press will be employed. To mold and press the bricks, the hand-operated machine uses a combination of a steel mold box, and a lever-operated cam compressor. If experimentation and testing by MHT demonstrates that the press is suitable in terms of cost and output, quantity and quality, an adapted version of the model using multiple molds (up to four bricks pressed at a time, vs. the double brick of the Belgian press) will be designed by MHT and manufactured in Botswana.

Slop molding is only possible if the clay mix has a high moisture content. This high moisture content causes high levels of cracking. Low moisture bricks need a higher pressure for molding. MHT will test various hand-operated brick presses to select a model which will be produced locally.

BRICK KILN... This trench kiln is widely used in India. A similar principle, which does not involve continuous firing, is applied in the... used in the ATI brick-making project in Botswana.

Wool Spinning, Nepal



HIGH QUALITY WOOL...A Nepalese carpenter builds an improved spinning wheel, part of a technology package intended to increase off-farm employment.

The purpose of this project is to introduce a commercially feasible wool spinning technology to increase off-farm employment and provide a reliable supply of high quality yarn for the hand-knotted carpet industry in rural Nepal.

Three improved, manually operated wool spinning technologies will be employed in the project: a cradle picker, a drum carder, and a flyer-treadle spinning wheel. Application of these technologies at the small unit production level in Nepal will be a major innovation and will address principal constraints to rural income-generating activities in Nepal, particularly for women.

1. *Cradle Wool Picker:* This cleans and "fluffs" raw wool in preparation for the carding process. The Cradle Picker is constructed from wood and consists of a base with two uprights which hold a shaft from which a cradle is suspended. The top surface of the base and the bottom surface of the cradle are set with nails. The nails are slanted in opposite directions so that when the cradle is swung back and forth, the raw wool is pulled apart. The slant of the nails at the front end of the cradle draws the wool into the machine, while the slant of the nails at the rear continuously pushes the separated wool out the back of the machine. Foreign matter (dirt, seeds, burrs, sand, grass, dung, etc.) is removed from the wood and drops through the machine.

The Cradle Wool Picker will replace the traditional process of pulling raw wool apart by hand and shaking out the dirt. The improved equipment will produce at least 8 times as much wool as the traditional method. The Cradle Picker effectively separates foreign matter from the wool; the result is a cleaner yarn that takes a dye more effectively and lowers the shipping weight of the final product by as much as 25%. The improved technology reduces the wastage during the picking process by half.

2. *Drum Wool Carder:* This disentangles the wool after picking and arranges the fibers in a parallel position in preparation for spinning. The improved carder consists of one small feeder cylinder (or drum) and one larger cylinder for carding. A drive chain encircles the pulleys on both cylinders. When the hand crank is turned, the two cylinders rotate at different speeds. Picked wool is placed on a tray in front of the small feeder cylinder. When the crank is turned, the wool is drawn under the feeder cylinder to the large carding cylinder. This motion disentangles the wool fibers and they are wrapped around the larger cylinder. When enough wool has been fed into the machine to cover the carding cylinder, this forms a "batt". The "batt" is peeled off the carding cylinder and stacked for the spinner.

3. *Flyer-Treadle Spinning Wheel:* This will replace the hand turned *charka* wheel now being used throughout Nepal. This traditional *charka* originated in India nearly 1,500 years ago and is intended for spinning fine yarn--cotton and short staple types of wool. However, the *charka* is not an efficient technology for spinning the type of wool available in Nepal or the type of yarn required by the carpet industry. The *charka* was used in Europe until the Flyer Wheel was invented some 500 years ago.

The improved spinning wheel permits broken yarn to be easily combined with the previous length without interrupting the spinning process, thereby increasing yarn quality and reducing wastage. A greater range of yarn counts can be achieved with the Flyer-Treadle Wheel and the number of plys can be varied by adjusting the number of bobbins in use. Field tests indicate that with training, a traditional spinner, using the improved spinning wheel, can increase daily production of yarn four times.

Village Oil Processing, Tanzania

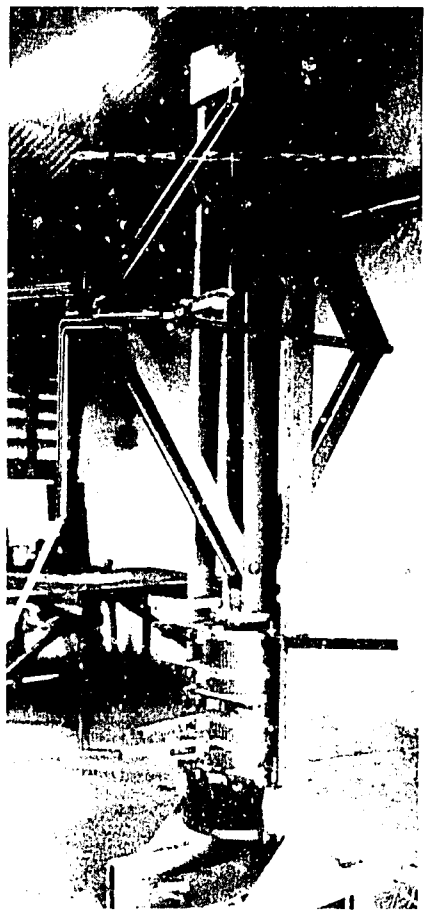
The basic objective of this project is to manufacture hand-operated sunflower seed oil presses for use in Tanzanian villages.

Most oil seeds such as sunflower or other oil bearing crops require high pressure and temperature before oil is released from the kernels. Attempts to introduce hand-operated mechanized technology in Tanzania and elsewhere have centered on the use of screw presses and *ghani* from India. The *ghani* is useful only on soft oilseeds and is not able to extract more than a very small percentage of oil from sunflower. Screw presses normally use a simple acme or square section screw directly exerting force in a piston which squeezes oil bearing material inside a cage. For softer seeds this system is adequate, but, it is unsatisfactory if higher pressure is required. As the pressure required increases, the workload increases in a geometric progression. This is caused as much by an increase in the friction of the moving parts of the screw as by the extra pressure needed to press oil from the seed.

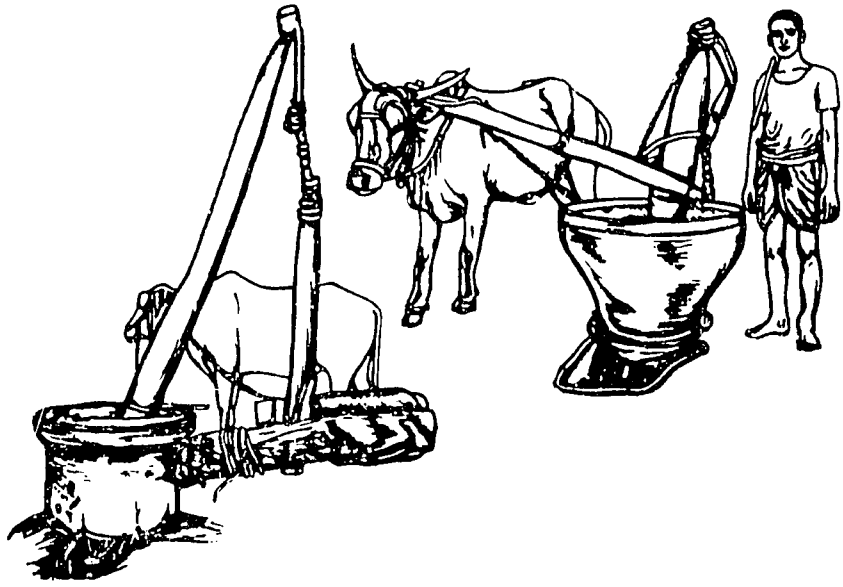
The press tested in this project maintains relatively constant workloads. Instead of having a screw directly attached to a piston which presses on the oilseed, the screw is set horizontally at opposite corners of a freely moving parallelogram of steel bars. As the screw is tightened and draws the opposite corners closer together, the alternate corners of the frame extend their distance from one another. The top of this flexible frame is attached to a piston which applies pressure to the seed. The press was developed by the Institute for Production Innovation (I.P.I.) at the University of Dar-es-Salaam.

A significant feature which contributes to the long life of the I.P.I. press is that the increase in pressure is largely borne by the reinforced bars of the parallel frame, and only marginally by the screw thread, which is the most vulnerable and expensive component.

The entire machine is constructed from common mild steel, except for the screw thread which is cut from ST 70 high speed steel or similar material. Using this high-grade steel will assure a life of approximately 5 years for the only wearing component of the press, but it is possible to substitute common mild steel, which will perform satisfactorily for as long as two years. The project intends to use ST 70 for the first 100 presses while exploring the practicability of using half-shaft material which is of similar quality and easily available as scrap. Processes used in manufacture are confined to cutting, drilling, bending, welding, milling and turning, all of which make it possible to manufacture the press in a general engineering workshop.



I.P.I. Press



TRADITIONAL GHANI: Using the Ghani to crush mustard (left) and kandi (right)

ATI's Project Partners

ATI's field projects are implemented by project partners: indigenous businesses and other private sector organizations that share ATI's commitment to the commercial, non-subsidized application of technologies which satisfy the demands of the market place and, at the same time, increase the productivity and employment of the poor.

These project partners can best understand the local social, economic, political, environmental, and policy context both of the formal and informal sectors in which productive technologies are tested. These indigenous institutions can best assess local resources, needs, skills, and markets.

ATI brings to its partnerships expertise in project design, technical assessment and adaptation, and commercial analysis. ATI also brings experience in linking scientific and technical communities with institutions that are working directly with the rural poor.

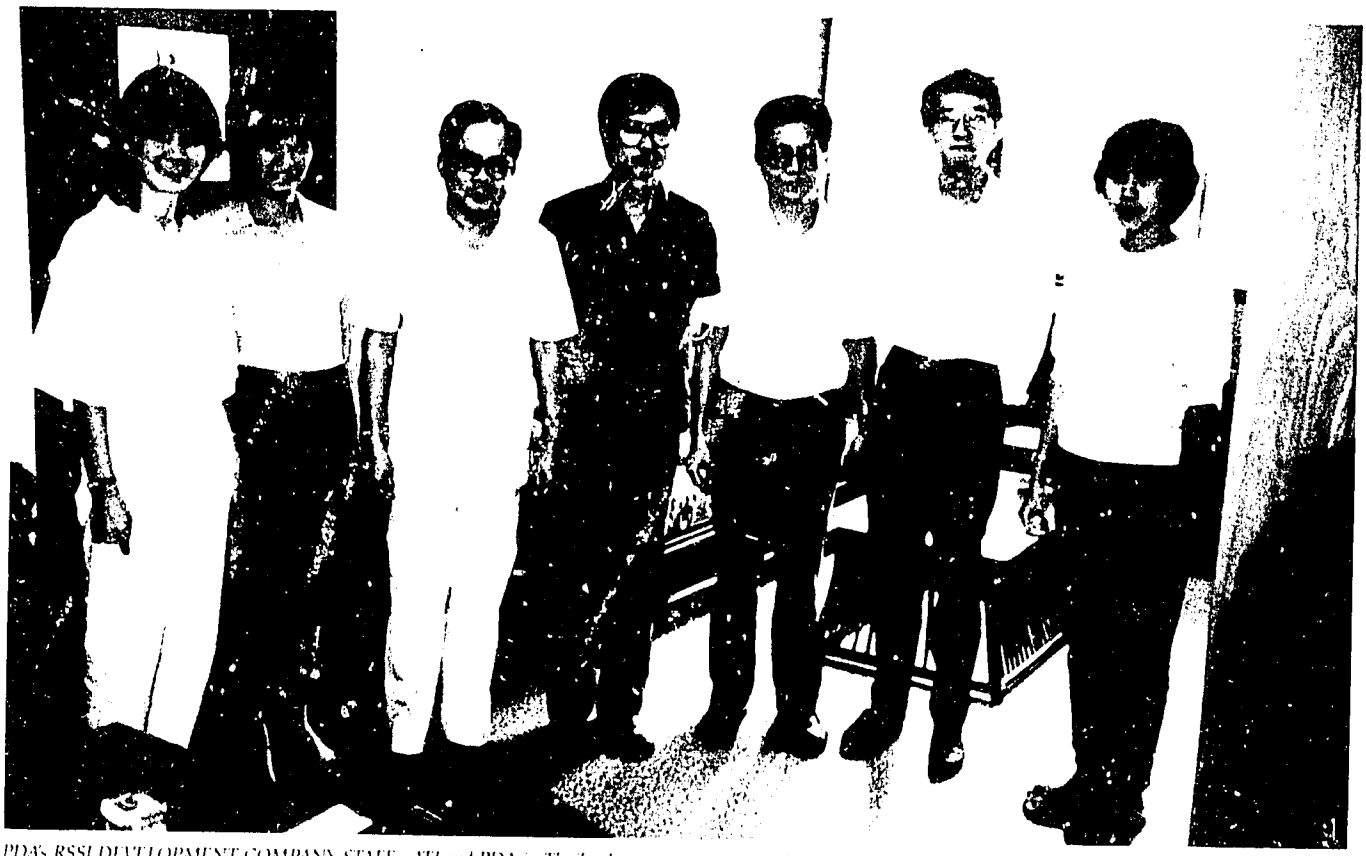
ATI's project partners are chosen because of:

Outreach Capacity: good working relationships with the communities of the poor; knowledge of and access to the informal sector;

Management and Staffing: personnel who are strongly motivated and who possess requisite technical skills and experience. Typically, project partner personnel have a high degree of institutional identification and a bias toward having technology serve the interests of the poor.

Disposition of Collaboration: A basis for project partner effectiveness is a tendency to work with other institutions, whether community-based or from relevant scientific disciplines or government. Pragmatic institutional linkages characterize many of the ATI projects.

Capability to Mobilize Financial Resources: In most instances, ATI project partners have the capacity to effectively mobilize local and sometimes even international financial resources necessary for project implementation. At the same time, project partners share ATI's commitment to demonstrate that the productive technologies which are the core of ATI projects are not only appropriate from an engineering or technical standpoint but also are commercially viable and economically sustainable within the resources of the poor.



PDA's RSSI DEVELOPMENT COMPANY STAFF. ATI and PDA in Thailand are partners in several projects. Shown here are the staff members of The Rural Small Scale Industries Project, a division of CBAIDS.

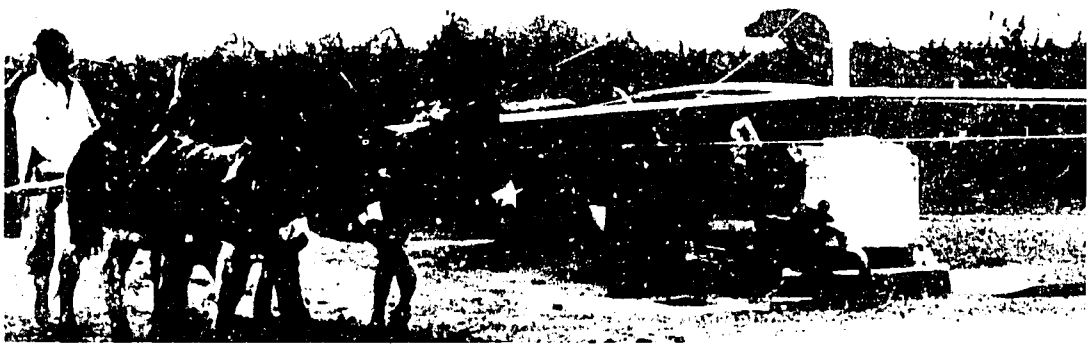
ATI Field Program Activities In Calendar Year 1984

ATI demonstrates the utility and cost-effectiveness of development strategies for rural and semi-urban areas. These strategies involve dissemination of commercially viable and economically sustainable technologies adapted to the resource endowment of the poor. Based upon practical demonstrations of appropriate technologies in their real-life settings, ATI promotes wide scale use of these development strategies—and the productive technologies—by other organizations.

Through its technical and financial assistance, ATI:

- Identifies production technologies which address the needs of the rural and semi-urban poor by adding value to their available resources;
- Acts as a catalyst in the appropriate technology process, providing limited amounts of resources flexibly and rapidly to carry out innovative activities which, although inherently risky, have a high pay-off potential;
- Develops multi-disciplinary approaches toward project implementation where the core "hard" technology is integrated with an equally essential "software" package (or support system) necessary not only to make the technology available to the poor but to enable these technologies to be under their control;
- Integrates and (when necessary) augments the talents of private organizations, science and technology institutions, private entrepreneurs, government extension services, public policy and other relevant institutions;
- Ensures that the technologies used will, after an initial period, become commercially viable and economically sustainable;
- Emphasizes that the potential benefits of a project should compare favorably with its costs;
- Works in a limited number of technical areas in order to build knowledge on general principles of success and failure of appropriate technology programs and projects;
- Gives high priority to replication of innovative elements of appropriate technology projects and programs by promoting the use of these technology elements by the private sector or by other development organizations;
- Informs, encourages, and assists development planners and decision makers—public and private sector, North and South—in adapting development strategies validated by ATI's experience.

ATI's 1984 field program in Africa, Asia, Latin America, and the Caribbean is described below.



Animal driven pumps lower the cost of water for agricultural and domestic uses.

AFRICA

Animal Driven Pumps, Botswana

Project Partner:

Rural Industries Promotions (Botswana)/Rural Industries Innovation Centre (RIP/B)

Purpose:

To establish a production unit that produces and sells animal driven pumps which lower the cost of water supply for agricultural and domestic uses in rural areas.

Expectations:

During the three year project period, 36 animal driven pumps will be installed, enabling at least 540 low-income, rural families to decrease their expenses for water by 10-50% and, if water is used for irrigation purposes, to increase their incomes by 20% or more.

Technology:

The project will produce and install simple, locally-designed animal driven pumps, consisting of a gear box comprised of metal sprockets which drive and are driven by a series of belts and chains. Powered by donkeys or mules, this device can drive either a shallow well, low lift centrifugal pump or a deep well, high lift piston pump. The animal driven pump has one-half less "down time" than commonly used diesel pumps and can be easily maintained by relatively unskilled personnel. In addition, the animal driven pump is less expensive than the diesel pump (as it does not use costly imported fuel for its operation) and, under certain conditions, decreases pumping time by 30 to 40 percent relative to diesel pumps.

Lime Production, Botswana

Project Partner:

Southern Rural Development Association, Minerals Holding Trust

Purpose:

To (1) establish a small-scale, commercially viable limeyard that produces a high quality product competitive with lime imported from South Africa; (2) develop the capacity to disseminate lime production technologies throughout Botswana; and (3) develop lime-based products for new small industries.

Expectations:

Major benefits expected from the project include foreign exchange savings of approximately $128,000 annually as locally produced lime is substituted for imported lime, direct employment opportunities for at least 77 rural people, capital formation in a rural area totaling about $33,600 annually, and the availability of locally produced lime wholesale for 10% less than what is currently being charged for imported lime.

Technology:

The project will use a locally modified version of an Indian-designed, mixed-feed, vertical shaft kiln. The kiln is relatively cheap to construct, fuel efficient, and has a relatively high output capacity in relation to its size. The kiln is operated continuously, and the use of a slaking platform will ensure the production of hydrated lime of high quality. One kiln (4.5m high and 1.5m inner diameter) will have the capacity to produce four tons of quicklime per day.

Brick Production, Botswana

Project Partner

Southern Rural Development Association, Minerals Holding Trust

Purpose:

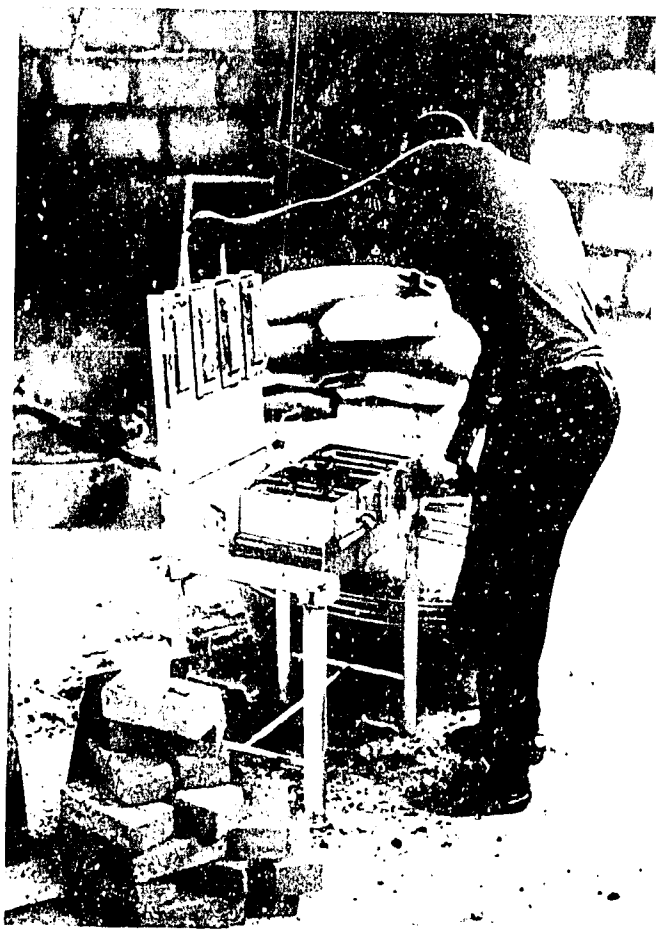
To establish two small-scale, commercially viable brickyards to produce a high quality brick which is less expensive than imported brick and within the means of low income people.

Expectations:

After three years, two brickyards will be in operation with a joint production capacity of 3 million bricks, doubling the supply of low-cost building materials in the area and enabling 800 low income families to gain access to adequate low-cost housing annually. At 60% capacity, pre-tax profitability of the company will total about $12,220 annually by the second year. By demonstrating the commercial potential of small to medium scale brickmaking, it is expected that these operations will pave the way for interested small investors and entrepreneurs to establish their own businesses based on this model.

Technology:

The project will introduce new brickmaking technologies to a local organization in order to improve the efficiency of the production process and to increase the quality and durability of the brick produced. The project will use a modified intermittent Hoffman kiln and will introduce low moisture brickmaking technologies. Two different manual presses and a hand-operated clay crusher are being considered.



A low moisture brick press is used to determine the optimal clay mix to produce bricks of high compressive strength per unit cost.

Reconditioned and or modified palm oil presses enable small farmers to significantly increase palm oil production and reduce processing time.

Palm Oil Extraction Unit, Cameroon

Project Partner:

Association for the Promotion of African Community Initiatives (APICA)

Purpose:

To create a commercially viable enterprise which manufactures and leases/sells improved palm oil extraction units to small-scale palm oil producers.

Expectations:

If successful, the project will increase the palm oil production of 1,360 farmers by 25-50%, reduce processing time by 50-75%, and, after the third year of the project, increase farmers' incomes from oil production by 52%.

Technology:

A palm oil press manufacturing firm will be established to (a) recondition old Colin Presses — hardy, dual screw, continuous feed oil presses which were manufactured in England and France and exported to Cameroon between 1930 and 1960, (b) assemble a proven, less expensive single screw version of the Colin Press (Altech Press) from locally manufactured components, and (c) operate a repair shop and stock locally manufactured replacement parts for Colin-type presses. The principal advantages of the Colin-type press are that it depulps and presses the palm nuts in one operation, is relatively rapid in its production, and has extraction rates which approach industrial methods and are higher than those of other small-scale presses. The Colin-type presses will be sold along with a locally manufactured palm nut bunch stripper and a clarifier to small-scale palm oil producers.

Oil Press Production, Tanzania

Project Partners:

Centre for Agricultural Mechanization and Rural Technology (CAMARTEC), Themi Farm Implements & Engineering Company, Ltd., and Institute for Production Innovation, University of Dar-es-Salaam

Purpose:

To capitalize a private factory in Tanzania to enable the manufacture of affordable, hand-operated sunflower oil presses for use in Tanzanian villages.

Expectations:

If successful, 48 oil presses will be installed annually, creating 270 jobs in rural areas and increasing the supply of edible oil for local consumption. In addition, over 5,000 families will increase their income from sunflower oil by a total of $172,000 annually through the increased cultivation of sunflowers on idle or under-utilized land and the sale of sunflower seed at increased producer prices.

Technology:

Two types of oil presses, initially developed and tested at the University of Dar-es-Salaam, will be manufactured under this project. The presses are made from common mild steel and can exert 20 to 80 tons of pressure, producing ½ and 2 gallons of oil per hour respectively. The press design is innovative in that it is the first practical, easily maintained oil press to be manufactured in country at an affordable price.

Village Oil Processing, Tanzania

Project Partner:

Evangelical Lutheran Church in Tanzania

Purpose:

To start a self-financing development company which will provide technical assistance and loan capital to help Tanzanian village entrepreneurs establish and manage small-scale sunflower oil extraction industries.

Expectations:

Nine projects will be established during the four year project period; thereafter, loan reflows will enable another 3 projects to be started in each of the next four years. If successful, approximately 120 new jobs will be created in rural areas and a total of $251,400 in additional income will accrue to over 690 farmers over an eight year period.

Technology:

The self-financing development company established in this project will disseminate the oil press technology tested in the Oil Press Production project described above.

Rural Potteries, Tanzania

Project Partners:

Centre for Agricultural Mechanization & Rural Technology (CAMARTEC) and Sheriff Dewji & Sons Ltd.

Purpose:

To make possible the commercial supply of firebricks, kiln furniture and glaze materials for sale to small village potteries in Northern Tanzania, thereby increasing the durability, value, and range of uses for which pots can be made.

Expectations:

During the three year project period, this will result in the creation of 45 jobs in rural areas, capital formation of $34,000 in village pottery industries, and the availability of approximately 55,000 pieces of utility tableware in Tanzanian villages per annum.

Technology:

Firebricks will be produced by pressing low moisture bricks in a hand-operated press and then drying and firing them. The glaze will be produced by fritting boric acid with ball clay, feldspar, silica and dolomite, and then heating the mixture in a kiln. This glazing process will increase the durability of village pottery, which tends to be porous, fragile and low-grade, thereby enabling village potters to increase the market and value of pottery products.

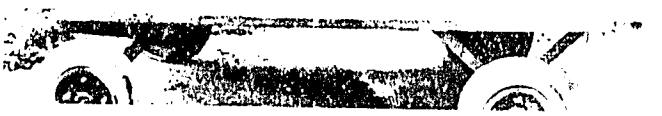
Improved Bricks, Tanzania

Project Partners:

Center for Agricultural Mechanization & Rural Technology (CAMARTEC) and Meru Earthworks, Ltd.

Purpose:

To introduce an improved firing technology which will enable private, small-scale rural brickyards to manufacture bricks of



This kiln produces improved firebricks to be used to build small-scale pottery kilns.

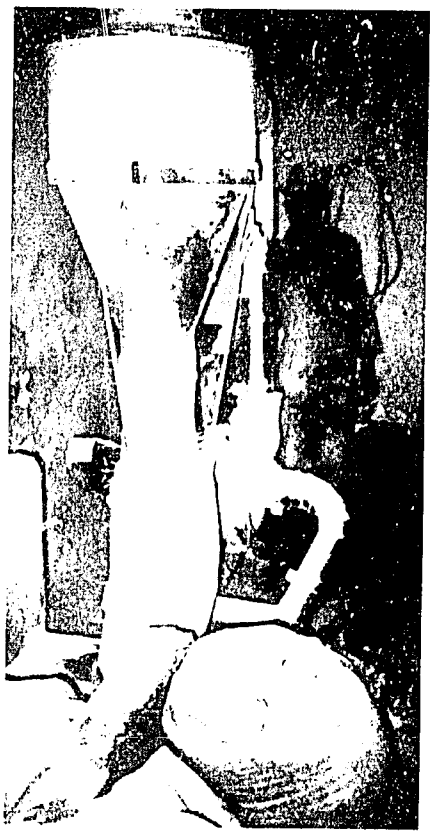
high strength and regular size, leading to penetration of the urban market for high quality building materials.

Expectations:

During the project period one to three rural brickyards will be established. One such plant, even when operating at 60% capacity, will be able to supply material for the construction of between 170 to 200 low-cost houses annually, directly creating work for 130-140 artisans. Between 550-1,200 people will be housed as a result. If successful, as many as twenty additional rural brickyards will be established throughout the country in the next ten years, all of which are expected to be locally capitalized.

Technology:

The project will define a brickmaking production equipment package using low moisture techniques. The package could be used in decentralized production units in rural areas. Three types of hand-operated brick presses and two types of clay crushers will be tested in order to properly specify a package of equipment that can be most profitably used in small enterprises. The projected annual output of the technology is 1.4 million bricks.



A mill at Shandisayi Ptungwa, Zimbabwe, provides maize milling services as part of a rural agro-industries program.

Agro-industries, Zimbabwe

Project Partner:

Foundation for Education with Production

Purpose:

To diversify and expand the economic base of a farming cooperative in Zimbabwe by establishing agro-industries which have links to the area's rural poor through direct and indirect income and employment.

Expectations:

Over a three year period, it is expected that the project will benefit up to 5,100 area residents (850 rural families) by: (1) providing a reliable market for local agricultural production and prices for local produce which will be at least 5 percent higher than prevailing producer prices; (2) adding value to local agricultural production; (3) lowering prices for locally produced basic goods and services by 17 percent; (4) providing employment opportunities and skills training for at least 117 people and productive skills training for an additional 43 people a year; and (5) increasing farmers' income by 50-70%.

Technology

Initial industries to be established include a bakery, a mill, and a shoemaking plant. Industries which the project may later establish include vegetable oil production, peanut processing, and fruit and vegetable processing.

ASIA

Venture Capital Company, Indonesia

Project Partner:

Yayasan Dian Desa (YDD)

Purpose:

To create jobs and increase incomes of the rural poor by establishing village scale manufacturing industries using appropriate technologies developed by Yayasan Dian Desa (YDD) and financed by a small venture capital company established by the project to promote small-scale enterprises established as joint ventures between YDD and local entrepreneurs.

Expectations Technology:

If successful, the company will have invested in 25 to 30 profit-making village industries by the fifth year of the project. These enterprises will have strong backward and forward linkage effects to the rural poor by (a) adding value to under-utilized or under-valued raw materials, (b) providing products and services to rural consumers at lower prices, and (c) providing rural based employment. In addition, this project will provide small producers with opportunities to build their equity through joint ventures.

Subject to feasibility studies demonstrating the commercial viability of particular production technologies, the project will invest in a variety of village-scale manufacturing industries that use appropriate technology, such as:

Coconut shell flour: Operating at 50% capacity, estimated profits of the enterprise after one year are $20,700 annually with an internal rate of return of 31%.

Sago palm noodle production: Operating at 60% capacity, estimated profits of the enterprise after one year are $41,106 annually with an internal rate of return of 29%.

Rice Husk Briquetting: Operating at a production capacity of 2.5 tons a month, estimated profits of the enterprise after one year are $5,844 annually with an internal rate of return of 40%. Small rural industries could realize significant daily savings in fuel costs by replacing kerosene with rice husk briquettes.

In Indonesia, a small-scale shrimp hatchery financed through an innovative venture capital mechanism, cultivates algae for shrimp feed.

Wool Spinning, Nepal

Project Partner:

Association of Craft Producers (ACP)

Purpose:

To commercially introduce an improved wool spinning technology among small producers that will increase off-farm employment and incomes of small-scale yarn producers and will provide a reliable supply of high quality yarn at a competitive price to the hand-knotted carpet industry.

Expectations:

If successful, the project will establish 40 wool spinning enterprises, employing over 800 cottage industry producers. After three years, annual income to the 800 women employed will amount to $117,572, which compares favorably to total annual income of $52,000 using traditional methods of spinning.

Technology:

The project will use improved, locally produced cradle wool pickers, drum carders, and flyer treadle spinning wheels. The equipment can be (a) manufactured by local carpenters using local materials, (b) easily maintained and repaired in rural areas, and (c) adopted by small producers after a short training course. The improved technology will increase the productivity of hand-spun yarn producers by 4 to 8 times over traditional methods, reduce the cost of wool yarn production by nearly 30% after profits, and enable cottage industry producers (mostly women) to spin the uniform, high-quality yarn demanded by the export market.

Nepalese women use improved, locally produced wool pickers, carders, and spinning wheels to manufacture high quality yarn for sale to the hand-knotted carpet industry.

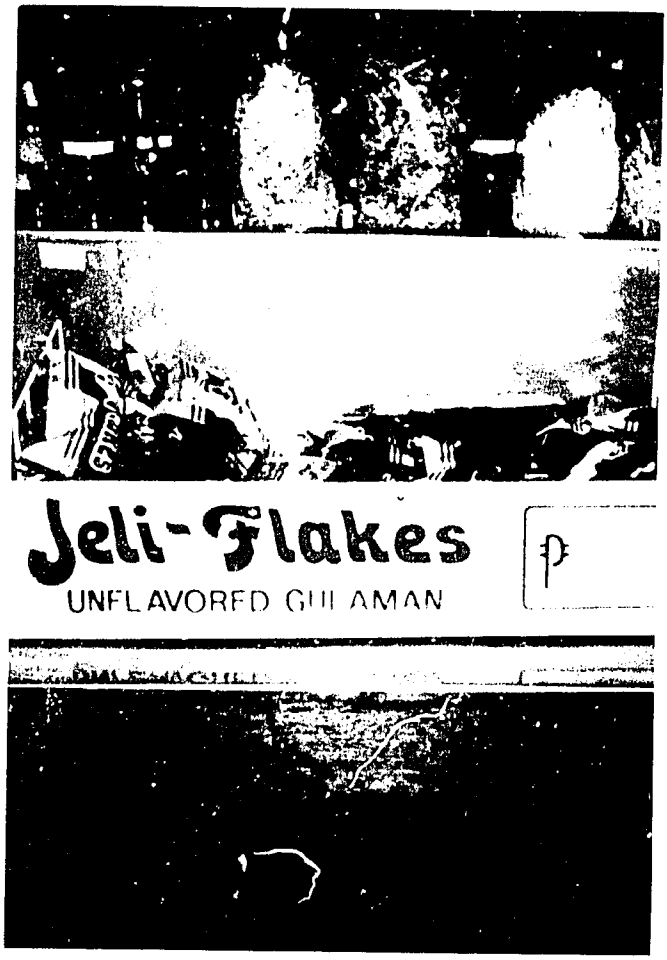
Turbine Driven Agro-Processing, Nepal

Project Partner:
New Era

Purpose:
To test the technical and commercial feasibility of a locally designed and manufactured turbine-driven heat generator to be employed in agro-processing enterprises in rural Nepal.

Expectations:
The project will increase the incomes of over 600 households through backward linkages to agriculture. The profits generated by the enterprise will be used for investment in other productive ventures in the region. In addition, the project will test the potential of community owned agro-processing enterprises, based on the heat generator, to create off-farm employment in industries with strong linkages to agriculture in the hill regions of Nepal.

Technology:
This applied research project will assess the technical and commercial viability of a water turbine powered, mechanical heat generator-kettle unit as a cost-effective source of process heat for manufacturing food and related products in the hills of Nepal. Initially the enterprise will process citrus fruits and dairy products for local markets using simple concentration (boiling) methods and, if successful, expand to other products including soap, dried fruits, vegtables, and spices. Although water turbine technology has been widely and successfully tested in the hill regions of Nepal, most such turbines are utilized solely for grain milling and oil expelling which do not exploit the full capacity of the generators. This project will diversify and expand the use of a heat generator to take advantage of the available capacity of the technology.



Manufacturing enterprises using appropriate technologies, such as snack food produced from agar-agar (seaweed), provide jobs and increase incomes in rural areas of the Philippines.

Rural Small-Scale Industries Development, Philippines

Project Partner:
Filipinas Foundation

Purpose:
To test a rural small-scale industries strategy aimed at creating jobs and increasing incomes of poor people by establishing manufacturing enterprises that use appropriate technologies appraised by the Filipinas Foundation and financed by a venture capital mechanism established by the project.

Expectations/Technology:
Based on estimates of enterprises proposed, over the five year project life, approximately 250 new jobs would be created and over 30,000 farmers would increase their incomes through raw materials supply or through reduced cost for commodities produced. If such outputs are achieved, preliminary estimates indicate that Peso 1.46 in direct and indirect economic benefits will result from every Peso 1.00 invested by the Venture Capital Company during the project's first five years. Subject to feasibility studies demonstrating the commercial viability of particular production technologies, the project will invest in a variety of technologies, such as:

Village rice milling: 592 rural families will increase their incomes through an increase in the rice recovery rate from 50% to 65% and a decrease in their transport and milling costs by 10%. Company profits over a 5 year period will total $19,086.

Agar-agar processing: At least 180 families will increase their incomes from seaweed harvesting by 30% and over 21 jobs will be created in the processing plant. Company profits over the 5 year project period will total $46,043.

Auricularia mushroom spawn production: Six jobs will be created at the enterprise and ten rural contract growers will increase their incomes by $75 per month. If viable, additional enterprises can be established, realizing significant savings in foreign exchange (currently 70% of the 24,000 kilo/yr national demand for auricularia mushrooms is met by imports). Company profits over the 5 year project period will total $75,125.

Rural Small-Scale Industries Program, Thailand

Project Partner:

Population and Community Development Association (PDA)

Purpose:

To establish a small finance and technical assistance company which uses venture capital and credit mechanisms to invest in rural small industries based upon improved production technologies which pass technical assessment, commercial appraisal, and economic benefit analysis. The company's objective is to increase income and employment opportunities in rural areas directly through jobs in small industries and indirectly through increasing the demand for raw materials produced by rural farmers.

Expectations/Technologies:

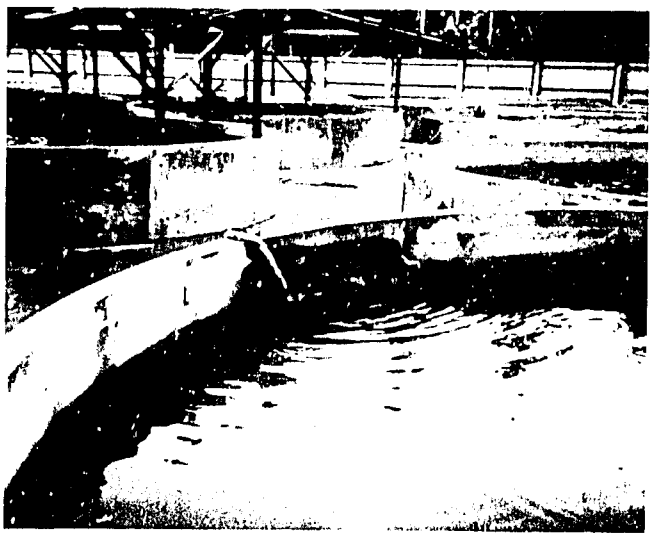
More than 40 companies will be established and approximately 7,000 people will be affected by the project. Subject to feasibility studies demonstrating the commercial viability of particular production technologies, the project will finance a variety of industries, such as:

Bamboo grass mat production: Annual income to 300 rural farmers of $43 a month or $350/season with company profits of $13,000 per 8 month production cycle.

Powdered pepper processing: 50 producers would sell to the plant. Gross annual income to farmers would be $1,800 annually plus shares in the profits, and company profits would total between $15,000 - $24,000 a year.

Shrimp paste manufacture: Annual payments to local fisherpeople to total $26,000 with company profits of $2,900.

Shrimp hatchery in rural industries program, Indonesia (p. 25)



Catfish production in ferro-cement tanks is the activity of one of the more than 40 companies to be established by a rural small-scale industries program in Thailand.

Rhizobium Inoculant, Thailand

Project Partner:

SVITA Foundation

Purpose:

To introduce rhizobium inoculant, a natural bacterium that fixes atmospheric nitrogen in leguminous plants, and gain its acceptance by soybean growers as an integral part of production inputs available to increase soybean production in Thailand.

Expectations:

The use of rhizobium is expected to enable thousands of small-scale growers to increase productivity, lower costs, and increase soybean production in Thailand, where two-thirds of the national requirements, or 324,000 tons, are imported annually. If successful, the project will increase the incomes of 1600 farmers by at least 25%. After five years, 20 production plants will be established, reaching over 16,000 farmers and producing an annual net gain in income of $2,782,600 to farmers.

Technology:

Rhizobium, a soil bacterium that occurs naturally, works in a symbiotic relationship with legumes to fix atmospheric nitrogen in the soil. The use of rhizobium inoculant with certain legumes increases plant productivity from 20-50% and lowers production costs up to 60% by reducing the input of imported nitrogen fertilizers. This project will develop a simple, small-scale production process for producing rhizobium, based on an aerobic fermentation process using a seed culture and a growth medium under aseptic conditions. A small-scale decentralized rhizobium production unit with a capacity of 8 tons/year will be established which will service scattered and difficult to reach rural markets.

Protein Enriched Cassava, Thailand

Project Partner:

Population and Community Development Association (PDA)

Purpose:

To develop and commercialize a bio-technology, discovered and researched in Thailand, which enriches the nutritional content of cassava up to 25% in protein content, enabling the production of a low cost, highly nutritious stock feed.

Expectations:

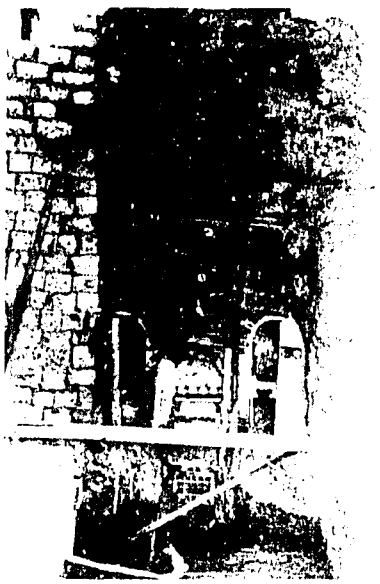
Thousands of small-scale pig and poultry farmers will be able to improve their cash incomes by using this lower cost stock feed, equivalent in nutrition to conventional formula feeds which use high cost imported protein sources. The project will demonstrate the commercial viability of a small-scale production plant. Each plant will serve approximately 500 small livestock farmers who will increase their profit per pig raised by 21-34% as a result of lower feed costs. Additional income benefits will accrue to cassava producers who will sell their produce to the plants.

Technology:

This technology enriches the protein content of cassava by using a combination of a mold and a yeast in a solid substrate fermentation process. Unlike most other cassava enrichment techniques, this new technique lends itself well to intermediate scale and cottage level production due to its economic use of capital and its labor intensive production process.

A biotechnology discovered in Thailand is used to enrich the protein content of cassava for use as pig feed.

LATIN AMERICA AND CARIBBEAN



An innovative ITCR lime kiln will increase production and quality of lime in Costa Rica. (Half-scale model of kiln).

Lime Kiln Technology, Costa Rica

Project Partners:

Instituto Tecnologico de Costa Rica (ITCR) and Cooperativa Nacional de Productores de Cal (CONAPROCAL)

Purpose:

To develop and test an improved process for small-scale lime production in the country, using an improved kiln design which should increase the production and quality of lime, and to create a revolving fund to finance the application of the new design in at least 45 lime producing businesses.

Expectations:

Over a thousand people who work in the industry will benefit indirectly from this project. Benefits include an increase in incomes due to a higher sales volume of good quality lime and direct savings in energy costs from a reduction in the consumption of firewood and imported lime. Results of the project will be documented and disseminated to enable replication of the technology in other parts of Central America and the Caribbean. (This project has already resulted in improved lime kiln designs in another ATI project in Botswana).

Technology:

The ITCR will develop and test an innovative kiln design to produce hydrated lime. The design enables continuous production, is thermodynamically efficient (reduces energy losses), and uses the structure of existing shaft kilns. Recommendations will also be made to enhance the hydration procedures to produce high quality lime.

Swine Feed, Dominican Republic

Project Partner:

Centro de Investigacion y Mejoramiento de Produccion Animal (CIMPA)

Purpose:

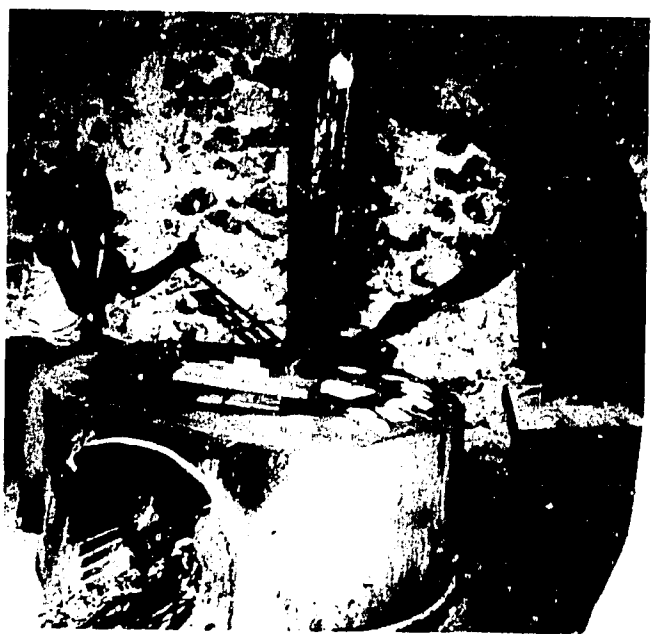
To establish a commercial system to improve the availability of specific feed ingredients and related inputs to small-scale swine producers.

Expectations:

If successful, up to 2,000 farm families engaged in small-scale swine production in the Cibao region of the Dominican Republic will earn an additional $83 per year (average) by lowering their costs of production. Ten local vendors of the supplies (farmer cooperatives, agricultural supply stores, etc.) will each increase their annual net income by approximately $5,000.

Technology:

The project will combine traditional feeds available on the farm with high protein feed supplements, molasses, veterinary supplies, and appropriate hog raising equipment to enable participants to both lower net feed costs and to increase feed conversion efficiency. Molasses is a by-product of the sugar industry and is the cheapest commercial feed ingredient available in the Dominican Republic. High protein feed supplements are a product of the animal feed industry.



A rural based processing plant provides cassava flour to local bakeries in Haiti.

A small-scale hydraulic press is one of the innovative production components in the Cassava processing plant.

Cassava Processing, Haiti

Project Partner:

Societe Agro-Industrielle de Valorisation Agricole de Camp Perrin (SAVACAMPE)

Purpose:

To determine the commercial viability and replication potential of a rural-based, small-scale cassava processing plant with a daily capacity of up to 1.5 tons. The plant will produce cassava flour for use in local bakeries as well as develop new cassava-based products.

Expectations:

If successful, (a) at least 200 hectares of marginal lands will come under cassava cultivation (b) 300 to 400 small-scale farmers in the area of the plant will have a new market outlet for cassava, and (c) these small-scale farmers will increase their incomes by 12-20% by selling to the plant. In addition, it is expected that 3 additional processing plants will be established in other rural areas.

Technology:

The project will establish a village-scale cassava production plant which operates on a commercial basis, using a technology developed in Brazil and modified locally. Production components consist of an improved mechanical peeling device, a mechanical chipper, a small-scale hydraulic press with a capacity to press up to 5 tons daily, improved solar drying chambers to reduce moisture content effectively, and a hammer-mill.

Linares Pump, Latin American Region

Project Partner: Save the Children Federation (SCF), Latin America/Caribbean

Purpose:
To transfer the Linares pump, developed in Colombia, to several Latin American countries, and to test the technology's suitability for supplying water for irrigation, livestock, and domestic uses.

Expectations:
A $400 investment in a Linares Pump will bring one-third of an acre of land under irrigation at a cost less than that of purchasing irrigated land. At least 320 farmers in 4 countries will visit the 9 Linares Pump test sites for demonstrations. It is anticipated that the project will lead to the establishment of rural based pump producing enterprises in each country.

Technology:
The project will install the Linares Pump, a stream-powered water pumping device originally developed and successfully tested in Ubaque, Colombia, in several other Latin American countries for testing purposes. The pump is an easily disassembled waterwheel with double pistons that operates effectively in streams with depths between .4 and 1 meter and flows of .7 and 1.5 meters per seconds.

The ATI/Hotchkiss wheelchair design provides a sturdy, low-cost means of mobility for the handicapped in Latin America and the Caribbean.

The Linares pump, a stream powered water pumping device, makes water available for irrigation, livestock, and domestic uses in Latin America.

Wheelchair Production, Latin American Region

Project Partners:
Fundacion de Educacion Superior (Colombia), Servicio Evangelico Peruano de Accion Social (Peru), Fundacion Hondurena de Rehabilitacion e Integracion del Limitado (Honduras), Centro de Rehabilitacion Vocacional (Guatemala), Programa de Ayuda a Pequenas Empresas (Dominican Republic), Ralf Hotchkiss & Associates (USA)

Purpose:
To assist small-scale enterprises in Peru, Colombia, Guatemala, Honduras and the Dominican Republic to commercially produce a wheelchair design adapted to rural conditions in developing countries.

Expectations:
This project will establish at least twelve small-scale wheelchair production enterprises in five countries. Each workshop will have a production capacity of 100 to 300 chairs per year. Collective annual production capacity will total at least 2500 wheelchairs. Lines of credit will be extended to rehabilitation institutes to enable them to sell ATI/Hotchkiss wheelchairs to the poor.

Technology:
The Hotchkiss design, developed under an earlier ATI grant and subsequently field-tested throughout Latin America and the Philippines, results in a very lightweight, durable, folding wheelchair that is well-balanced and adaptable to individual fittings. The chair can be manufactured in small local metalworking shops from locally available materials. A production manual and a standardized tooling set for wheelchair production were designed to facilitate widespread dissemination of the technology and to ensure quality control and standardization of the product.

APPROPRIATE TECHNOLOGY INTERNATIONAL
1984 SUMMARY
SERVICES TO THE FIELD

Financial Assistance

Region	Country	Project Name	Amount
Africa	Botswana	Brick Production	$ 90,400
		Lime Production	95,000
	Tanzania	Oil Press Production	112,276
		Village Oil Processing	142,676
		Improved Bricks	156,542
		Rural Potteries	97,512
	Zimbabwe	Agro-Industries	223,500
Asia	Indonesia	Venture Capital Company	307,340
	Nepal	Wool Spinning	165,144
		Turbine Driven Agro-Processing	29,959
	Philippines	Rural Small-Scale Industries Development	367,440
	Thailand	Rhizobium Inoculant	137,700
		Protein Enriched Cassava	235,300
		Rural Small-Scale Industries Program	350,333
Latin America & Caribbean	Costa Rica	Lime Kiln Technology	144,514
	Dominican Republic	Swine Feed	160,977
	Haiti	Cassava Processing	86,821
	Regional	Linares Pump	18,200
		Wheelchair Production	200,800
Miscellaneous 1984 Grants (under $7,500)			24,100
1984 Activity-Grants made prior to 1984			115,201
Total Financial Assistance			3,261,735
Project Development and Monitoring			760,526
Technical and Evaluation Services			306,956
Other Project Support			150,344
Total Services to the Field			$4,479,561

Price Waterhouse

1801 K STREET N.W.
WASHINGTON, D.C. 20006
202 296 0800

February 8, 1985

To the Board of Trustees of
Appropriate Technology International

In our opinion, the accompanying balance sheet and the related statements of revenues, expenses and changes in fund balance and of functional expenses present fairly the financial position of Appropriate Technology International at December 31, 1984, and the results of its operations and changes in its fund balance for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year. Our examination of these statements was made in accordance with generally accepted auditing standards and the standards for financial and compliance audits contained in the U.S. General Accounting Office Standards for Audit of Governmental Organizations, Programs, Activities and Functions and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

Price Waterhouse

APPROPRIATE TECHNOLOGY INTERNATIONAL
BALANCE SHEET
DECEMBER 31, 1984

ASSETS

Cash	$ 17,388
Grants receivable (Note 2)	6,644,795
Furniture, fixtures and leasehold improvements, at cost less accumulated depreciation and amortization of $206,430 (Note 2)	245,428
Advances	7,671
Deposits	55,595
Other	31,228
	$7,002,105

LIABILITIES AND FUND BALANCE

Accounts payable and accrued expenses	$ 99,889
Unconditional grants payable (Note 2)	3,561,511
Deferred grant revenue (Notes 2 and 5)	3,338,636
	7,000,036
Commitments (Note 4)	
Fund balance	2,069
	$7,002,105

APPROPRIATE TECHNOLOGY INTERNATIONAL
STATEMENT OF REVENUES, EXPENSES AND CHANGES IN FUND BALANCE
FOR THE YEAR ENDED DECEMBER 31, 1984

Revenues	
AID grant	$5,772,562
Other	18,770
Total revenues	5,791,332
Expenses	
Services to the field	
Financial assistance	
Agricultural product processing	2,181,724
Local mineral resources	737,738
Equipment and support for small farms	166,001
Other	176,272
	3,261,735
Project development and monitoring	760,526
Technical and evaluation services	306,956
Other project support	150,344
Total services to the field	4,479,561
Policy and information services	238,980
Total program services	4,718,541
Supporting services	
Unrestricted funds	3,472
General and administrative	1,069,561
Total expenses	5,791,574
Excess of expenses over revenues	(242)
Fund balance, beginning of year	2,311
Fund balance, end of year	$ 2,069

APPROPRIATE TECHNOLOGY INTERNATIONAL
STATEMENT OF FUNCTIONAL EXPENSES
FOR THE YEAR ENDED DECEMBER 31, 1984

	Program Services										
	Financial Assistance	Project Development & Monitoring	Technical & Evaluation Services	Other Project Support	Total Services To The Field	Policy & Information Services	Total Program Services	Unrestricted Funds	Total Direct Costs	General Administration	Total Expenses
Financial Assistance											
Field operations	$3,261,735				$3,261,735		$3,261,735		$3,261,735		$3,261,735
Policy						$ 95,560	95,560		95,560		95,560
Total financial assistance	3,261,735				3,261,735	95,560	3,357,295		3,357,295		3,357,295
Operating Expenses											
Salaries		$439,896	$189,639	$100,454	729,989	97,328	827,317	$2,401	829,718	$ 292,464	1,122,182
Benefits		92,959	38,981	18,470	150,410	18,490	168,900	393	169,293	59,774	229,067
Other payroll costs		38,303	15,513	8,103	61,919	8,109	70,028	156	70,184	26,761	96,945
Consultants		8,226	22,295	6,128	36,649	3,637	40,286		40,286		40,286
Travel		181,142	40,528	17,189	238,859	15,856	254,715	166	254,881	32,604	287,485
Occupancy costs (Note 4)										274,569	274,569
Communication										82,061	82,061
Materials and supplies										18,941	18,941
Copying and printing										34,207	34,207
Publications										15,963	15,963
Recruitment and relocation										8,361	8,361
Professional services										100,106	100,106
Insurance										6,495	6,495
Miscellaneous								356	356	14,601	14,957
Equipment maintenance and rental											
Depreciation										16,406	16,406
										86,248	86,248
Total operating expenses		760,526	306,956	150,344	1,217,826	143,420	1,361,246	3,472	1,364,718	1,069,561	2,434,279
Total expenses	$3,261,735	$760,526	$306,956	$150,344	$4,479,561	$238,980	$4,718,541	$3,472	$4,722,013	$1,069,561	$5,791,574

APPROPRIATE TECHNOLOGY INTERNATIONAL
NOTES TO FINANCIAL STATEMENTS
DECEMBER 31, 1984

Note 1 - Organization

Appropriate Technology International (the Organization) was incorporated on December 10, 1976 as a private, non-membership, non-profit corporation. Since its inception, the Organization has been awarded grants totaling $33,900,586, of which $4,500,000 was awarded in 1984, by the Agency for International Development (AID), under Section 107 of the Foreign Assistance Act of 1961, for the development and dissemination of technologies appropriate for developing countries. The Organization's current funding award from AID extends through September 29, 1986 and provides additional funding of $7,071,000 pending its availability and mutual agreement with AID. Since 1980 the Organization has also been awarded grants from various other enterprises totaling $188,112.

The Organization is exempt from Federal income taxes under Section 501(c)(3) of the Internal Revenue Code.

Note 2 - Summary of Significant Accounting Policies

Basis of Accounting

The Organization records revenues and expenses in conformity with the accrual basis of accounting.

Grants Receivable

Grants are recorded on the balance sheet when notice of award (or amendment thereto) is received, and are recognized as revenues only to the extent of expenditures that satisfy the purpose of the grant. Unexpended amounts are included in the financial statements as deferred grant revenues.

Furniture, Fixtures and Leasehold Improvements

Furniture, fixtures and leasehold improvements are recorded at cost and depreciated over their estimated economic life of 5 years on the straight-line basis. Computer software is recorded at cost and depreciated over an estimated economic life of 3 years on the straight-line basis.

Grants Awarded

A grant awarded is recorded as an expense and liability at the time the recipient is entitled to use of the funds.

Functional Expenses

The expenses of providing the various programs and other activities of the Organization are reported on a functional basis. Accordingly, expenses are charged to the programs and supporting services benefited.

Accrued Leave

Under the Organization's annual leave policy, employees are permitted to accumulate unused leave up to certain maximum amounts. The policy also provides for payment to employees of such unused amounts at termination. The cost of annual leave is accrued as earned.

Note 3 - Retirement Plan

The Organization maintains a non-contributory defined-contribution retirement plan. Employer contributions are equal to fifteen percent of each participant's base annual salary. All full-time employees participate in the plan upon employment and are fully vested after 3 years.

Pension expense included in the accompanying financial statements approximated $146,000. It is the Organization's policy to fund retirement plan costs as they accrue.

Note 4 - Lease Commitments

The Organization leases office space under two five-year leases which expire February 1986 and April 1989, respectively. The agreements provide for annual adjustments based upon a consumer price index. Such amount includes costs and expenses for utilities, insurance, janitori l and cleaning services, maintenance and repairs and real estate taxes. Under the above agreements, future minimum rentals net of sublet rentals are as follows:

	Gross Rentals	Sublet Rentals	Net Commitment
1985	$ 482,000	$271,000	$211,000
1986	222,000	45,000	177,000
1987	185,000		185,000
1988	185,000		185,000
1989	62,000		62,000
	$1,136,000	$316,000	$820,000

Future minimum rentals under operating leases for equipment approximate $41,000 in 1985 and $21,000 in 1986.

Occupancy costs in 1984 are net of $195,627 of sublease income.

Note 5 - AID Grant Awards

AID grant awards received as of December 31, 1984 have been disbursed or obligated as follows:

Grants awarded:		
1983 and prior	$10,201,821	
1984	3,357,295	$13,559,116
Other expenses:		
1983 and prior	$14,587,567	
1984	2,415,267	17,002,834
Grant expenses to date		30,561,950
Deferred revenue as of December 31, 1984		3,338,636
Total AID grant awards received		$33,900,586

STAFF MEMBERS

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Executive Secretary

Judith Polsky
Executive Assistant

Sharon Johnson
Administrative Assistant

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