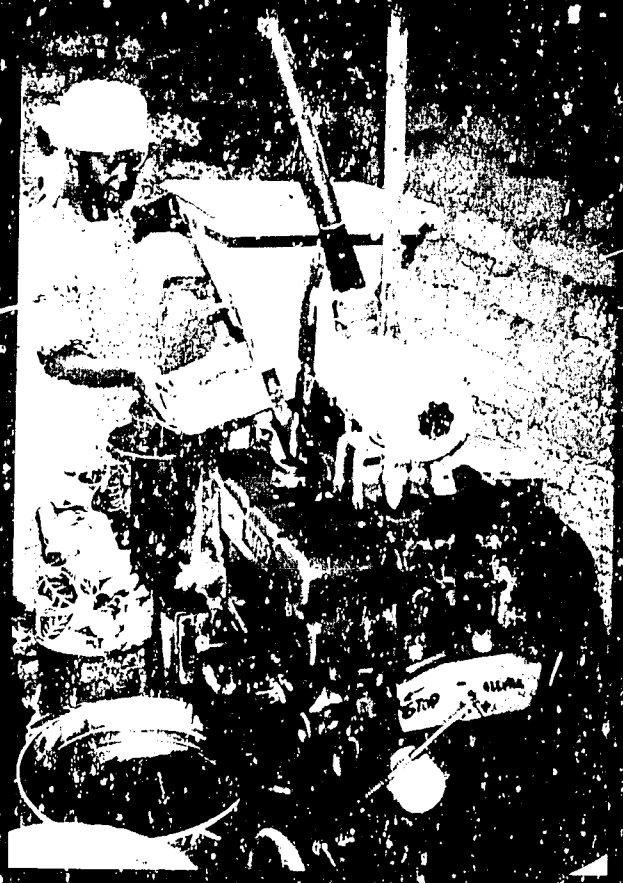
Appropriate Technology International



REPORT OF APPROPRIATE TECHNOLOGY INTERNATIONAL 1984–1987

Appropriate Technology for Small Enterprise Development

SHEA BUTTER extraction units (Mali) reduce considerably the time and physical effort required to process shea nuts into butter. This appropriate technology has considerable replication potential throughout West Africa.
(Photo by Ed Perry)

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

This report constitutes ATI's Annual Report for 1986.

Letter from the Chair

As an active practitioner in agricultural development since the 1950s, I have studied, observed, and been a part of three major stages in the evolution of development philosophy and practice.

Initially, the emphasis was on innovation—i.e. the technology. For example, in an attempt to increase corn productivity, the use of hybrid seed was promoted among the rural poor. In essence, this was one way communication. The scientist imposed his innovation on the farmer and the recipient became dependent on the source. There was no real exchange of ideas—the recipient was expected to accept the innovation and benefit from it.

In the late 1960s, the emphasis shifted to adapting the innovations to the characteristics of the people who were to use the technologies at specific locations. Technologies began to be implemented taking into account the social, cultural, and economic context of the recipients of the technology. The scientist was still the source of the innovation but the source learned, through experience, that if the technology was to be successfully utilized, the source needed to understand the circumstances of the recipient. This was not true two-way communication. The communication related only to the context in which the innovation was to be implemented—not necessarily to the true needs of the recipient.

In the third and most recent stage in the evolution of development practice, innovations are not only adapted to fit the social and economic objectives of the users of the technology, but, in addition, the roles of source and recipient are interchangeable. Ideas originate just as often with the recipient as with the source. The people in the developing countries are contributing to the creation of innovations that respond to their particular conditions. Development is a continuing, participatory process. The system is open-ended; there are no "sources" or "receivers." This is true communication—a joint dialogue.

Some development organizations continue to base their efforts on the traditional donor attitude. Others work in the Stage Two development mode. Appropriate Technology International is trying to work within the third stage of development philosophy. I believe it is this attitude that accounts for our success.

For example, more than 90% of the ideas for our demonstration projects originate in the field and come from ATI's project partners, the implementing organizations in the developing countries. ATI works with local people—producers, scientists, administrators, technicians, as well as officials in private and government agencies—to promote their ideas in the design, implementation, and evaluation of strategies relevant to their social and economic objectives.

This has been an efficient way to develop cost effective approaches for establishing productive activities that add significant value to local resources—activities that can be maintained and improved locally. ATI does not seek to introduce technology but works with local organizations to commercialize development innovations. Through direct participation in these projects, local people learn within the context of their traditional value systems and culture to appropriate innovations to their benefit.

The results are far-reaching. Jobs are created, income levels rise, nutrition improves, small-scale processing plants are built, and these are owned and managed by local people. People have more time available to devote to other income-generating activities. Their overall quality of life is improved and the hopes and prospects for the future are brighter. They no longer are just "recipients" of improved technology. They are committed to and involved in their own development. People who initially were the recipients and followers have now become the innovators and leaders.

ATI's activities over the past four years demonstrate that it is an innovative and dynamic organization. ATI has selected challenging target regions for its programs—the intertropical belt of the world where most developing countries are located and a region described by many authors as a cemetery for very conspicuous development projects. ATI works in 20 countries in Latin America, the Caribbean, Asia and Africa, on projects ranging from rhizobium inoculant in Thailand to oil processing in Tanzania and Cameroon to mining and a natto production in the highlands of Peru.

This report describes the efforts ATI and its project partners are making to motivate people to take charge of their own development and that of their countries. ATI is serving as a linkage whereby the people in the developing countries teach us the really effective strategies for the application of science and technology to development. The capacity and experience of local people are serving as the central nervous system for their own development.

On behalf of ATI's Board of Trustees, I would like to take this opportunity to urge the ATI family—staff in Washington, D.C., the staff of our project partners and especially the people in the field—to continue your outstanding work in the years ahead.

Leobardo Jimenez Sanchez
Chair
Board of Trustees

June 18, 1987

Dedicated to the people in developing countries—the small farmers, artisans, small entrepreneurs, technicians, scientists,—who are teaching us the effective strategies for the application of science and technology to development.

Editor: Arleen Richman

Editorial Staff: Laura Brainard, *Assistant Editor*
Scott Ripley, *Photos*
Sabra Breslin, *Copy*

Contributors: Carolyn Hairston
Diana Ingraham
Kazem Oryani
John Slavics
Lisa Stosch

Photos: Ian Fraser
Eric Hyman
Carlos R. Lola
Ed Perry
Arleen Richman
John Skibiak
E. F. Swartzendruber

All photos are from the files of ATI.

Appropriate Technology for Small Enterprise Development

REPORT OF APPROPRIATE TECHNOLOGY INTERNATIONAL 1984-1987

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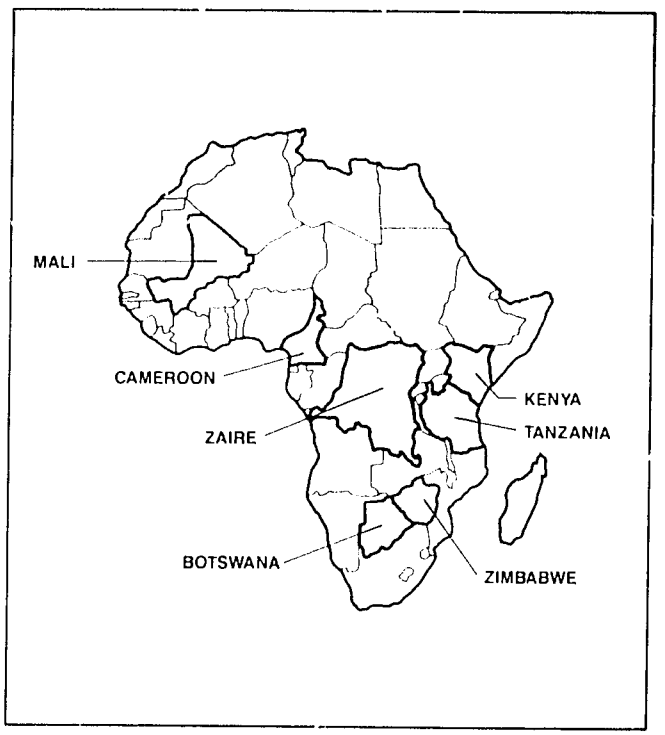
AFRICA

Partners and Projects



BOTSWANA

Animal Driven Pumps

RIP/RIIC: David Inger, Managing Director; Kit Morei, General Manager

Brick Production

SRDA: B.R. Chibana, Managing Director; Manfred Boehmer, Technical Advisor

Grapple Processing

Thusano Lefatsheng: Tabe Tietema, Board Chairman and Acting General Manager; Francoise Horenburg, General Manager (until 3/87)

Lime Production

SRDA: B.R. Chibana, Managing Director; Manfred Boehmer, Technical Advisor

CAMEROON

Anguh Maize Mills

APICA: Barnabus A. Anguh, Director General; Joseph Moutsi, Project Coordinator

Composite Flour

ENSIAAC: Michel Parmentier, Director (until 9/86); Vincent Truchetto, Project Manager.

Palm Oil Extraction Unit

APICA: Alain Laffitte, Secretary General

KENYA

Ceramic-Lined Jikos

KENGO: Achoka Aworry, Coordinator

MALI

Mini-Dehullers

CMDT: Jean-Pierre Derlon, Chief of Training

Shea Butter Extraction Units

Bernard Clamagirand, General Delegate

TANZANIA

Improved Bricks

CAMARTEC: Edward Ngaiza, Director General

Oil Press Production

CAMARTEC: Edward Ngaiza, Director General; William Ngange, Managing Director

Rural Potteries

CAMARTEC: Edward Ngaiza, Director General; Aliasghar Sheriff, Project Manager

Village Oil Processing

LWR/ELCT: Lynn Schlueter, Project Manager

ZAIRE

Hydro-Powered Grain Mills

SODERZA: Soheyl Mottahedeh, Director General

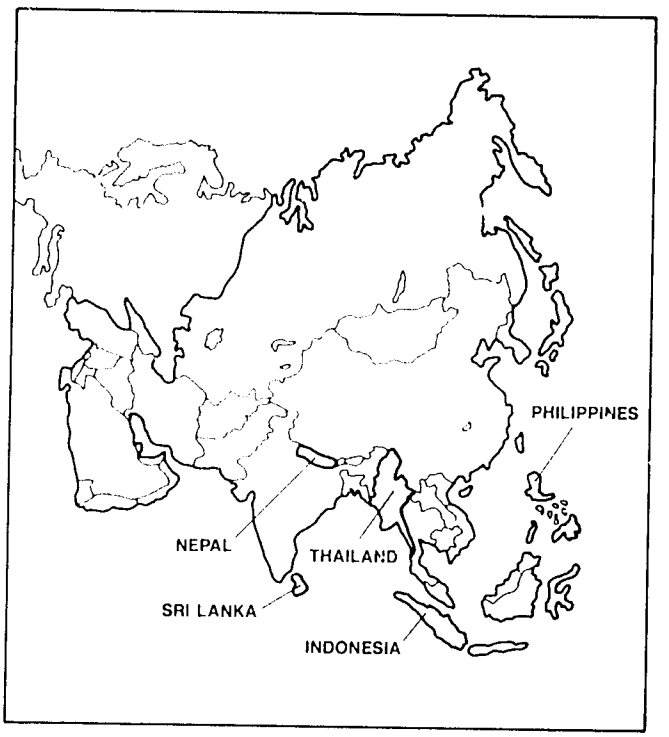
ZIMBABWE

Agro-Industries

FEP: John Conradie, Project Manager

ASIA

Partners and Projects



INDONESIA

Venture Capital Company, Indonesia

YDD: Anton Soedjarwo, Director

NEPAL

Turbine Driven Agro-Processing

New Era: Shree Krishna Baidya, Field Coordinator; Bhim Bahadur Durra, Vice Chair, R.K. Watershed Conservation Comm.

PHILIPPINES

Organic Fertilizer

FFI: Melo Cabrera, Manager, Science and Technology Research Center

Rural Small-Scale Industries Development

FFI: Margarito B. Teves, Executive Director; Marita Guevara Cuaño, Manager VCD

SRI LANKA

Cinnamon Processing

ATC: Calayanatissa Gunawardene, Executive Director

Computer-Video Training

Dasuna: Nihal de Mel, Chairman; Christy Jayakody, Manager

Mahaweli Rural Industries

Mahaweli: K. Gunatilaka, Director General; Lalit Godamunne, Secretary General

THAILAND

Protein Enriched Cassava and Rural Small-Scale Industries

PDA: Mechai Viravaidya, Secretary General; Pairojana Sornjitti, Director, ACPD; Siriyong Reuwiwat, Manager, RSSI Co.

Rhizobium Inoculant

SVITA: Malee Suwana-adth, Executive Director; Karnitha Karnchanachari, Managing Director

LATIN AMERICA/ CARIBBEAN

Partners and Projects

REGIONAL

Linares Pump

SCF: Jairo Arboleda, LA/C Regional Director; Jesús Linares, Inventor and Project Coordinator

Wheelchair Production

(Various project partners in Colombia, Peru, Honduras, Guatemala, Dominican Republic plus Ralf Hotchkiss & Associates, USA)

COSTA RICA

Lime Kiln Technology

ITCR: Francisco Pacheco, Academic Research Director and Lime Project Coordinator; CONAPROCAL: Juan Bautista Monge, Manager

DOMINICAN REPUBLIC

Swine Feed

CIMPA: Raul Osvaldo Hernandez, Director; Pedro Azcona, Project Manager

GUATEMALA

Wool Production and Processing

FUNDAP: Roberto Gutierrez, Project Director; Jorge A. Gándara, Asst. Project Director

HAITI

Cassava Processing Evaluation

IRD: Chavannes Jeune, Director

MEXICO

Farm Support Enterprises

Colegio de Postgraduados: José Cortes Flores, Project Director; Antonio Turrent, National Director of Research, Ministry of Agriculture

PERU

Annatto Production

CAL: Juvenal Paz, Processing Manager

Placer Mining Equipment

CEDCA: Ricardo Chavez, Director; Roberto Zegarra, Project Coordinator

Potato-Based Foods

Centro IDEAS: Alfredo Stecher, Director; Eduardo Burga, Project Coordinator

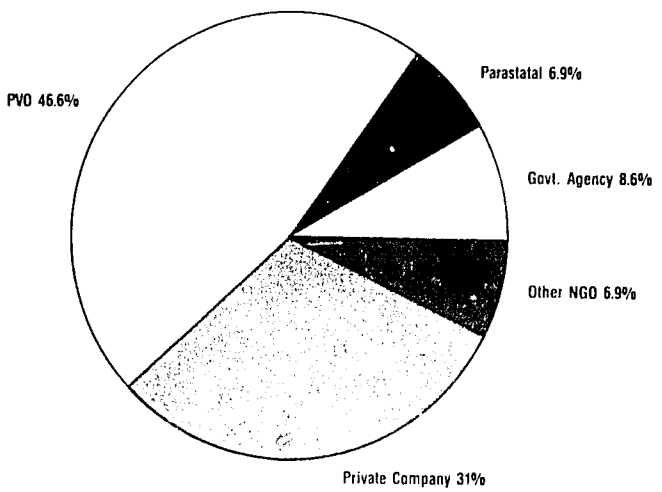
Introduction

What is ATI?

Appropriate Technology International (ATI) is a private, not-for-profit development assistance corporation based in Washington, D.C. ATI works with local businesses and organizations in Africa, Asia, and Latin America to identify, assess, adapt, disseminate and transfer technologies, and establish commercially viable enterprises in rural and peri-urban areas that are appropriate to the needs and resources of the poor in the Third World.

ATI seeks answers to the challenges of rural and peri-urban development by supporting profit-making small enterprises, which create employment and increase productivity. By applying modern science and technology to local resources and existing skills, ATI and its project partners are improving the productivity, incomes, and quality of life for tens of thousands of low-income people in developing countries.

ATI's Project Partners
Private versus Public Sector



Adapted from Figure E-2 AID Evaluation Study #45 which analyzed 58 ATI Project Partners during 1984 and 1985

What is ATI's Business? What are ATI's Products?

ATI's major "business" is to get productive technologies into the hands of poor people in developing countries. To do this, ATI:

- Tests cost-effective, innovative, development strategies that are based on applied science and technology;
- Transfers successful innovations tested in commercially-viable small-scale enterprises from original site to other countries;
- Provides technical, financial, and managerial services to help local enterprises and institutions establish small-scale businesses;
- Analyzes policies of governments, banks, and local institutions which affect commercially-viable, small-scale enterprises;
- Documents the experiences gained in its projects and the results of policy analyses and disseminates this information to development organizations, governments, and other institutions.

Who Are ATI's Project Partners?

Most of ATI's project partners—the implementing organizations—are businesses and other private sector organizations. These project partners share ATI's commitment to the need for commercially-viable productive activities. Because investment programs in productive activities in the poor areas of the Third World are largely unexplored and, are therefore very risky, ATI seeks project partners that are motivated, creative, organizationally sound, businesslike, innovative, willing to learn and to share their learning. ATI works to improve the capabilities of small businesses, small entrepreneurs, and other local organizations. During the development and implementation of a project, local people are trained in the technical aspects of operating equipment, as well as in project planning and administration. They gain hands-on experience in financial analysis, cash flow projections, market forecasting, quality control, and management.

How Does an Idea Become an Approved Project?

Project ideas usually originate in the field, a result of ATI staff discussions with local businesses, bankers, government agencies, and development organizations. ATI's rigorous project selection process begins formally with a Concept Review meeting. Here, ATI staff screen the idea, not only for soundness of technology choice, but for potential commercial success, economic sustainability, and widespread use beyond the original project locale. All ATI projects must provide direct returns to ATI's target group—the poor in rural and peri-urban areas. Once a target area is approved, the Project Officer returns to the field and formulates a detailed project plan, in collaboration with local project partners. This plan includes technical and financial appraisals, market analyses, and a thorough assessment of the assumptions underlying expectations for project success. In preparing the plan, the Project Officer utilizes the expertise of other ATI staff—technical, business, and evaluation specialists—who are members of ATI's two support wings, the Technical Resources Group and the Business Development and Replication Group.

Following ATI scrutiny, the project plan is then presented to the Project Review and Advisory Committee (PRAC), composed of outside experts from the international development and scientific communities. Based on the PRAC's advice, plans are submitted to ATI's Board of Trustees, prior to receiving the final approval of the Executive

Director. The entire process, from idea to approval, takes between four and eight months.

Once a project is formally approved and funds are committed, ATI staff provide management and technical assistance on a regular basis to implement, monitor and evaluate the project. Based on the specific needs of the project, Project Officers and or evaluation and technical staff visit the project to discuss the progress and resolve problems. This multi-disciplinary approach to project selection and development is an integral part of ATI's knowledge building and sharing process.

What Types of Technologies Does ATI Support? In What Countries Does ATI Work?

ATI works in three technical areas: agricultural products processing and utilization of agricultural wastes; local mineral resources development; and equipment and support for small farms.

Examples of projects in each area include:

Agricultural Products Processing and Utilization of Agricultural Wastes: small-scale processing and extraction of edible oils; processing of cereals and staple foods; production of animal feed from agricultural wastes; and processing of fruits and vegetables.

Local Mineral Resource Development: small-scale production of cement and cementitious material; small-scale production and use of lime; production of ceramics, bricks and tiles, as well as the improvement of ovens and kilns.

Equipment and Support for Small Farms: small scale applications of bio-technologies, such as rhizobium inoculant for increased soybean yields and protein-enriched cassava for animal feed; and production and marketing of small farm implements.

Occasionally, ATI might support a project outside these three major technical areas. At present, ATI supports two such "innovative opportunities": testing of computer video training and the establishment of small-scale enterprises to manufacture the ATI-Hotchkiss Third World Wheelchair.

In order to concentrate resources and to maximize the effects of ATI's successful development strategies, ATI works in a limited number of countries. At present, ATI has projects in 20 countries in Africa, Asia, Latin America and the Caribbean.

ATI constantly searches for opportunities to disseminate innovative technologies already proven in demonstration projects to areas outside the original locale ("replication"). Thus, a successful appropriate technology may be transferred to a country or countries where ATI does not usually work.

EXHIBITS at conferences, such as Carlos R. Lola's exhibit at the Tenth International Council for Building Research, September, '86, help disseminate lessons learned by ATI and our project partners.

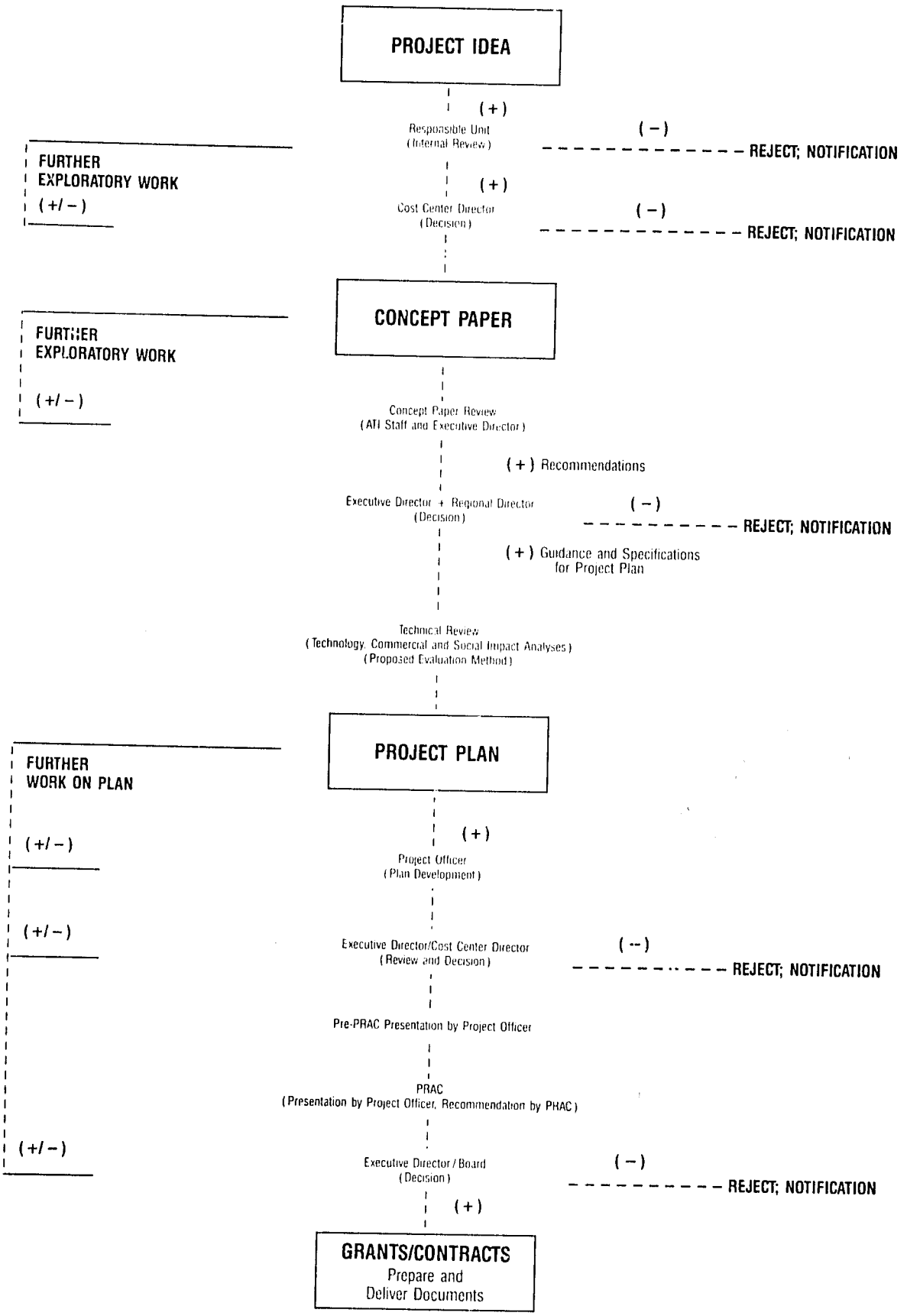
COMPANION ORDERING AGREEMENT

In mid-1987, ATI is expected to sign with A.I.D. an Ordering Agreement that will make our knowledge and expertise in appropriate technology, choice of technology, transfer of technology and small-scale enterprise development more readily available to A.I.D. Missions.

A.I.D. Missions may request a Technical Services Order for specific tasks such as: sector assessments; policy studies; project identification; analysis, design and monitoring; project implementation, including technical assistance; development of training materials; evaluation of programs and projects and design of evaluation methods. A.I.D.'s announcement of the Ordering Agreement stated that ATI "is particularly qualified to provide project identification, analysis and design assistance for medium and small-scale enterprise activities involving contribution of local currencies to capitalize revolving loan and venture capital funds."

The Companion Ordering Agreement will enable A.I.D. Missions to purchase ATI's services without incurring administrative delays and will help integrate ATI into the regular A.I.D. development program.

PROJECT APPROVAL PROCESS



Small Enterprise Development: Changing Paradigms and Contexts

By Ton de Wilde

The importance of small-scale enterprise development has been emphasized time and time again by governments and development philosophers. Yet, if we look at the development of industrial societies, credit for increasing the material wealth of their populations goes to large-scale enterprises. At the same time, large-scale enterprises are blamed for the breakdown of culture and tradition, the uprooting of people and the destruction of traditional value systems.

The importance government leaders place on small-scale enterprise development is, with few exceptions, not reflected in the resources that governments make available for its development. However, this picture might change in the near future — for a variety of reasons.

Table 1 summarizes the reasons behind the renewed interest in small-scale enterprise development.

Table 1. Factors Stimulating the Renewed Interest in Small Scale Enterprise Development

Negative	Neutral	Merit
Violence and Unemployment Protection of Industry in Industrialized Countries Reduced Availability of Credit for Large Enterprises	Development of Technology Reduces the Importance of Economics of Scale	Traditional Advantages Development of New Insight and Knowledge in Small Enterprise Development

Factors Discouraging Large-Scale Industry

First and foremost, there is growing pressure on governments to create jobs in rural and peri-urban areas. In most countries, population growth has dramatically exceeded the growth in employment in industry and agriculture. Governments are reviewing their development policies to look for strategies that combine economic growth with employment creation as opposed to strategies that focus only on economic growth.

Second, industrialized countries, in particular the United States, are reassessing their foreign assistance programs. Because they are concerned about economic growth in their own countries, they are less and less willing to support development activities that create competition for domestic products. Current legislation (in the U.S.) already prohibits development assistance for programs that would support sugar, citrus, and palm oil production for export. Industrialized governments see two advantages in supporting small-scale enterprises that produce for a domestic market. In the first place, this creates local economic growth and consequently a potentially greater market for the products of industrialized countries. Second, these small-scale enterprises do not immediately compete with their own domestic industries or farm produce.

Finally, in materially poor countries, the credit available to invest in large-scale industry has been reduced. The large deficits of most of the developing countries, partly due to depressed performance of investments made in the 1970s, have made governments more careful about guaranteeing large loans to industries. More governments are searching for solutions in less capital-intensive commercially viable activities and finding them in small-scale enterprise development.

Neutral Factors: Development of Technology

The development of technology itself is also promoting small-scale enterprise development. Since the beginning of the industrial revolution, the development of technology focused on the transformation of material. Machines were developed to relieve humans from the physical burden of transforming material. Blacksmiths, who transformed iron into plows and other goods, were replaced by factories, which transformed steel into cars and cooking pots. The work of carpenters was replaced by factories that transform lumber into furniture. New materials were developed to transform petroleum into plastics. In the transformation of materials, the scale of the operation is critical to the efficiency of the enterprise. Economies of scale benefit the large enterprise rather than the small enterprise.

In the last ten years, the development of technology has changed directions. Now, technological development is focusing more and more on the transformation of information. Electronic calculators have increased the efficiency of bookkeepers; information on plant genetics has led to higher yielding plant varieties; studies in soil conservation have resulted in methods of soil preparation that require less or no tillage. Some economists are beginning to argue that the role of economies of scale is less vital in the case of new technologies.[1] For example, combines that harvest wheat and other grains are only advantageous on very large-scale farms. The development of a high yielding variety of wheat or rice, in principle, benefits the small farmer as much as the large farmer. We recognize that larger enterprises will still benefit from economies of scale — despite the fact that the technology itself might be scale neutral — because of other factors, such as access to capital, information, training, and management experience.

Merits of Small-Scale Enterprise Development

The success of small-scale enterprise development has stimulated renewed interest in this area. Small-scale enterprises are inherently more efficient than large-scale enterprises. People know each other, they can talk to each other, they can identify with the product they produce, they know when they duplicate each other's work or when the work is not relevant to achieving the goals of the company. Organiza-

tional waste in small-scale enterprises is reduced to a minimum.[2]

Small-scale enterprise development programs have acquired a great deal of knowledge in the last two decades. More and more, we are able to point to successful small-scale enterprises, not only from the perspective of employment generation, but also from the perspective of profitability and development. This trend can be observed in both industrial countries and in developing countries. For example, a recent study sponsored by Appropriate Technology International (ATI)[3] shows that while conditions in rural areas in Taiwan and the Philippines two decades ago were more or less similar, today, partially due to a set of policies that favored small-scale enterprise development in Taiwan, a 1% increase in agricultural output in the Philippines leads to a 1% increase in rural non-agricultural employment, whereas in Taiwan, a similar 1% increase in agricultural output leads to an increase of more than 2% in rural non-agricultural employment. Other examples[4] include the successes of local credit mechanisms and rural oriented banks.

Table 2. Expanded Levels of Analysis	
Traditional Enterprise Development Programs in an Industrial Environment	**Small Scale Enterprise Development Programs in Rural and Peri-Urban Areas**
	Human Value Systems
	Structural Factors
Technical/Project Factors	Technical/Project Factors
	Informal Structural Factors

Analysis and Assessment: An Expanded Paradigm for Small-Scale Enterprise Development

The laws and theories which govern traditional enterprise development in industrialized environments are important but *inadequate* in understanding and improving the performances of small-scale enterprises in rural and peri-urban areas of developing countries.

Dr. A.T. Ariyaratne, the Founder and President of the Sarvodaya Shramadana Movement in Sri Lanka, whom I had the privilege of working with in the 1970s, successfully followed a model that includes four levels of analysis basic to understanding the behavior of development activities. These four levels (1) the informal structural level, (2) the technical project level, (3) the structural level and (4) the level of human value systems — are discussed below.

The Informal Structural Level

Definition: The combination of individual, social, traditional and moral factors that influence the behavior of a small-scale entrepreneur.

Poverty has its own rules. The need to survive in an environment where material resources are scarce necessitates a strong system where individuals and families are mutually dependent on one another. Who is going to feed the members of a poor family if the income earner gets sick, or worse, dies? Who is going to provide cash for medicines if there is no money in the family? In most cases, the answer is relatives and neighbors.

Establishing small enterprises in cohesive communities requires an understanding of the priorities of the inhabitants. A new enterprise is risky; it takes time away from activities with known outcomes, even if the efficiency of the known activity is very low. The uncertainty surrounding the establishment of a new small enterprise inhibits people (despite often high wages) from shifting their priorities away from traditional community activities such as helping their family or neighbors with the harvest, planting, or building a house.

Similarly, although the profit margin of a small enterprise may be outstanding, the village entrepreneur may still refuse to invest in it or start operations because of the uncertainties related to starting up a new business. Because he is operating in an environment of scarcity, he would rather invest in an enterprise that is marginally profitable, but one in which the returns are known. Most entrepreneurs operating in materially poor conditions can only afford a small margin of risk. ATI has successfully experimented with mechanisms that share the risk of the village entrepreneur. In Asia, the principles of venture capital have been applied in establishing rural-based, small enterprises. These enterprises are the products of joint ventures between a development organization supported by ATI and local entrepreneurs. The entrepreneurs use their share of the profits of the enterprise to buy the shares held by the development organization, gradually increasing their ownership in the company. In Africa, ATI experimented successfully with lease-purchase arrangements, which not only share the risk involved in establishing new enterprises, but also provide credit for potential buyers.

To successfully start and maintain small enterprise development programs, an assessment of the social-psychological environment or "informal" factors has to be made and a strategy has to be developed to address these conditions.

The Technical Project Level

Definition: The combination of technical and project factors that influences the efficiency of the enterprise.

This is the area most familiar to traditional enterprise development: market analysis, market strategy, product quality, management of the production process, technology choice, spare parts and stock management, personnel management, energy management, and financial management. The literature on these subjects is abundant[6].

BANK OF MEXICO changed its lending criteria to permit loans to individual farmers participating in the Farm Support Enterprises project. Previously, only cooperatives could borrow money.

The Structural Level

Definition: The combination of formal and informal institutional and governmental arrangements that influence small enterprise development.

Studies in recent years have shown the importance of the "enabling environment."[7] While actual decisions about small enterprise development and technology are made at the micro-level, these decisions are strongly influenced by the external environment. Apart from direct interventions, governments can only affect small enterprise development and technologies used in small enterprises by influencing this external environment.

Too often policies and practices of governments and financial institutions end up favoring large enterprises over small enterprises because the side effects of the policies have been overlooked. Development schemes which make available subsidized credit for large-scale investments automatically create an extra burden for small-scale enterprises which now have to find scarce unsubsidized capital. Bank policies, geared to the better-known industrial environment, often unintentionally put up barriers to small enterprise development. Even small factors such as the procedures to collect credit information — the forms to be completed, or the limited accessibility of the loan officers — can be obstacles to effective small enterprise development.[8]

However, more important than policies specific to an institution, are the banking practices and government policies which often adversely affect small enterprise development. As already mentioned, this is dramatically demonstrated in a study on rural linkages in the Philippines and Taiwan. This study indicated that rural linkages are a way of promoting *production technology-based small enterprises.* The study which compared developments in the Philippines and Taiwan over recent decades showed that Taiwan's rate of growth in rural non-agricultural employment was more than twice that of the Philippines. A number of reasons were given to explain this difference in output. First, more capital-intensive technology in Philippine agriculture has generated less employment and fewer rural backward linkages. Capital-intensive, highly mechanized production methods usually rely on an industrial environment to supply urban-produced and imported inputs, while components of less mechanized technology can often be manufactured and serviced in rural areas. The high rate of large-scale mechanization in the Philippines was due to a set of price interventions, including subsidized credit, which favored tractors, and to unequal land distribution.

In Taiwan, the rapid growth of labor-intensive crops such as mushrooms and asparagus, among others, enhanced domestic consumption and provided a basis for establishing local cannery factories, which generated additional employment in rural areas. Generally, in Taiwan the processing of agricultural crops is more decentralized. In contrast in the Philippines, processing was done by multinational companies in large-scale plants in the urban areas.

In both countries the evidence suggests that the use of appropriate technology in rural-based small enterprises has generally stimulated the efficiency of the economic system as compared with urban industrialization. Production technology-based small-scale enterprises tend to make more use of local materials, and produce more products that can be used for local consumption, increasing local economic activity.[9]

Level of Human Value Systems

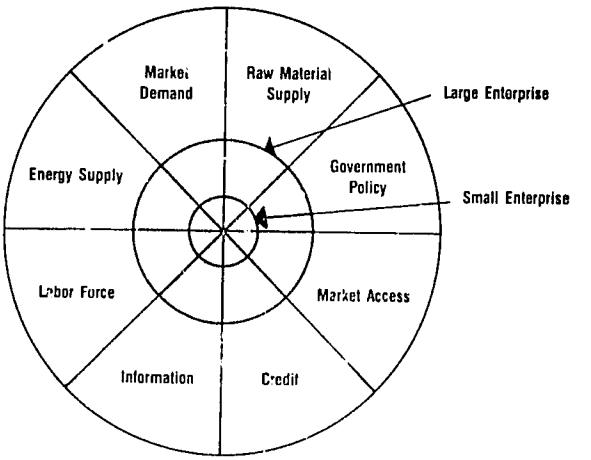
Definition: Factors influencing the value system of small entrepreneurs, their objectives in life and the environment affecting the motivation of entrepreneurs and workers.

Human value systems are formed through the interaction of people and their mutual expectations about life in society. These systems are based on culture and tradition as well as religion. Max Weber's analysis of the Protestant work ethic provides a better understanding of the forces that motivate traditional entrepreneurs in some industrial countries. Different behavior patterns in the Third World are the result of different value systems based on different religions. For example, while the Buddhist philosophy does not preclude competition, it may not provide the

same incentive for this mode of behavior as do the Protestant teachings. Different underlying philosophies help define the relationship between the small enterprise and its environment. To what extent can one expect a small enterprise to attempt to dominate more and more of its environment through advertising or by creating markets for its product? To what extent should one expect the small enterprise to adapt to the existing environment and only produce goods for which demand already exists?

Structure and Strategy for Small Enterprise Development

The essence of formulating a competitive strategy for small enterprises involves relating a small-scale enterprise to its environment. It is here that a major difference occurs between small and large-scale enterprises. Because of differential access to resources, large-scale enterprises generally dominate a larger portion of their environment than do small-scale enterprises. Large-scale enterprises also have more knowledge about their environment since they operate in an industrial context in which more data is available. If the market for their products changes, they try, through advertising and marketing strategies, to influence their environment in ways that benefit them. Often small-scale enterprises do not have this capacity and must adjust to such changes. If raw material supplies become a problem, large enterprises can find other suppliers, take control of the supply of raw material, or find production processes that allow substitution of raw materials. In contrast, small-scale enterprises are more dependent on the suppliers of raw materials since they often lack the resources to take full control over raw material supply. If a large-scale enterprise encounters difficulties obtaining an adequate supply of energy, it might purchase fuel-storage facilities or install generators to supply electricity. Small-scale enterprises generally lack the scale of operation to make such an option viable. To summarize, a small-scale enterprise is more dependent on its environment than a large-scale enterprise. Consequently, recognizing competitive forces in the environment is even more important for a small-scale enterprise than it is for a large-scale enterprise.



Enterprise Control Over Environment

Yet, strategic planning theory assumes that outside forces usually affect all firms in an industry equally, because forces outside the competitive industry are thought to be significant only in a relative sense. Experience in small enterprise development in LDCs has taught us that this is not true for small-scale enterprise development in rural and peri-urban areas. In particular, the institutional infrastructure (defined below) differs from region to region, and provides a significantly different environment in which enterprises operate. (See diagram above).

Institutional Infrastructure

What are the types and quality of institutional support available? Are services available to repair equipment? Can spare parts be readily supplied? How can products be transported to markets? Is financing available that not only provides for capital investment and working capital, but also enables low income customers to buy products? All too often, the assumption is made that services readily available in an industrial environment are also available for rural and peri-urban based small-scale enterprises. Like their counterparts in the large-scale sector, successful small-scale enterprises require access to services such as credit schemes, training facilities, reliable sources of energy, and assistance with quality control. Feasibility studies that assume an uninterrupted supply of electricity are useless in areas where electricity is only available a few hours per day. Similarly, it is a mistake to assume unlimited access to gasoline or diesel fuel to power machinery in rural and peri-urban areas of developing countries. Often, fuel is rationed due to foreign exchange shortages and the indebtedness of the national government.

But even the existence of services is not enough. It must also be determined that such services function. It is not enough to check if the local blacksmith has a lathe or a welding machine to make repairs. The more important questions are: can he indeed make the required repairs, does he know how to use his machines and are his machines usable? It is not enough to initiate a credit scheme if the lending conditions are not appropriate to the local situation. Poor people are unable to provide collateral, unable to visit the bank during conventional business hours and often unable to complete conventional written credit applications.

Finally, there are three factors important to small enterprise development programs which are commonly and erroneously assumed to always be available. These are transport to markets, access to information on the market situation and new or improved production processes, and financing. Traditional small enterprise development programs assume the availability of consistent transport facilities. Yet, a small-scale rural enterprise with insufficient resources to invest in a vehicle is

dependent on other, often unreliable, sources of transport.

An entrepreneur in a rural village does not receive a daily newspaper or trade magazine that provides his counterparts in an industrial environment with price and market information. This situation, however can be remedied in developing a small-scale enterprise program. For example an entrepreneur establishing wheelchair factories in Latin America has successfully introduced a newsletter that provides the owners and managers of the local enterprises with information on the prices and sources of various raw materials, thus increasing the competitive position of these manufacturers. This type of institutional assessment has become an integral part of ATI's project development and has contributed significantly to the success of several of its projects.

Reflections on a Strategy for Small-Scale Enterprise Development

ATI started its current program four years ago with the expectation that two out of ten projects would be successful. At present, 7 out of 10 projects have resulted in the establishment of profitable, commercially viable small-scale enterprises. However, as demonstrated by ATI's macro-policy studies, if these micro-interventions are not put into a larger context, their full potential will not be realized. Therefore, ATI's long-term direction calls for a focus on regional or sectoral programs that combine a number of micro-interventions or projects in a particular region of a country, in order to improve the overall social and economic development of that region.

For example, ATI currently supports development of specific technologies in the Puebla area in Mexico. The success of this project is measured by the commercial performance of the small-scale enterprises that introduce these technologies. In the future, ATI would look at the Puebla region and identify those local resources to which value can be added through commercially viable small-scale productive activities as well as the linkages needed to add value to some locally produced "half products."

In such a regional approach, success would be measured by changes in specific social and economic variables, such as a decrease in unemployment and/or an increase in the per capita income of the population of that region.

It will take some time for ATI to change its focus from demonstration projects to regional/sectoral programs. Then, as now, ATI will continue to experiment with ways to adapt both the technology to be transferred and the ways enterprises are managed, working within the traditional social and cultural environment of the small enterprise.

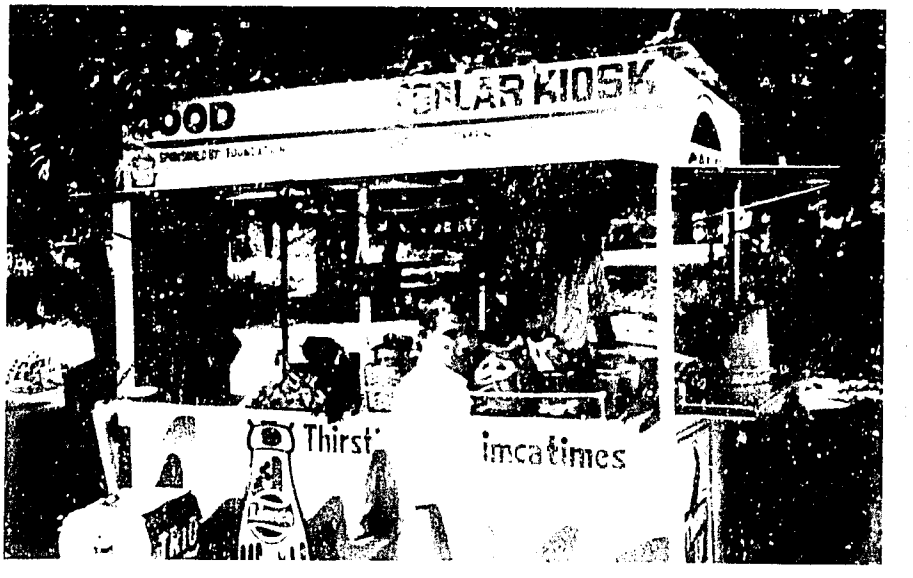
ANGUH MAIZE MILLS are being commercially manufactured in Cameroon as a result of an ATI project.

FOOTNOTES

1. See among others: Paul Hawken, *The Next Economy* (New York: Holt, Rinehart and Winston, 1983); Dian Cohen and Kristin Shannon, *The Next Canadian Economy* (Montreal: Eden Press, 1984); Raphael Kaplinsky, "Changes in Economy of Scale: The Implications for Appropriate Technology," (Institute for Development Studies, Sussex, 1986, Mimeographed).
2. Carl Liedholm and Donald Mead, *Small-Scale Enterprises in Developing Countries: A Review of the State of the Art*, MSU International Development Working Paper, no. 25 (East Lansing: Michigan State University, 1986).
3. "Small is Beautiful," *Business Week*, 27 May 1985.
4. Frances Stewart, ed., *Macro-Policies for Appropriate Technology in Developing Countries* (Boulder: Westview Press, 1987).
5. See among others: Paul E. Robinson, Jr., "The Grameen Bank of Bangladesh: A Viable Banking Alternative for Meeting the Basic Human Needs of the Rural Poor," (University of Pennsylvania, Philadelphia, Pa: 1986, Mimeographed).
6. For a recent overview see: Merilee S. Grindle, Parker M. Shipton and Charles Mann, *Capacity Building for Resource Institutions for Small and Micro Enterprises: A Strategic Overview Paper* (Cambridge, Mass: Harvard Institute for International Development, 1986).
7. Stewart, *Macro-Policies*.
8. Robinson, "Grameen Bank."
9. Gustav Ranis and Frances Stewart, "Rural Linkages in the Philippines and Taiwan," , in Stewart (ed.), op cit. ref. 4.

Commercial Analysis: A Tool to Assist Small Enterprises

By Michael O'Donnell and Eric L. Hyman



BUSINESS PLANNING reduces the risks associated with establishing new ventures. In India, all owners of franchised tea kiosks (FOOD) move into sites which have been market tested.

Entrepreneurial aspirations of the rural poor in developing countries often go unrealized because these people lack access to financing, management skills, knowledge of appropriate technologies suitable for commercialization and an understanding of the potential market for the product. Small businesses in these areas operate in very difficult environments. Capital is scarce because incomes and savings rates are low. Commercial banks and government development banks shy away from investing in small-scale rural enterprises because they perceive the risks to be high. Also, it is expensive to evaluate and administer many small loans. Even when conventional financing is available, new entrepreneurs may not be able to meet collateral and equity requirements and find it difficult to surmount bureaucratic hurdles.

Financing is not the only problem rural entrepreneurs face. They often lack information about appropriate technologies that are more productive than the traditional alternatives. Furthermore, because these technologies have not yet been commercialized in a particular area information is not available about the costs and benefits of adopting these technologies. The demand for a new product may be unproven and entrepreneurs might not know the best way to reach potential markets. It is difficult to convince the rural poor to buy a new product because they cannot afford to take risks and have limited information about the choices in products.

Good business planning can reduce the risks associated with establishing a new venture. It is sometimes argued that small businesses cannot afford business planning. On the contrary, small businesses cannot afford NOT to plan because they are even more vulnerable to changes affecting supply or demand than are large businesses. Most successful small entrepreneurs have a keen intuitive sense of business planning. However, many other entrepreneurs either fail or do not even attempt to start a small business because they do not know how to go about it. This is particularly true when innovative technologies or products are involved. To ensure successful enterprise development, one must constantly reassess the effectiveness of plans and methods of operation.

Good business planning is also important for international and national organizations involved in small enterprise development. For example, many credit programs have failed because of the nonprofessional approach of the lender. Borrowers in both developed and less developed countries will avoid repayment if allowed to do so. Many international and local organizations involved in small-scale lending programs are reluctant to seriously enforce loan repayments. As a result, in effect, the loans become a grant-charity and the credit programs fail. Because the borrowers have learned that repayment is not really expected, subsequent credit programs become even riskier. Then the financing organizations say that credit programs do not work because the people "do not know how to use credit" and such programs are abandoned.

Financial responsibility requires more than good intentions. Enterprise development requires hard skills in:

1. Market assessment
2. Commercial analysis
3. Financial controls
4. Technical support (engineering, training, extension, management and legal)
5. Business evaluation

In the remainder of this article, we will discuss market assessment, commercial analysis, and financial controls.

Market Assessment

Before beginning an enterprise, it is important to have a thorough understanding of the industry. It is said that in starting a new enterprise there are possibly a hundred problems that you must avoid, and if you are very smart you might be able to think of fifty of them beforehand. One of the most critical areas is knowledge of the market—supply and demand and the numerous factors affecting prices. Other important questions include:

1. Who else is producing the goods and at what cost and quality?
2. What are the trends in production and consumption and why?
3. Do a few firms control the market or vital inputs to the manufacturing process?
4. How do government policies affect the business—are there price controls?
5. Who are the targeted consumers?
6. How much can people afford to pay for the product?
7. How will people get information about the product and at what cost?

Within every major market, there are usually many submarkets. For example, in the lime industry in Costa Rica, one grade of lime is used to treat water, another is used in agriculture, and a third for road construction and building materials. The submarket you wish to enter will have a major influence on the technology you choose for producing lime.

Market research and marketing techniques must be matched to the realities of rural areas in developing countries. Taste tests, surveys, focus groups, direct mailings, and media campaigns that are effective in developed countries need to be adapted for consumers who might not be literate, are slow to accept new products and ideas, and are less exposed to conventional advertising. The market for a new product must be tested and not just studied. The degree of sophistication of these tests depends on the level of risks and the costs. This is why ATI has begun to provide small grants to test the market before funding certain projects.

The outline below serves as a guide in considering various market questions:

I. Analyzing Marketing Opportunities
   a. Market environment
      1. Inputs
      2. Outputs
   b. Consumer markets and buying behavior
   c. Organizational markets and buying behavior
   d. Market measurement and forecasting

II. Planning Marketing Strategy
   a. Marketing planning
   b. Competitive marketing strategy
   c. Product life-cycle strategy
   d. New product development strategy

III. Assembling the Marketing Mix
   a. Product decisions
   b. Price decisions
   c. Marketing channels decisions
   d. Advertising decisions
   e. Sales promotion and publicity decisions
   f. Sales force decisions

IV. Administering the Marketing Program
   a. Marketing organization
   b. Marketing research and information system
   c. Marketing control

Adapted from: Kotler, Philip, *Marketing Management*

Getting an "objective" view of a technology's commercial potential in the early stages of project development is not always easy. Entrepreneurs and project officers often become personally attached to proposals. The "I know it can work" syndrome often explains why investments are made before sufficient hard data is available. Quantifying the costs and benefits and listing all the assumptions behind those numbers provide a firmer foundation on which to base investment decisions.

Over the past few years, ATI's procedures for business planning have evolved into a system that is realistic and cost effective for the scale of the projects undertaken. A recent evaluation by the Agency for International Development, (A.I.D. Evaluation Special Study No. 45, November 1986) noted that "ATI has significantly improved its project planning process, including technical and commercial appraisals...[since] the 1982 evaluation. Project plans are now comprehensive documents prepared by the regional teams and reviewed through a formal project approval process. The Project Review and Advisory Committee—composed exclusively of outside experts—provides valuable advice. ATI has increased its capability in technical appraisal by relying on a mix of staff technical specialists, use of local technical specialists in each country, and, less frequently, outside consultants."

The A.I.D. evaluation did note that although "business planning models that identify, quantify, and help control the risks involved in new technology ventures...have been applied well in many of its projects," ATI still has a lot to learn, which we will do together with project partners.

Responding to these recommendations, ATI is now using cashflow analysis as its basic commercial analysis tool rather than just breakeven analysis. ATI's new commercial appraisal consists of a month-by-month cashflow analysis, a projected income and expense statement, a projected balance sheet, and a sensitivity analysis. Each of the commercial enterprises supported by a project must have a business plan in this format. Table 1 contains an illustrative cashflow analysis for one of the mills established by the Zaire micro-hydro project. In addition, greater attention is being given to market assessment at an early stage.

The specific accounts included in a cashflow analysis vary with each project, but the basic structure remains the same. It begins with projection of key variables such as the quantity of the product to be produced and sold, broken down by quality and price projections. The next section projects revenues for each item produced. This is followed by operational expenses including loan interest, but excluding depreciation since it is not a cash cost. After that, capital expenditures, net borrowings, and principal repayments are listed. In ATI's new format, all assumptions for each line item in the cashflow analysis must be documented. A sensitivity analysis examines the effect on the cashflows of possible changes in key variables such as the capacity use rate, raw material costs, and sales prices.

An analysis based on monthly figures is important because of the large seasonal variations that a business can experience. This has important implications for the working capital requirements of the enterprise. An enterprise may be very profitable over a longer period, but if it does not have the cash to cover immediate expenses, it will go out of business.

ATI places a high priority on an enterprise's commercial viability, socioeconomic impacts on the rural poor, and potential for widespread replication elsewhere. These criteria are applied in the selection, planning, implementation, and evaluation of projects. Among nongovernmental development assistance organizations, ATI has been a pioneer in the use of tools for commercial analysis. ATI will continue to experiment with techniques in this area. This work is being supported by the newly-created Business Development and Replication Group which helps project partners incorporate more sophisticated business planning into their small enterprises.

Table 1.

CASHFLOW PROJECTIONS

Hydro-Powered Grain Milling, Zaire (Project 85-0020) Bushumba Mill

May 1987-April 1988

INC & EXP ITEMS	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	Total
Production–service milling	13,000	26,000	39,000	39,000	39,000	39,000	39,000	39,000	39,000	39,000	39,000	39,000	429,000
Price–service milling	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Production–com'l milling	0	0	0	0	0	0	0	0	0	0	0	0	0
Price–com'l milling	–	–	–	–	–	–	–	–	–	–	–	–	
Revenues													
001 Service milling fees	19,500	39,000	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	643,500
002 Com'l milling sales	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	19,500	39,000	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	58,500	643,500
Salaries and Wages													
101 Management	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	24,000
102 Security	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	14,400
103 Mill operators	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	14,400
Total	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	52,800
Direct Purchases													
201 Grain for com'l Sales	0	0	0	0	0	0	0	0	0	0	0	0	0
202 Packaging materials	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
General Expenses													
301 Licenses & permits	0	0	0	0	0	0	0	0	0	0	0	0	0
302 Transport hire	0	0	0	0	0	2,000	0	1,000	0	0	0	2,000	5,000
303 Supplies for recordkeeping	160	160	160	160	160	160	160	160	160	160	160	160	1,920
304 Advertising	4,000	800	800	800	800	800	800	800	800	800	800	800	12,800
305 Interest on loans	0	0	0	0	0	0	0	0	0	8,508	8,508	8,508	25,524
Total	4,160	960	960	960	960	2,960	960	1,960	960	9,468	9,468	11,468	45,244
Repairs & Maintenance													
401 Mill equipment	0	0	0	0	0	1,500	0	1,500	0	0	0	3,000	6,000
402 Civil works	0	0	0	0	0	0	0	0	0	0	0	1,350	1,350
403 Tools	0	0	0	0	0	0	0	0	0	0	0	0	0
404 Office equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1,500	0	1,500	0	0	0	4,350	7,350
501 Taxes	1,094	3,364	5,314	5,314	5,314	4,964	5,314	5,064	5,314	4,463	4,463	3,828	53,811
502 Cash From Operations	9,846	30,276	47,826	47,826	47,826	44,676	47,826	45,576	47,826	40,169	40,169	34,454	484,295
New Capital Expenditures													
1101 Buildings	0	0	0	0	0	0	0	0	0	0	0	0	0
1102 Land	0	0	0	0	0	0	0	0	0	0	0	0	0
1103 Mill equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
1104 Tools	0	0	0	0	0	0	0	0	0	0	0	0	0
1105 Office equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
2003 Repayment of principal	0	0	0	0	0	0	0	0	0	19,722	19,722	19,722	59,166
3000 Share capital	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cashflow	**9,846**	**30,276**	**47,826**	**47,826**	**47,826**	**44,676**	**47,826**	**45,576**	**47,826**	**20,447**	**20,447**	**14,732**	**425,130**
Cumulative Cash Balances	**9,846**	**40,122**	**87,948**	**135,774**	**183,600**	**228,276**	**276,102**	**321,678**	**369,504**	**389,951**	**410,398**	**425,130**	**425,130**

Successful Project Development Requires Planning, Monitoring, Evaluation

By John Skibiak

Three years ago, ATI began experimenting with a system to monitor and evaluate all its projects, as opposed to ad hoc project-by-project evaluation. When this system was evaluated in 1985 by ATI and the A.I.D. evaluation team, it was concluded that although the monitoring and evaluation system was conceptually challenging, it did not fulfill its intended purpose. ATI then spent considerable effort developing a new system that emphasizes local participation and rigorous commercial analysis, and adds social impact assessment in an integrated framework for data collection and analysis. This system is more cost-effective and compatible with available resources.

The key to ATI's new strategy is a revised project plan format that assigns specific monitoring and evaluation roles to the implementing organization, local research institutes, project beneficiaries, and of course, ATI itself. Each plan includes an evaluation framework that precisely defines the kinds of data to be collected and the ways they will be incorporated into the overall project assessment. In designing each project, members of ATI's Business Development and Replication Group and the Technical Resource Group collaborate with the responsible regional project officer to formulate strategies that not only generate material benefits for the rural poor, but also enable colleagues in the development community to learn from ATI's project experience. All ATI projects are designed to test basic assumptions underlying current strategies for technology transfer and small enterprise development. The multidisciplinary nature of the design process, therefore, helps to ensure that project goals and implementation strategies actually test these assumptions and measure the effectiveness of appropriate technology-based small enterprise development.

SOCIAL IMPACT assessments of ATI projects measure the benefit of new employment opportunities, such as those created for women working in the lime project in Botswana.

Social Impact Assessment

ATI's focus on small-scale, cost-effective technologies has enabled it to reach groups often neglected by traditional large-scale development programs. ATI demonstrates its success in this area by systematically assessing each project's social impact. Using field data as well as material gleaned from published sources, social impact frameworks are prepared for each project plan. Typically, the framework outlines a three-part strategy for data collection and analysis. The first part entails a broad socioeconomic survey of the principal groups and economic strata represented at each project site. Through collaborative efforts with host country universities, local development agencies, or applied research institutes, in-depth interviews are conducted with individuals, households, and other relevant groups to establish a reference point or "baseline" against which subsequent changes can be compared. Although ATI's limited financial resources prohibit extensive sampling of the population, these surveys and interviews do provide excellent insight into the qualitative aspects of the project.

The second part of the assessment framework outlines a strategy for monitoring the overall performance of specific benefit strategies such as adding value to local resources, employment creation, local production, or expansion of market opportunities. The typical monitoring framework, therefore, could assess changes in local employment, prices of key goods or services, or the degree to which local beneficiaries make use of project-established facilities. The primary objective of this monitoring system is to ensure that the project partner and ATI are continuously aware of project benefits and any other variables likely to influence the course of local activities.

Using data reported during the monitoring phase, the final step of the assessment process involves identifying significant changes for more in-depth analysis. If, for example, a marked shift is noted in the relative participation of an identifiable socioeconomic group, members of that group could be interviewed and the results compared with data collected during the baseline survey. In summary, ATI's approach to social impact assessment is a flexible system designed to monitor change at the regional level, yet also assess impacts at the household or individual level. It not only describes the changes that have taken place, but seeks to understand why they have occurred.

Commercial Analysis

Social impact analysis is only one component of ATI's overall monitoring and evaluation strategy. Commercial analysis and marketing assessments also form an integral part of ATI's project monitoring process.

Along with the impact framework, a commercial analysis format is included within each project plan to guide monitoring activities over the life of the project. The format consists of a month-by-month cashflow analysis, a projected income and expense statement, a projected balance sheet, and a sensitivity analysis. The categories have been standardized, but the format is expandable so that changes in commercial information can easily be entered on computerized spreadsheets. Not only is this information useful for management and evaluation purposes, it can also feed into economic analyses of the project's net present value to the national economy and to analyses of the impacts on the incomes of owners and workers.

The standardized formats are particularly useful in considering the replication potential of the projects because of the ease in factoring in differences in wage rates, cost of inputs, and other variables in different locations.

Local Participation

When ATI was established in 1976, its founders envisioned an organization that would "serve as a source of experimentation, evaluation and ideas in appropriate technology . . .". These objectives underlie ATI's current efforts to involve host country participants at each stage of the evaluation process. ATI's goal is to develop within each host country the institutional capacity to carry out simple baseline studies, impact assessments, commercial analyses, and other components of the evaluation process. Not only will this help to reduce local dependence on foreign consultants, but it should lead to improvements in the quality of the field data. By taking advantage of indigenous talent and energy, it is possible to overcome many of the methodological biases inherent in short-term field visits of foreign specialists. The presence of local researchers, for example, often makes it possible to monitor field activities on a more regular basis. It can also foster a greater sensitivity to local needs. Overall, local participation in the evaluation process significantly benefits the target populations, host-country research institutes and their members, and ATI.

Coordination of Monitoring Activities

To more effectively coordinate the roles and contribution of each participant in the monitoring and evaluation process, ATI has developed a format for organizing and storing key data on the status of each project. This simple, easily accessible format consolidates key sets of data on financial, administrative, technical, social, and commercial issues. It does not duplicate the more detailed records of the regional files, but integrates the critical information of each into concise, readily available summaries of a project's development and current status. The system also includes:

1. Current data on the indicators or variables specified in the social impact and commercial appendices of the project plan.
2. Data provided in field reports that document key decisions taken, options available, and lessons learned.
3. A chronology of key events, institutional changes and technological developments during the life of a project.

Using information contained in the data monitoring format, the regional teams prepare an annual progress report on each project. These reports are the primary mechanism by which ATI synthesizes, analyzes and communicates up-to-date information on the major achievements of projects and lessons learned.

ROLE OF LOCAL ORGANIZATIONS

At ATI, monitoring and evaluation is a collaborative effort, involving project participants, implementing organizations, applied research centers, and other host-country groups. During 1986, this approach was used for the first time in the final evaluation of ATI's Cassava Processing Project — a two-year project designed to reduce Haitian imports of foreign wheat through village-scale production of cassava flour. The evaluation team included ATI's Evaluation Specialist and several representatives of Développement Rural Intégré (IRD), a nongovernmental development organization headquartered near the project's principal site at Camp Perrin.

The team members collaborated on all phases of the evaluation process, from the collection and analysis of field data to the writing of the final evaluation report. They began by identifying key groups of project participants in Camp Perrin, neighboring Les Cayes, and Port-au-Prince. After two weeks of intensive interviewing and data collection, a series of working hypotheses was developed to help pull together and analyze the team's preliminary findings.

During the second phase, ATI staff and the remaining team members worked independently, using field data and documentation to appraise project accomplishments and failures. Because additional information was often required, the groups kept in close contact. IRD continued to collect and forward updated field data, while ATI regularly sent project documents unavailable in Haiti.

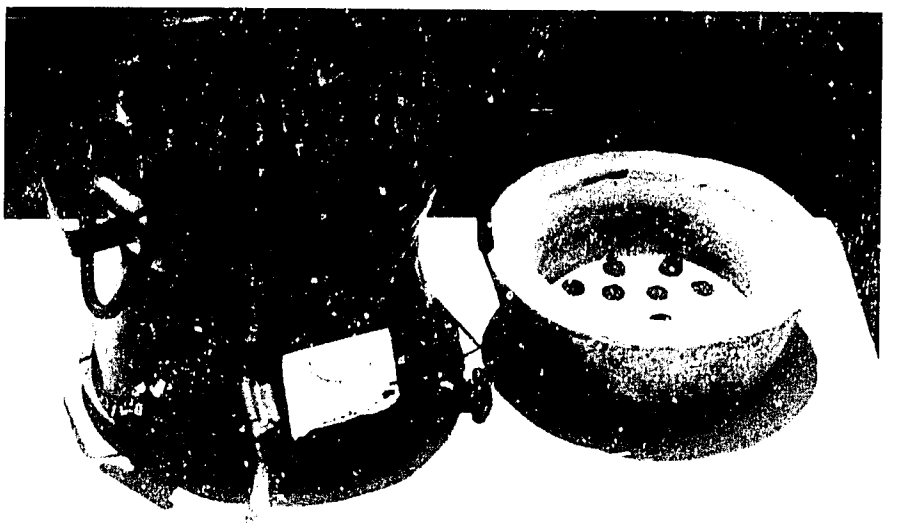
The trust and understanding that developed between IRD and the residents of Camp Perrin was indispensable in soliciting candid responses from an otherwise wary populace. The result of this collaboration was a final document that neither ATI nor IRD could have completed on its own.

Involving local organizations and outside groups in ATI's project evaluations not only improves the quality of the evaluations but also builds local organizational capacity to carry out subsequent evaluations. In addition, the process creates an awareness of both the opportunities and the potential difficulties involved in establishing small-scale rural industries, knowledge many of these organizations would not otherwise acquire.

International Technology Transfer: Replication

In May, 1984, as part of his review of the first five years of ATI's experience, the new Executive Director, Ton de Wilde, wrote: "...ATI struggled to support effective community development projects to build and strengthen local institutions, to facilitate small entrepreneurs to enter markets all this in the spirit of satisfying basic human needs. However, in this initial period of testing and learning, little attention was paid to replication in economic and commercial terms."

Three years later, exciting, positive results have been reported for most of the demonstration projects begun in 1983. Accordingly, ATI has begun to replicate several of the hard and soft technologies proven in those demonstration projects. ATI's concern with replication—traditionally called international technology transfer—is based on the need to be cost-effective. Once ATI has demonstrated that a specific production process can be commercially successful in a specific environment, ATI wants to maximize the use of the technology in other areas.



IMPROVED CERAMIC-lined charcoal stoves, disseminated in Kenya, now are being introduced in several East African countries.

"Replication" Contradicts "Appropriate" Technology

In its efforts to replicate a proven technology, ATI has been reminded time and time again that replication contradicts the meaning of the word "appropriate." "Appropriate" implies appropriate under what circumstances? To what conditions? What are the local materials, skills and resources, to which value might be added in a productive process? A technology appropriate in one particular area might be very inappropriate in other conditions.

In spite of this contradiction, common sense and our project practices dictate that often only small adjustments are required to successfully transfer a proven technology. Some examples follow of replication activities in which ATI is presently engaged.

ATI has obtained encouraging results from the low moisture brick pressing project in Botswana. This technology introduces a modified Hoffman Kiln, manually operated presses and new plant layouts. ATI is replicating this technology in Tanzania and is considering a proposal to implement the new technology package in a small brickmaking enterprise in Kenya.

The improved, ceramic-lined charcoal stove or "jiko," disseminated through an ATI project in Kenya, is now being introduced in other African countries by CARE and other organizations. ATI is investigating the possibility of transferring to Haiti the liner-molding technology (Jiko Jolly) developed in Kenya by ATI staff; this would improve stove quality and appearance, at the same time that it reduces production costs.

A river-driven turbine to pump water (Linares pump) developed under an ATI Save the Children project is being tested in Mexico, El Salvador, Honduras, the Dominican Republic and Panama.

A manual sunflower seed oil press, developed by ATI staff in Tanzania, has been transferred to Zimbabwe with extremely encouraging results. A commercial manufacturer is producing the press. As a result of ATI's project, small-scale pressing of sunflower oil is now permitted by the Government of Zimbabwe; previously only parastatals were allowed to engage in commercial oil pressing.

In the Dominican Republic, 900 small farm families participating in the swine feed project have increased their yearly incomes by an average of $125—exceeding project expectations by 66%. As one component of this project, ATI introduced ramie, a crop grown for its fiber in Asia, as an additional locally grown, high protein feed component. This technology is now being replicated in Haiti, supported by the A.I.D. Mission. The first ramie plants were taken to Haiti from ATI's demonstration project in the Dominican Republic.

The design concepts developed in the ATI-sponsored lime project in Costa Rica have been incorporated in a lime project in Botswana.

ATI-Hotchkiss wheelchairs, already being fabricated in workshops in six countries in Latin America, are also being produced in small workshops in Zimbabwe and Sri Lanka (See box). Workshops in Zimbabwe, Sri Lanka and the Dominican Republic are operating without ATI funding support; ATI did supply training to the principals.

The manual and mechanized versions of a palm oil press, modified and disseminated with ATI funding in Cameroon, are being introduced in Zaire. A World Bank project in Eastern Zaire has purchased from the ATI producer in Cameroon several units; if the results are positive a local firm will begin commercial production of the presses.

The wet processing of coconuts is being considered by the Philippine Government for wide-scale dissemination in that country. In Sri Lanka, ATI has contracted with Appropriate Technology Consultants to collaborate with FFI (Philippines) and a Sri Lankan entrepreneur to set up a village coconut processing plant in Sri Lanka's coconut

triangle—the first international replication of the Philippine technology.

Success of the mushroom and spawn production business in the Philippines led ATI to contract with experts in mycology at Katsetsart University, Thailand, to develop a manual and a training program for growing five varieties of commercially-raised mushrooms. In October, 1987, ATI plans to sponsor an inter-regional mushroom raising course for participants from the five Asian countries, several African nations, and Mexico.

ATI has provided Cementos Vilcanota, S.A. with technical and economic information to produce portland cement on a small scale (30 tons/day) in a plant planned for the Cuzco area of Peru. This technology was developed with ATI support by the Appropriate Technology Development Association in Lucknow, India.

WHEELCHAIRS ROLL IN THREE CONTINENTS

Five years after ATI began supporting Ralf Hotchkiss to develop and test a lightweight wheelchair especially adapted for use in the Third World, the ATI-Hotchkiss wheelchair is being produced in small-scale workshops in eight countries on three continents. The wheelchair is extremely well-balanced, adaptable to individual fittings, and of simple but rugged construction. The lightweight foldable chairs can be carried on top of a bus, or a burro. Because they are maneuverable and have good traction and stability, they are especially conditioned for the rough "roads" prevalent in rural areas in developing countries. The materials and components to produce the chair are available in most countries. The prices charged by the various small enterprises are 20% lower than for other locally produced wheelchairs of similar quality.

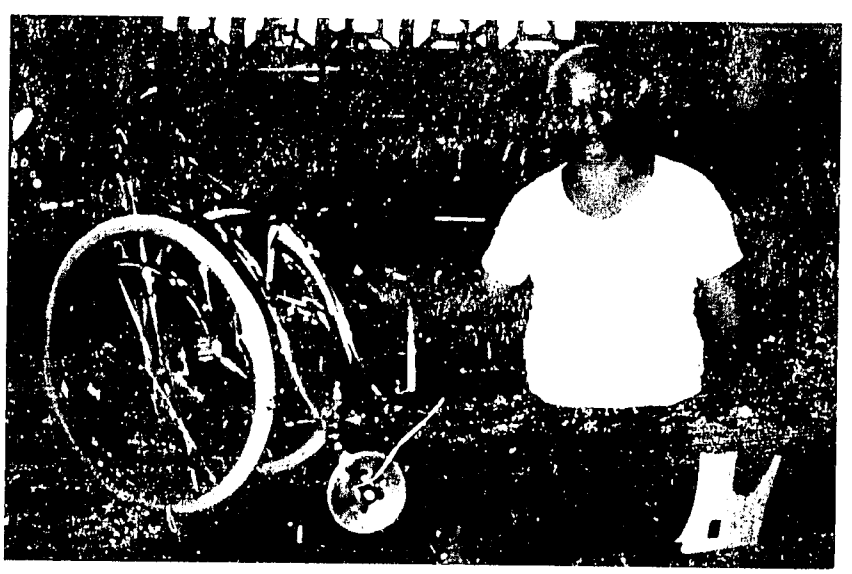
This project is the first one to be launched on a regional scale. In collaboration with various partners in the LAC/Caribbean region (Peru, Colombia, Guatemala, Honduras, Dominican Republic) 10 small-scale wheelchair manufacturing enterprises have received training, technical and financial support, and marketing assistance. Production capacity of these workshops ranges from 50-200 chairs a year.

In 1986, ATI launched a program to expand this appropriate technology to regions outside Latin America. Training is a key component of this replication effort. In August, 1986, Ralf Hotchkiss conducted an 18-day hands-on technical training for prospective manufacturers from Colombia, Brazil, Sri Lanka and Zimbabwe. Included in this training was a special course in the administration and management of a small-scale production enterprise. IBM Brazil paid all expenses for three Brazilian participants and plans to finance the implementation of this project in Brazil. In addition to sponsoring the training, ATI donated tool kits, prototype wheelchair kits, and production manuals to each participant. The training expanded the domain of the ATI-Hotchkiss technology to Africa and Asia, in addition to increasing the technology presence in Latin America.

Subsequently, in the Dominican Republic, Zimbabwe and Sri Lanka, participants in this and earlier trainings have obtained local funding to begin their own small businesses. ATI continues to donate tool kits and provide training. In June, 1987, Ralf Hotchkiss trained a group from the Hesperian Foundation in La Hoya, Mexico. The standardized tooling system, combined with a production manual which is available in both English and Spanish, have helped maintain the integrity of the design in the various workplaces.

A newsletter, written and distributed by Hotchkiss, keeps producers informed of up-to-date adaptations of the technology and availability and prices of raw materials and encourages them to adapt the chairs to fit local needs and share modifications.

As production of quality wheelchairs increases and consumer credit systems become routine, more and more lives change everyday. Today several workshops employ disabled persons. These workers now are able to repay loans they have taken out to purchase the chairs. People who once were restricted to their homes have become independent adults, capable of improving the quality of their lives and the lives of others.



DOMINICAN entrepreneur Rafael Martí established a small workshop to manufacture the ATI-Hotchkiss wheelchair, after receiving training. This Third World wheelchair is being replicated worldwide.

Macro-Policies Influence Technology Choice

By Arleen Richman

In March, 1987, Westview Press and ATI published *Macro-Policies for Appropriate Technology in Developing Countries*, a compendium of seven case studies, commissioned by ATI, which explored the relationship between macroeconomic policies in developing countries and the adoption of appropriate technologies in various sectors in these economies. The book, edited and prefaced by Frances Stewart, a well-known economist and a recognized authority in development for the past two decades, is serving as the basis for three regional conferences for appropriate technology which ATI is organizing together with local agencies. The workshops, (scheduled to take place in the Philippines in March, 1988; in Nairobi in June, 1988, and in Mexico in late 1988) are being jointly funded by ATI and the Government of the Netherlands. Additional case studies, focused on relevant local policies, will be undertaken for each conference. The 50 participants invited to each conference will represent governments, small-scale industries, and the academic community.

In *Macro-Policies for Appropriate Technology in Developing Countries*, Dr. Stewart argues that appropriate technology has not reached its full potential because "...of its near exclusive focus primarily on micro-interventions... development and introduction of specific appropriate technologies in specific contexts." This assertion underlies ATI's long-term direction which calls for a focus on regional or sectoral programs that combine a number of micro-interventions or projects in a particular region of a country in order to improve the overall social and economic development of that region.

In the following interview, Dr. Stewart explains the reasons for the relatively limited application of appropriate technology; why donor agencies favor inappropriate technologies; and what must be done to change present government-donor agency policies.

Q: What is your definition of appropriate technology?

Appropriate technology (AT) aims at providing technologies which generate income for poor people in developing countries, especially those people left out of the conventional

FRANCES STEWART

development process. It usually means a low cost per workplace; tends to be small-scale and produces simple products; is efficient and involves an output equal to or greater than conventional technologies. It generally is rural-based. ATs are suited to the needs and abilities of the people who will use them. They can be repaired locally and are harmonious with the local culture. Conventional development usually applies modern technologies which are large scale, capital intensive and usually urban-based. This type of development excludes the majority of the people in a country—the rural poor—which appropriate technology is intended to serve. An example of an appropriate technology is finding a way to provide improved rice milling for a community without resorting to building a million dollar mill.

Q: But wouldn't a million dollar rice mill be needed to produce the highest quality product for export markets?

I will say that too little attention has been paid to devising appropriate standards—and the whole question of standards is a value judgement. Western standard products are often chosen because this is what the elite demands. And often, inappropriate large-scale technologies are selected to produce AAA-rated products because it is claimed that the highest quality product is needed to meet export market standards. For example, in the Philippines a modern rice mill has displaced small-scale rice milling at the cost of jobs of many poor people. The Asian Development Bank justified financing the modern rice mill because they said the Philippines would become an exporter of rice. It has not on any scale. I could cite numerous instances where governments chose to go for the so-called "export market," which never materialized. There are many markets for a product. Who in the local market wants the highest quality products? Typically that's the very rich. If your goal is to meet the basic needs of the poor, it is usually better to use simpler, less costly methods. Choice is the underlying issue. Are you going to produce private cars or appropriate public vehicles, such as small trucks or vans? The jeepneys produced in the Philippines show it can be profitable to produce appropriate vehicles for public transport.

Q: Why do you believe that appropriate technology is such a critical area in development activities?

Appropriate technology is the best way to generate employment so that poor people—who represent the bulk of the total population in the LDCs—benefit. In contrast to the social welfare philosophy—giving the poor handouts of food or money or both, it generates productive employment so that the poor can produce for themselves. Appropriate technologies help people to help themselves to improve the quality of their lives.

Q: If appropriate technology is generally recognized as an essential part of any development strategy, why is its application so relatively limited?

Really good ATs, like the Singer sewing machine, Mark II pumps, Oral Rehydration Therapy (ORT) ...really good innovations...are taken up spontaneously because they benefit millions at a relatively low cost. First you need a really good invention. R&D (research and development) tends to favor large-scale innovations. More money needs to be spent on developing technologies that originate in LDCs, improving the productivity of existing ATs, developing local R&D institutions, promoting relevant skills to use the ATs and encourag-

ing local capital-goods industries. And the ATs needn't be new inventions. The MOSTIs (Manually Operated Shallow Tubewells) were not even designed for irrigation but they were successfully adapted for this purpose.

Then again simple technologies, developed by and for the poor, don't get marketed as easily. You need money to produce the technology and the people need money to buy it. Small firms and low income people often lack any access to credit at reasonable rates of interest. This would require changing the collateral requirements for the informal sector. Poor people don't have collateral to pledge as security for a loan. Therefore, finance for investment is high risk and very expensive. Do you know the difference between interest rates in the informal vs. the formal sector? In Nigeria, in the informal sector it's 200% vs. 6% at a bank; in Bolivia it's 100% vs. 9%. This high cost of interest means that a small entrepreneur needs to be ten times as productive using a simpler technology. They can't compete. We need to solve this problem. Take the Grameen Bank in Bangladesh, which has very successfully extended loans to the poor and the landless, especially focusing on women. The very poor are divided into groups and they guarantee each other's collateral. The first person gets a loan; four others guarantee it. All are responsible for payment because if the first person does not repay his loan, the others will not get their loans. This Grameen Bank has a 99% rate of repayment...phenomenal. One weakness of loans for very small-scale enterprises is that no AT component is usually built into the lean criteria. We need to find ways, other than charging high interest, to lend to high risk groups. Any promotion of AT should introduce a banking element and credit schemes for the very poor.

But beyond these points the reasons why AT is not more successful in terms of actual on-the-ground investment is that to date almost all AT development efforts are focused on micro-interventions — the development and introduction of specific ATs in specific contexts. The average poor, Third World rural dweller has been struggling all his life at the micro-level, yet his efforts have been thwarted by macro-policies—i.e., the general policies within which decision makers operate. If AT is to become universal, all decision makers need to adopt more appropriate technologies. This means changing the general context within which individual decision makers operate.

Q: How can ATI and other development organizations best foster the spread of appropriate technologies?

Institutions like yours, ATI, have a choice. Do they focus on micro-specific projects...a rice thresher here, a mill there, a small-scale wheelchair production enterprise? Or do you spend your resources persuading governments in developing countries and other institutions, like the World Bank, that the macro or general environment really is decisive. You have to choose whether you are going to make a big difference to a small number of people or whether you are going to influence the entire system which could affect many, many more. We do need the micro-projects to learn how to develop effective ATs. Successful projects also should be replicated elsewhere as ATI now is doing. But to disseminate AT on a wide scale you really need to change macro-policies. The problem is this is a very slow process, and people don't like to fund approaches which don't show results quickly. The whole policy framework is generally biased against small-scale, relatively low-cost technology. There will be little overall change unless you can get the environment changed.

Q: In your book you state aid donor agencies and parastatals (companies owned by governments) tend to favor inappropriate technologies, and often replace ATs with inappropriate technologies. Why?

Governments, foreign aid agencies and parastatals find it easier to deal with large-scale projects and foreign machinery. Foreign agencies support technologies exported from their own economies which mean large-scale, capital-intensive technologies. Remember, aid donors and parastatals are bureaucracies; they need to program large sums of money quickly and they need to be sure that the projects financed can comply with the procedures established. It's easier to deal with a large-scale multinational than to locate 1,000 small producers and deal with 1,000 managers.

Q: Isn't U.S.A.I.D. headed in the right direction? It's funding ATI, which uses a private approach to get ATs into the hands of the rural poor.

Yes, ATI and the PISCES projects are explicit efforts made by the U.S. government to promote appropriate technologies. But these are exceptions. We have many examples where aid agencies—both bilateral and multilateral—have favored inappropriate technologies. And, as I said before, ATI isn't focusing on changing the overall environment...the macro-policies.

Q: How do you change decision making in aid agencies?

AT must be introduced explicitly into decision making at every level. Whenever a project is even contemplated, the first question asked should be...Is this technology appropriate to the needs and abilities of the people it will serve? Generally, if this question is asked at all, it's asked as an afterthought. You need to think of appropriateness *before* a policy is formulated or a technology chosen. This includes the choice of consultants. I say use local consultants whenever possible. Consultants, if they come from a developed nation, are biased in favor of sophisticated technologies. They tend to discount the simple.

AT must be brought into the search for a technology. Most choices are not based on a widespread search. The need is defined, the product is defined, but alternatives are not assessed in the beginning. Appropriateness needs to be considered in every phase of project design, implementation, and evaluation. Even so-called ATs must be evaluated to determine if these really are appropriate.

Further, you need to establish and strengthen local institutions which are able to implement the project and distribute the money. Otherwise, programming the money is cumbersome. And if programming funding is difficult, inappropriate technologies will replace the ATs. You also have to guard against special interest groups who will benefit from the inappropriate technology.

Q: Isn't the political power of certain groups one of the major reasons why desired policy changes are not adopted?

Certainly. The political economy—interaction of economics and political decisions—produces decisions that are not best for the poor, for the rural poor, for the country overall. All decisions favor certain groups. As my book points out, gainers from AT include the un- and underemployed, small local firms and the landless poor. Those who benefit from inappropriate technologies include large-scale domestic producers, bureaucrats, large farmers, and foreign technology, management and machinery suppliers from developed countries. Obviously, those who tend to gain from inappropriate technology hold the balance of power in many cases.

Q: Are there any policies that don't create major conflicts—that are readily acceptable to everyone?

Generally, promotion of rural agriculture falls into this classification. Rural agriculture has positive indirect effects on services/consumption linkages; agricultural processing creates many jobs. Ideally, rural agriculture should be widely dispersed so that the largest share of the positive gains goes to the poor. However, the extent to which the increase in agriculture in a country affects the nonagricultural sector is dependent on the macro-policies in that country. For example, look at the study I conducted with Gustav Ranis on rural linkages in the Philippines and Taiwan. In the Philippines, a 1% growth in agricultural output led to approximately a 1% growth in rural, nonagricultural employment. In comparison, in Taiwan, at a time when agricultural output growth was similar for both countries, the rate of growth in rural nonagricultural employment was more than twice the rate of growth found in the Philippines. The differences can be attributed (among other factors) to the nature of the agricultural sector...small peasants vs. absentee landlords, the labor intensiveness of the crops chosen in Taiwan, large-scale mechanization in the Philippines due to a set of price interventions, including subsidized credit which favored tractors. In the Philippines, a comparative lack of infrastructure discouraged rural linkages.

MARK II PUMP is one of the most widely-disseminated appropriate technologies.

It is absolutely necessary to establish the proper infrastructure to promote productive agricultural growth and facilitate the development of nonagricultural activities in the rural areas. Electricity, water, transport are all necessary if the appropriate technology is to succeed and produce a ripple effect. However, in both countries the evidence suggests that technologies adopted in rural industrialization are generally more appropriate than those used in urban industrialization.

Q: How would you summarize the relationship between appropriate technology and macro-policies?

If appropriate technologies work, and if they are put into widespread use, the rural poor will become empowered. They will have incomes and will be able to influence, to a greater degree than at present, the decision making. If more poor people have good technologies to work with, and can help themselves and increase their productivity and their earnings, then markets for the simple labor-intensive products would increase; savings among the poor would rise; and there would be more investment in appropriate technologies. Success does breed success. But inappropriate decisions and technologies also reinforce inappropriate patterns of development. That is why it is so important to change the conventional pattern of technology choice and industrialization, so as to encompass the poor in productive work, and raise the productivity of traditional technologies. That is why it is essential to change macro-policies to favor rather than impede the spread of appropriate technology.

Dr. Frances Stewart *is a senior research officer at the Institute of Commonwealth Studies and a fellow of Somerville College, Oxford University. She has served as a consultant to the World Bank, the Ford Foundation, OECD, and many UN agencies. She is the author and/or editor of numerous books and articles, including "Technology and Underdevelopment," and "Planning to Meet Basic Needs."*

(*Macro-Policies for Appropriate Technology in Developing Countries*, published by Westview Press, is available from ATI at a cost of $29.85 plus $2.50 postage and handling.)

Local Minerals Resources: Prospects for the Future

By Carlos R. Lola

Technologies for the production of lime and bricks as well as for the extraction of minerals date back to prehistoric times. Copper was first used on the island of Cyprus by Stone Age people who made tools by beating the local red stones. In fact the word copper is derived from the word "Cyprus." It is claimed that the world's oldest brick comes from Kalibangan, in what is present-day India, and is 5,000 years old. Between 4,000 and 2,000 B.C. Egyptians used lime and gypsum to make mortar and plaster to build their pyramids. Throughout the world, ancient civilizations have used copper, silver, gold, and other minerals to make jewelry, religious artifacts, tools and weapons.

The production procedures that have been handed down from generation to generation are called "traditional technologies." Most of these traditional technologies still are used in the LDCs. Traditional technologies are low in capital investment, labor intensive, accessible to small groups, and use local materials and local skills to operate and repair. Modern science and technology have made it possible to understand how these traditional processes work, to identify their inefficiencies, and to upgrade these technologies in terms of yields and quality.

Appropriate Technology International's business is to get productive technologies that are commercially viable and economically sustainable into the hands of poor people in rural areas in developing countries. A description of a few of the strategies ATI is using to upgrade traditional Local Minerals Resources (LMR) technologies follows:

Brickmaking in Botswana and Tanzania

In 1984, ATI began working with the Minerals Holding Trust (MHT) in Botswana, Africa, to upgrade the production of clay bricks. MHT is a wholly owned subsidiary of the Southern Rural Development Association (SRDA), a nongovernmental organization recognized in Botswana as the model for small-scale mining and mineral processing enterprises.

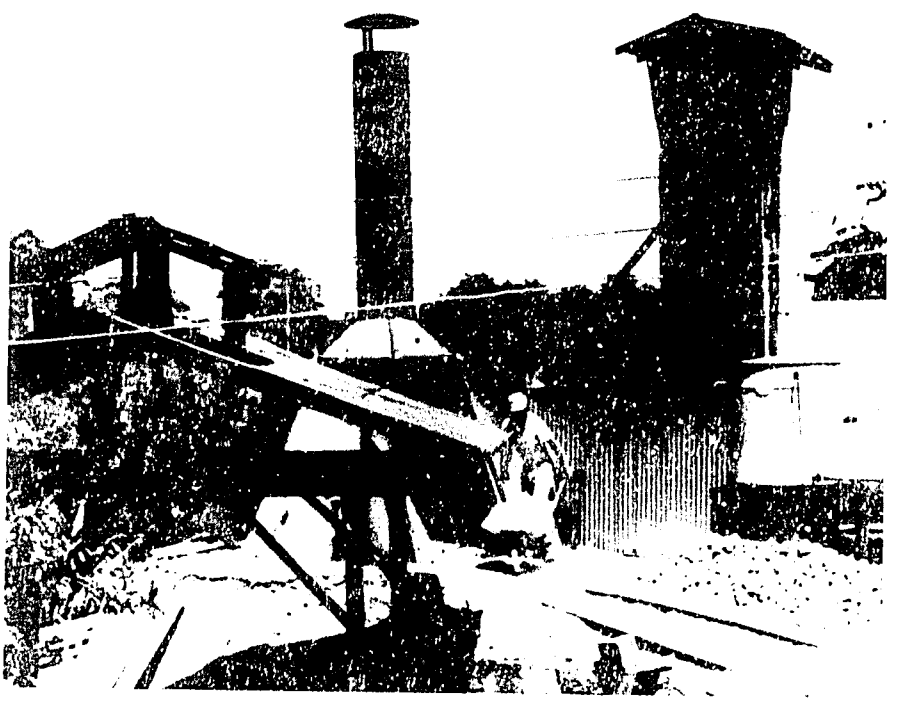
ATI's project at the Moshaneng brickyard, near the town of Kanye in southern Botswana, has introduced a new brickmaking technology which upgrades the traditional slop molding process. Innovative elements of this approach include adequate selection and preparation of raw materials, the introduction of a permanent kiln based on the Hoffman design principle, manual pressing technologies that use low moisture (Terstaram Press) and improvements in the drying process. Results of this project to date include

- A new brickmaking technology has been introduced. A 5-man team, using a manually operated press (Terstaram) can produce 1300-1400 bricks per day.
- The permanent kiln (modified Hoffman) consumes approximately 5050 Mega Joules per 1000 bricks. This represents a 60% fuel savings compared to the traditional "field clamp" used in Botswana.
- The quality of the bricks meets the building code standards in Botswana. Compressive strength is at least 7.0 Newtons/millimeter^2 or 7.0 Mega Pascals.

The Moshaneng brickyard should begin commercial operations by the end of 1987.

At another brickyard in Arusha, Tanzania, ATI has been working since 1983 with the Center for Agricultural Mechanization and Rural Technologies (CAMARTEC). Three types of clay

IMPROVED LIME processing operation in Patarra, Costa Rica (below) increases quality of lime and the yield compared to traditional methods.



HYDRATION PLATFORM ensures production of a high-quality hydrated quicklime.

crushers and three types of manually operated presses are being compared to determine the most suitable technology for the small-scale village-based manufacture of clay bricks. The assessment of this equipment will be included in a technical service package that ATI will make available to prospective brickmakers/entrepreneurs in Tanzania and neighboring countries.

Hydrated Lime Production in Costa Rica

Since May, 1984, The Technological Institute of Costa Rica (ITCR) has received technical and financial support from ATI to improve existing traditional lime processing technology used in Costa Rica. This process, similar to that used in many LDCs, has many inefficiencies: a vertical shaft kiln with a high fuel consumption and reduced life span, a poor degree of limestone calcination, an inadequate size of limestone feed, a batch (discontinuous) system production, and a poor hydration system.

In the first phase of the project, ITCR staff worked with a 2:1 scale kiln model to test new design concepts. Based on the model, they are now developing a prototype kiln that uses traditional shafts. The objective is to increase the quality of the output and the yield by transforming the batch operation to a semi-continuous or continuous model. Hydration processes also are being reviewed in order to define the optimal manual and mechanical hydration systems. The experimental phase should be completed by the end of 1987.

As of April, 1987, the ATI ITCR Lime project had:

- Reduced the wood consumption by 15 to 20% compared with the volume consumed by the traditional design;
- Defined a limestone size—3 to 5 inches—which maximizes calcination;
- Tested the design of a discharge cone built with refractory bricks. The cone allows for a more even heat distribution, precludes direct contact of limestone and wood fuel, and controls discharge;
- Studied the heat transfer mechanism for traditional kilns. Optimization of this process is almost complete. The ideal heat transfer process ensures complete calcination of the limestone despite reduced fuel consumption.

In the second phase of the project, expected to begin in 1988, the Local Lime Producers Association (CONAPROCAL) will commercialize the results of the experimental phase.

The Next Decade: Biotechnologies for Mining

In ancient times, societies fermented food and recovered metals from bacterially activated mine waters without understanding the scientific principles involved. With our present day knowledge of biology and chemistry it is possible to understand bacterial leaching and to apply this biotechnology to traditional minerals processing enterprises. A.E. Warhurst explains, "Bacterial leaching is basically a natural process. It is known that certain microorganisms (*Thiobacillus ferrooxidans*) help to dissolve normally insoluble sulphide minerals—containing for example copper, zinc, nickel or gold—freeing the associated metals for subsequent recovery."

Bacterial leaching is in large measure responsible for the success of the Andean Pact Copper Project in Chile, Peru and Bolivia. Chile, in particular, has achieved the lowest production cost per unit of output in copper mining; it is increasing its copper production at a time when mining companies in developed nations have been forced to close down. ATI just recently began to research the possible application of biotechnologies in small-scale local minerals processing projects.

It appears that the greatest potential in this area, especially for copper extraction, depends on stimulating the growth of the microorganisms. This involves controlling both the environmental and physical factors—such as the acidity (pH) of the mine water and the temperature. ATI is investigating a potential pilot project which would test biotechnologies for copper mining tailings in the Philippines. Not only would this improve the incomes of the rural poor—the copper miners—but it would reuse abandoned mineral resources to create viable small-scale enterprises.

Choosing Technologies for Agricultural Products Processing

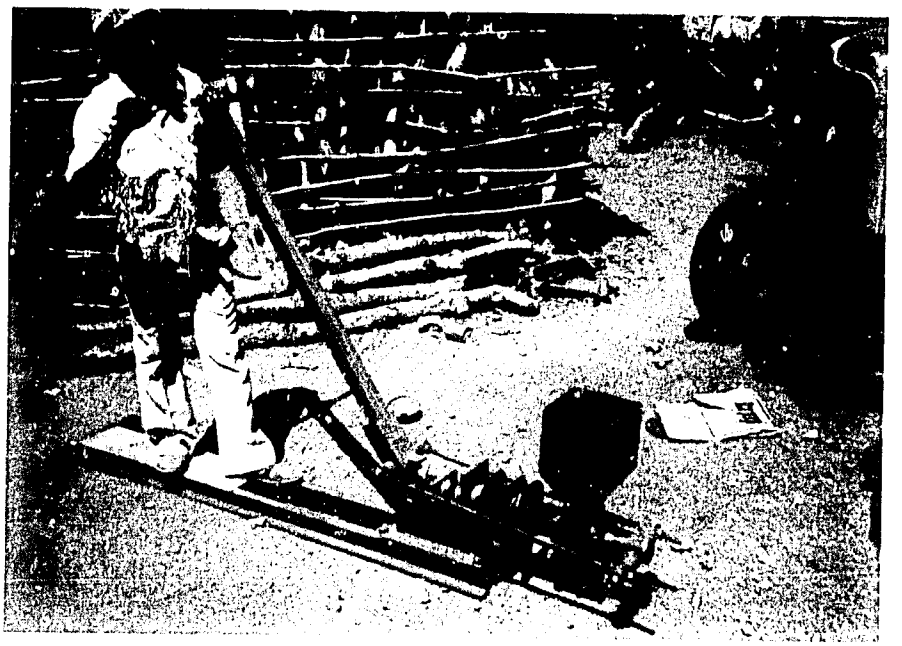
Although the delivery mechanisms, financial arrangements, and other 'soft' technology issues are addressed in every ATI development project, the core of each field project centers on a 'hard' technology. In selecting what technology to use in a specific project, ATI reviews the range of technical options to determine which are the most cost-effective. The technology must be suited to the physical infrastructure where it will be used, it should be compatible with the skills and education of the people who will be using it, and it should be easy to manufacture and repair locally. The technology must have passed the research and development stage, and its performance potential must be proven, at least in a laboratory setting. Although the majority of these technologies have not yet been used in a commercial enterprise, the basic technology must be in place. During the R&D stage, the promising technology will be adapted for commercial utilization.

In selecting the technology to be used in a specific project, ATI has the following choices: to upgrade or improve traditional technologies, to modify or downscale modern technologies, to adapt or combine technologies used in other industries or geographical areas, and or to introduce entirely new technologies.

This article discusses the technologies ATI is using in agricultural products processing. In Africa most of the projects are upgrading traditional technologies. In Asia and to some extent in Latin America, modern technologies are being modified to fit local conditions. In Latin America, elements of proven technologies are also being adapted and combined in innovative ways to create truly indigenous, profitable small enterprises.

Upgrading Traditional Technologies

In developing countries, efforts to increase food supplies are hampered by the fact that post-harvest losses, due to spoilage and insect and other infestations, range from 20-40 percent, depending on the crop. The use of appropriate technologies can reduce these losses and increase both the quantity and quality of food supplies. ATI's activities in upgrading traditional, edible oil production in Africa illustrate the benefits to be gained by increasing the efficiency of simple machines.



SMALL INEXPENSIVE hand-operated sunflower seed oil press serves as an alternative to larger presses in Tanzania.

Tanzania: Sunflower Seed Oil Press Production

Sunflower seeds are a cash crop in Tanzania. In Tanzanian villages, it is rare to find anyone using the traditional processing method, which has fallen into disuse. The few modern expeller-based oil producers are only found in the larger cities. Cooking oil is very scarce in many rural areas, and is therefore expensive.

This project was designed to manufacture innovative, hand-operated oil presses for use in Tanzanian villages. Initial plans called for the manufacture of two types of oil presses, developed and tested at the University of Dar-es-Salaam. The presses operate on the principle of a scissor jack, exert 20 and 80 tons of pressure on the charge of shelled sunflower seed and produce 1/2 and 2 gallons of oil per hour respectively. The press is the first practical, affordable, easily maintained oil press to be manufactured in Tanzania. Once the project was under way, ATI staff developed a small, inexpensive hand-operated ram press to serve as an alternative to the larger presses. ATI's project partner has manufactured all three types of oil presses. The small ram-type press has enabled very low income groups in rural Tanzania to press their own cooking oil.

Zimbabwe: Ram Type Oilseed Press

Building on its work in Tanzania, ATI recently began providing support to a project partner in Zimbabwe to test and evaluate the manual ram-type sunflower oil press developed in Tanzania.

Cameroon: APICA/CALTECH Press

The purpose of this project is to create a commercially viable enterprise, which manufactures and leases or sells improved vegetable oil extraction units to farmers' groups. By reducing processing time 50-75 percent, and increasing the extraction rates, oil production can be increased significantly.

The traditional oil extraction process requires arduous work of stripping the palm nuts from the spiny bunch, manually pressing and clarifying the oil. This project is manufacturing the Caltech Press, a hardy, single screw, continuous feed oil press which depulps and expresses oil in one operation, thus saving considerable time and labor. Its efficiency of operation is between 18 and 20 percent, which is com-

petitive with large-scale presses. Throughput of the manual versions can reach 160 kg/hr, while the motor driven version of the Caltech Press can process 310 kg/hr. A palm oil nut bunch stripper and a clarifier, both manufactured locally, complete the oil extraction package. The stripper is a hexagonal drum composed of wooden slats, turning on a horizontal steel shaft. The palm nut bunches are introduced, the drum revolves, and the separated palm nuts fall out between the slats. The oil clarifier, also manufactured locally, is a traditional design improved by careful workmanship.

Modifying Modern Technologies

Thailand: Rhizobium Inoculant

Developing countries use only 15 to 20 percent of the world's fertilizer supply. Because fertilizer is expensive, no more than one in five rural farmers in LDCs uses fertilizer: those that do primarily apply it only to cash crops. In Thailand, ATI is working with SVITA to develop an appropriate technology for small-scale production of rhizobium inoculant to give poor farmers access to an inexpensive fertilizer supply. Rhizobium bacteria fix nitrogen from the air and make it available in soluble form for plants. On-farm soybean trials in Thailand indicate that rhizobium inoculant can increase soybean productivity by 20-50%. Chemically produced nitrogen would cost twice as much to produce the same results.

Peru: Potato-Based Foods

By introducing small-scale commercial potato processing to rural areas in Peru, this project will provide a market for potatoes as well as a more nutritious food product at a reduced cost for low-income Peruvians. The product is a shelf-stable pre-mix which can be added to soups and stews, or can be used in puddings, desserts, and beverages. Made from a combination of potatoes, legumes and cereals, it contains a complete amino acid profile for protein, appropriate for child nutrition. All equipment for the small-scale commercial processing plants is fabricated locally. The technology, designed by the Centro Internacional de la Papa (CIP) in Lima, consists of grinding, cooling, blending and solar drying and packing under strict sanitary conditions.

PREPARATION of RHIZOBIUM cultures must be done in a sterile environment.

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-scale soybean farmers at a low cost, to increase soybean production.

Rhizobium is a genus of bacteria that live symbiotically with leguminous plants by infecting the roots of the plant. They help provide the plants with an essential nutrient, soluble nitrogen. Rhizobia are able to "fix" nitrogen 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 nodules 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 in developing countries except for subsidized agricultural projects.

This project in Thailand developed a method to decentralize the production and packaging process so that the need for cold storage and transport is eliminated. Production of the inoculant is accomplished through a fermentation process that uses sucrose and other nutrients. Then the live bacteria is spread on sterilized peat moss or other organic carriers to sustain their growth.

The 800 farmers participating in the project report a 25-30% increase in soybean production. In June, 1987, farmers reported that since using rhizobium, their profits from recent sales of soybeans have increased between $100 to $300 compared to prior years.

Adapting and Combining Technologies

ATI's Latin America program includes several projects that contain one or more adapted technologies, packaged in a commercial operation. The Farm Support Enterprises Project in Mexico is establishing 21 rural businesses to provide the equipment, supplies, and services required by small farmers to support improved farm production technologies. The project plan called for development of a one-row, animal-drawn corn planter/fertilizer which would save a total of 10 days planting/fertilizing labor per hectare compared to the traditional hand method. The planter has been significantly modified into a multipurpose field tool, called a multibar, with attachments of a reversible plow, a harrow, a corn planter/fertilizer applicator and a wheeled cart to transport, by animal, the attachments to the field. The prototype multibar has been enthusiastically received by the small farmers in field trials and and is now ready to be manufactured commercially. The multibar costs the equivalent of the average revenue of one year's corn yield from half a hectare. Another component of this project is development of a high-protein cattle feed which reduces feeding costs by 45 cents per day per cow relative to traditional feed formulas. This feed uses cornstovers fortified with molasses and nitrogenous waste materials, such as chicken manure, as protein substitutes.

In Guatemala, ATI and U.S.A.I.D./Guatemala are jointly funding a Wool Production and Processing project. Twelve technical assistance centers will be established to assist thousands of highland Indians in raising sheep and processing wool. Technical support will be provided for improving breeding stock, establishing artificial insemination technology, improving feed technology, improving shearing technology, introducing a wool classification system and scouring technology, and drum carders to replace laborious hand carding. The traditional hand-operated spinning wheel will be modified with a flyer bobbin to enable spinners to increase yarn output. The project, which essentially overhauls the entire highland wool processing industry, is expected to benefit some 30,000 highland families.

Introduction of New Technologies

ATI also is seeking ways to commercially incorporate advanced biotechnologies into traditional, basic industries. For example, a project introduced in Thailand in 1984 enriches the protein content of cassava for animal feed. Cassava is cultivated by poor rural farmers because it can be grown on marginal lands. However, cassava has a very high concentration of carbohydrates and very little protein. Recent research in biotechnology has led to a fermentation technique to enrich the protein content of cassava for use as a low-cost feed for dairy cattle, swine or poultry. This project uses a solid substrate fermentation technique developed in Thailand; chipped cassava and an acid nutrient solution are combined on a small scale to produce cassava with a 12% protein content. (See article, page 30)

Biotechnology and the Future in LDCs

Genetically engineered organisms will improve the efficiency of production processes in traditional food industries and thus greatly increase the food supply in the developing countries. Today, protein obtained from beef costs 2 1/2 times as much as the same amount of protein obtained from rice or other locally available foods, such as soy.

Vegetables constitute man's richest source of vitamins, minerals and plant proteins. Yet the yield of most vegetable crops in the tropics is less than 1/3 of the same crops grown in temperate zones. Presently, scientists are focusing attention on breeding varieties of tomato, potato and Chinese cabbage that produce abundantly in the hot climates found in tropical countries.

Another biotechnological advance that will greatly increase food production in the Third World is hormonal control of plant growth, flowering, fruiting, and seed production. Currently underutilized food crops, such as the pejibaye palm, the grains amaranth, arracacha and quinoa may provide protein and other nutrients for far less cost than conventional crops. Genetic engineering will make crops more resistant to environmental factors, such as heat, problem soils, draught, and environmental stress.

ATI and the Institute of Development Studies in Sussex, England, presently are exploring the trends in the development of biotechnologies to assess their potential positive and negative effects on the rural poor in the Third World.

LOADING WASHED POTATOES into the peeler is the first step in producing potato-based foods.

PROTEIN-ENRICHED CASSAVA

Cassava converts solar energy into carbohydrate more efficiently than any other crop, with the exception of sugar cane. However, the ratio of carbohydrate to protein is unfavorable for human and animal nutrition. Several decades of research worldwide have investigated protein enrichment of cassava through filamentous fungal and yeast fermentations.

Most efforts to improve the protein content of cassava have focused on a capital-intensive, deep tank fermentation process. This process generally requires the use of costly, high-speed mechanical centrifuges. In Thailand, Dr. Jahroon Kumnuanta and his co-workers have developed an alternative fermentation technique to enrich cassava for use as feed for dairy cows, swine and poultry. The technique lends itself well to intermediate-scale and village-level production because it conserves capital, is labor intensive, and is culturally acceptable.

PROTEIN-ENRICHED CASSAVA project results (Thailand) will be incorporated in a commercial enterprise in another country.

Small batches (10 kg) of protein enriched cassava (PEC) have demonstrated the suitability of this process for preparing feed. The process uses cassava chips that are treated with an acid solution containing sulfur dioxide to reduce the population of contaminating organisms. A bed of moistened cassava chips is inoculated with a filamentous fungus *(Rhizopus oryzae)* which converts cassava starch to dextrose. Yeast *(Saccharomyces cerevisiae)* is added to the cassava, and the cells multiply, using the sugar for energy and urea nitrogen for protein synthesis. Heat treatment stops the fermentation process when it is complete. The biomass and residual cassava are dried for storage. The resulting PEC contains exceptional amounts of lysine, an essential amino acid. To balance the amino acid profile, a small amount of methionine and some low protein cassava chips are added to the PEC. Finally the PEC is fortified with minerals.

Considerable efforts have been made to design a process that is safe for both workers and livestock. *Rhizopus oryzae* has not been implicated as a human pathogen and poses no known health risks during fermentation, when numbers of live cells are bound to disperse into the atmosphere. During fermentation, the development of pathogenic bacteria is prevented by the following:

- the initial treatment of the cassava chips;
- the acid generating properties of *Rhizopus oryzae*, which naturally prevent or repress the growth of competing species;
- a high fermentation temperature;
- fermentation under conditions of abundant oxygen to prevent development of bacteria that are tolerant of high temperatures but that require oxygen-free conditions; and
- a final heat treatment to destroy vegetative cells.

Micro-Computers Teach Skills in Developing Countries

Micro-computers and their accompanying packaged programs have made it possible for the average person, without any special knowledge, to perform data processing and calculating functions that ten years earlier could only have been performed by computer specialists. In the micro-computer environment, many functions that previously required a specialist now are programmed into the operating system. The system is ready to use simply at the flick of the "on" switch. Canned programs (packages of pre-written codes of general use) have eliminated the need to write specific programs for specific jobs. Word processing, spread sheets, data base management: there are a variety of canned programs for each of these routine jobs as well as for leisure pursuits such as entertainment and education. Systems analysts and programmers are needed to create a computer system for a particular job for micro-computers but canned packages are sufficient for most routine, straightforward tasks.

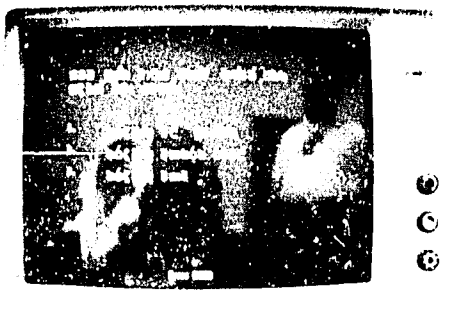
As computer technology has improved, computing performance price ratios have dropped sharply. A micro-computer that cost $3,000 in 1981 was the equivalent of a $1 million IBM 360 of the early 1970s. Entry level computers which can be used for professional tasks—IBM clones of U.S. or Asian origin—are available today for less than $1,000.

Reduced costs do not apply to hardware only. Because of the greatly expanded market, a software package for a micro-computer can be purchased for a fraction of the cost of royalties required to use a package for main-frame computers.

Many development experts fear that introduction of micro-electronics will seriously hamper employment generation in developing countries. On the other hand, the advances in S&T that can be achieved through the use of micro-computers should increase productivity and efficiency in the Third World.

Uses in LDCs

Under what conditions are micro-computers appropriate for LDCs? In its mission to make modern scientific and technological advances accessible to the rural poor, ATI finds itself questioning the circumstances in which we should support the introduction of micro-computers in developing countries. Although ATI has not yet developed a policy governing the overall use of micro-computers, we have begun to experiment in those areas that promise the greatest positive impact on the rural poor.



COMPUTER VIDEO TRAINING lessons in Sinhala teach rural villagers in Sri Lanka basic skills in spice cultivation.

Many uses of the micro-computer in LDCs are still in the experimental stage. One which holds tremendous worldwide potential is the use of computers to train farmers in agricultural skills, in their native language. In Sri Lanka, ATI is presently supporting a project that uses a combination of computer-based lessons and training videos to teach basic skills in spice cultivation, harvesting and drying to rural villagers. This project is ATI's first attempt to test the effectiveness of computer-video training in transferring technical skills directly to rural populations in a developing country. If the CVT program is successful in Sri Lanka, ATI plans to create additional computer programs, complete with graphics, to help disseminate proven appropriate technologies—i.e. the Hotchkiss wheelchair, brickmaking and shrimp culture.

Job and Skills Training

Computer based instruction material can be used for job and skill training in developing countries. Because there are relatively few experts who face many demands on their time, and rural travel in the Third World can be difficult, it makes financial sense to have experts produce programs for job and university course training. These could be used to train workers in factory-type enterprises. For example, a computer training program could supplement an available manual and a hands-on training course in the techniques of constructing the ATI-Hotchkiss Third World wheelchair. It would provide valuable skill reinforcement for those who had taken the initial training, and could serve as the basic instructional tool for new workers. Computer programs are just as appropriate in teaching Ph.D. university classes, or in other educational institutions where the instructor/student ratio is very high—a common situation in the Third World.

An examination of three case studies conducted by Janice Brodman[1] in the use of micro-machines in the public sector in Kenya and Indonesia shows that they are used primarily for information processing, creating reports and documents, and providing access to information for decision making. The systems have improved file maintenance and record keeping for the planning divisions of the Government ministries. They are used by foreign advisors to train professional staff in analytical skills and design research models. In Kenya, micro-computers are testing models of crop production and calculating demand and population trends. In hospitals they are used to maintain patient records—both accounting and medical.

A list of available programs, already written by major development agencies for use in developing countries, can be found in *The Guide to Software for Developing Countries, IBM*, 1985.

FOOTNOTE

1. Janice Brodman, *Micro-Computers in Developing Countries, Opportunities and Obstacles, A Summary of the Final Report on Micro-Computer Adoption*, Harvard Institute for International Development, Harvard University, 1986.

Dairy Project Dramatically Changes Lives In Thailand

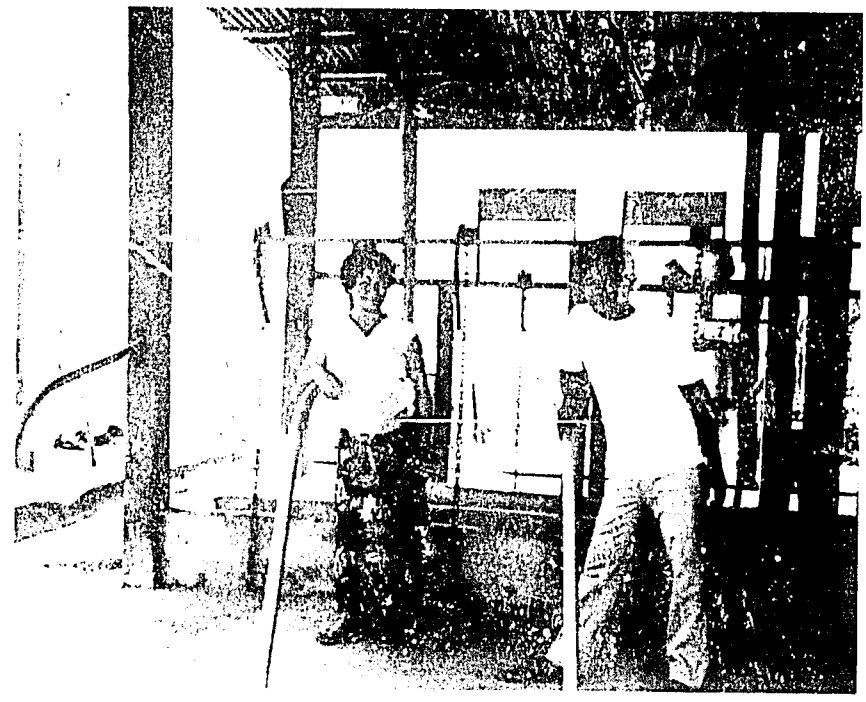
By Arleen Richman

SARABURI PROVINCE, THAILAND— *"I saved 2,000 Baht ($US 80) last month—more money than I earned all during 1984, before we got the cows."* Mrs. Boontieng Lattisoongern, a widow with 4 children (all adults), owner of 13 cows.

"In the 20 years I have been headman of this village, the dairy project is the first program that has brought hope and a better life to all of us. Previously our only hope was to win the lottery. We grew corn, but we never did well. We were so poor that many days our only food was a bowl of rice with salt. Now families with cows complain they have so much food they are getting fat." Chantee Masoongnern, age 70, leader of Tambon Ban Klong Muangnua. He was the first village leader willing to take the risk of promoting, among his people, the SVITA-coordinated dairy project.

"In the beginning we had to take care of the cows. Now the cows are taking care of us. Raising cows is better than a job in the Thai Civil Service." Miss Tipawan Suwanwichit, 30, manager of local feed mill. The feed mill, established to complement the dairy farming, paid out 81,000 Baht ($US 3,240) in dividends in its first year of operation.

"Not only have my wife and I made a lot more money, and built a new house because of the income from my cows, but I have improved myself. I used to drink a lot. The cows would kick me because I wasn't milking them correctly. Finally I got so tired of being kicked by the cows, I stopped drinking." Manoon Maepchantip, headman of Ban Supnoinua, who owns 16 cows. "My husband just got this plaque from *our Land Reform Department for not having a drink for a year,"* said Obcherry Maepchantip, his wife. *"I never thought we could be so happy, have so much, and that my husband would stop drinking."*



MODERN STALLS, complete with nameplates, house 16 cows owned by Manoon and Obcherry Maepchantip.

Government authorities describe the Thai Agribusiness Dairy project as the "most outstanding project in Saraburi Province, if not in all Thailand." Average annual net income per participating family increased from 10,500 Baht ($US 420) in 1983 to 49,000 Baht ($US 1,960) in 1985. As the farmers became more skillful in milking and caring for their cows, milk production per cow has increased from 6-8 liters per day to 16 liters per day average. In April, 1987, a few dairy farmers reported yields of 27 liters per day per cow — considerably above the 12-15 liter per day per cow guaranteed by the breeders. The 540 cows initially imported from New Zealand now number more than 1,000. The cows are a hybrid cross between New Zealand and Pakistani dairy cows and are especially acclimated to the hot climate.

The driving force behind the Thai Agribusiness Dairy project is SVITA, a private, nonprofit organization founded in 1978 by concerned business, academic and technology professionals, to consolidate the efforts of NGOs to combat poverty in rural areas and urban slum communities. To launch the dairy project, SVITA coordinated the efforts of 13 different agencies, both private and government, local and foreign. Ms. Karnitha Karnchanachari, Manager of SVITA's SEEDS (Small Economic Enterprise Development) project, emphasizes that SVITA is a facilitating organization, rather than "just another implementing organization." There already were some 3,000 registered PVOs in Thailand, she pointed out. "But there was no one organization to bring together all available resources, NGOs, private and government, to identify innovative projects and technologies, to secure financing, management and other inputs," she says. SEEDs coordinates resources to establish small enterprises, designed to increase employment and generate income among the rural poor. Although projects are not specifically designed for women, they are designed with women in mind.

Appropriate Technology International (ATI) provided SVITA with technical assistance and $72,780 to get the SEEDS project under way, including some $6,000 allocated to the Business Development (loan) fund. Earlier, in 1982-83, ATI had granted SVITA $9,000 to develop and plan the SEEDS concept; it was during the planning period that the dairy project was identified.

Khun Karnitha says she considers it

"amazing that a small organization like SVITA, with less than 10-full time staff, was able to mobilize a huge dairy industry that has generated 30 million Baht ($US 1,250,000) using just ATI seed program money and technical assistance." Identifying the first SEEDS project was easy, she says. More than 80% of all milk sold in Thailand was imported--Bangkok was the major market. Although dairy farming in Thailand is a very young industry, and the Thais traditionally have not been a milk-drinking people, milk products are being promoted by the government and market studies indicate milk consumption will continue to increase. Originally the project was planned as a mini-enterprise; 10 families would raise a total of 50 cows. "But, as we mobilized the resources, the program got larger and larger," she says.

Identifying the general location was not that difficult since there are few places suitable for dairy farming no more than two hours from Bangkok. The Thailand Institute for Scientific and Technical Research compared the technical aspects of proposed locations. Because the government-run Dairy Farming Promotion Organization (DFPO) was active in Saraburi Province, locating the project there meant the farmers would receive a guaranteed price for their milk. DFPO also would help train the farmers in dairy technology. SVITA next sought the approval of the provincial government, which suggested contacts with several other government agencies. This led to the designation of the Land Reform Department as the project's implementing organization. "The Land Reform people told us which of the possible sites most needed this project," adds Khun Karnitha. She feels strongly that the very "detailed planning . . . down to pinpointing the families to be included in the project, could not have been done by a commercial organization because it just is not economical. The strength of private voluntary organizations lies in their flexibility and ability to take the time to plan and to do everything at a minimum cost."

The first village leaders SVITA spoke with refused to take the risk necessary to promote the project. Kamanan Chantee Masoongnern, leader of Tambon Ban Klong Muangnua saw the project's potential. "I knew we had no future living the way we were," he recalls. "If SVITA was giving us the possibility of hope, we had to take that opportunity."

LOCAL FEED MILL, now managed by Ms. Injuan Sucontachit, paid dividends in its first year of operation.

Although the project was conceived with women in mind, at this point, the only women actively involved were the SVITA organizers. Khun Karnitha chuckled as she related the process SVITA used to raise the social conscience of the villages. "We asked the village leader and other men for the names of their wives. Then at orientation meetings, we would call out the names of the women. At first, the men tried to answer the roll call for their wives and other women family members. The audience would laugh hearing a man answer for a woman. It didn't take very long for the women to speak for themselves."

Almost 100 people in Ban Klong Muangnua village applied for cows. The applicants were reviewed to make sure there was enough family labor and enough acreage to raise four dairy cows, the minimum number that would be profitable. Then the neighboring village demanded to be allowed to join the project. At the same time, in Ratchburi Province, a second site was identified—a small land reform cooperative of five villages that badly needed a commercially viable venture to generate income. SVITA now needed to locate more cows and a much larger loan than it had originally anticipated.

Thanks to the intervention of a SVITA Board member who guaranteed the loan, the Bangkok Bank, a commercial bank that was interested in involving women in development, agreed to loan 82 families in Saraburi Province a total of 18,750,000 Baht ($US 750,000) to purchase the cows, barns, insurance, water wells, and milking equipment. The package and its timing also was coordinated by SVITA. "I still can't believe the Bank accepted 1 million Baht collateral to guarantee an 18 million Baht loan," adds Khun Karnitha. The bank charged 1% less interest than usual and a one-year grace period was allowed for the 12-15 year loan repayment.

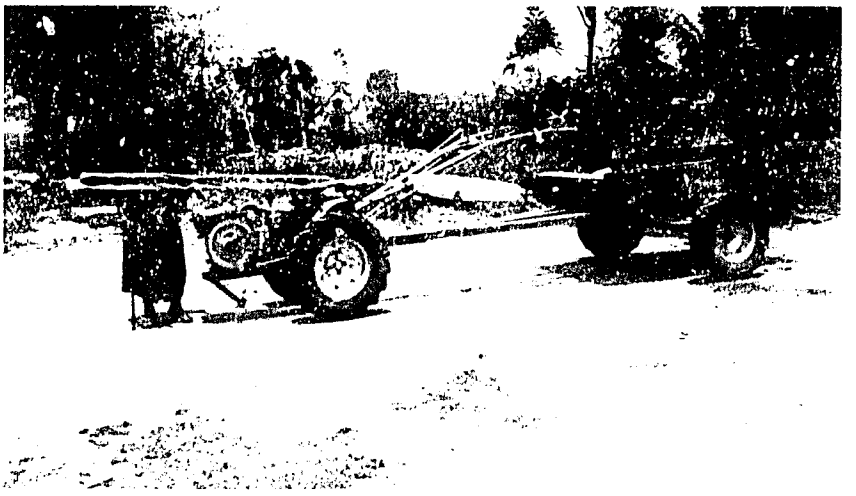
In a separate agreement, the Bangkok Bank agreed to provide 3,750,000 Baht ($US 150,000) in credit to the Ratchburi group to purchase 70 cows. Women were signatories on all but two loans; the husbands were the guarantors. SVITA promoted the formation of a group of NGOs - Friends of Women's World Banking in Thailand (FWWB) which deposited 1 million Baht at the Bangkok Bank as a guarantee and obtained a commitment of an additional 2 million Baht loan guarantee from U.S.-based Women's World Banking. A.I.D.'s Bureau for Private Enterprise contributed $100,000 (2,500,000 Baht) to the Women's World Banking loan guarantee fund.

SVITA arranged to import 540 cows from New Zealand and to distribute them by drawing lots. Although it had never before been a Thai practice to insure livestock, SVITA convinced a Thai insurance agency to insure the cows. The first year, due to inexperience of the farmers, 17 cows died. The following year, the farmers felt the insurance premium the insurance company offered was too expensive so they pooled their resources for group insurance. The second year, there were no fatalities—only more calves.

The villagers all received extensive education on dairy farming as an all-year agribusiness operation. Although the entire family participates in various aspects of the feeding, cleaning, and milking, women are responsible for the financial management of the operations. This not only promotes women's participation in development but eases the fears of Thai Banking officials who believe that women are less likely than men to misuse credit funds by gambling or drinking.

The second year of the project, SVITA established a feed mill, which is administered by a central committee. The small feed mill buys corn and other inputs from the local farmers, grinds up the feed, and sells it to the local farmers. Some villagers who don't own cows grow cassava or corn to sell to the feed mill. The mill charges the same price as other feed stores; however, it delivers the feed to the farmers and eliminates the need for cash disbursements. After its second year of operation, the feed mill paid a dividend to its 81 family owners.

Boontieng Lattisoongein is a member of the central committee responsible for the management of the feed mill. A widow, she moved here 10 years ago from Bangkok where she had a food stall. "Before this project, I used to make frequent trips to Bangkok. I never thought I would make it here. Now I'm so comfortable, I don't go back to Bangkok anymore but I've brought all my friends here to see what I have," she says with a smile. Her original five cows now total 13. She's bought a new shed and modern milking equipment, and upgraded her pasture land. She's saving more money per month now than she used to earn in a year. Although her three oldest children, all sons, only completed elementary school, she's using some of her savings to send her fourth child, a girl, to the university.



THAI VILLAGE LEADER Chantee Masoongnern was the first leader willing to take risk of promoting SVITA's dairy project

"She's majoring in business so that she can take over our business," she explains.

"This whole area is so improved," adds Khun Karnitha. "Before there was no fencing, it looked so poor and so bad. Now it looks prosperous." Spurred by SVITA, the Land Reform Agency and the provincial government have worked together to develop the area. Access roads have been built, some dirt roads have been paved, a water reservoir was constructed as well as access canals for irrigation. Schools were built and a modern health center now serves the two villages in Saraburi Province. Project participants, many of whom initially were illegally encroaching on government lands, now have deeds granting them the right to use the land during their lifetimes.

Based on this project, the government has incorporated dairy farming into other land reform projects. However, the number of applicants for cows far exceeds the supply. As many as 300 families in the Saraburi area alone are wait-listed to receive cows. SVITA does not plan to facilitate any more dairy projects. "We've proven it's commercially viable," explains Khun Karnitha. "Now the business sector should take this up." In Chiang Mai province, a private company is doing just that, as is the National Economic Social Development Board. Recently, the Ministry of Agriculture asked SVITA's advice in planning a similar program for recent high-school graduates.

SVITA is pleased that the villagers' earnings have increased so dramatically. "With ATI's help, we have demonstrated that women in rural areas can establish small businesses and increase their incomes, provided they have access to credit, agricultural extension services, land, and training," concludes Khun Karnitha. "Now we can go on to other pilot programs."

"COWS are like family," says Mrs. Boontieng Lattisoongein.

Stonegrinding: Age-Old Technology Comes to an End

By Carolyn Hairston

BAMENDA, CAMEROON — Dorothy Gwe stood proudly beside the motor crank of the maize mill. "If I start the motor now, they will come." After a couple of false starts, the motor roars to life. Within minutes, two small children enter the small, clay block shed, one carrying a tub of maize. "You see," Dorothy says with a confident smile. "The people are needing to grind their maize. They want to come here."

"Here" is the shed that houses the maize mill operated by the Boyar Group of the Northwest Province of Ndu, a locally organized women's group made up of 118 members. Boyar is one of two local women's groups identified by the Northwest Cooperative Association that are testing this locally manufactured mill.

In Buh village, located near the mountain top town of Wum, many hours drive away, there is another small building with a similar mill. This mill is owned and operated by a private entrepreneur, Abel Akwoh. He runs three other mills, all using imported equipment, but he prefers the locally manufactured version. "I have confidence in this mill," he says as he points to the test model. "The operator can control the maize fill because the shakers don't overflow. With imported mills the operators have to use their hands to shift the maize, and the mills sometimes crack from too tight castings."

Two different types of users are seeking the same thing—a reliable, easily operated and reparable maize mill. ATI's $164,000 grant to Association pour la Promotion des Initiatives Communautaires Africaines (APICA) is making such a mill a reality in the Bamenda and other Northwest Province areas of Cameroon. APICA, a regional appropriate technology agency based in Douala, manages a partnership comprised of several diverse organizations — CATMI, MIDENO and the Northwest Cooperative Association. These organizations are providing motor-driven maize mills primarily to women's and other village groups and private entrepreneurs. There are more than 140 women's groups or societies, representing 20,000 members in the immediate project area.

Maize is one of the major agricultural crops of the Northwest Province. About 70,000 metric tons are produced annually. 25 percent of Cameroon's total production. About 80 percent of the maize is consumed locally. Grain porridge, called foofoo, is the preferred food and is cooked at least once daily.

BOYAR WOMEN'S GROUP actively markets the maize milling service. Dorothy Gwe (center) and Hana Yulah want to repay the loan they took out to purchase the mill quickly so they "can get another one and make more money."

Women spend countless hours grinding maize, which allows little time to care for homes and children, prepare family meals and grow food crops. The women are instrumental in marketing this excess production, selling an average 560 pounds of grain a year in local markets. The traditional hand rubbing, mortar pounding, winnowing, and stonegrinding maize processing method is very time-consuming. It takes about 150 five-hour days to grind one metric ton of maize.

Until the mid 1940s, when the first hand-mill was introduced into the Northwest Province by a local trader who charged a penny to grind a small basket of grain, the traditional process of maize milling was used exclusively. As the economy grew and demands on women to devote more time to farm production increased, it was clear that this labor-intensive activity presented an opportunity for change.

In the 1950s, Elizabeth O'Kelly, a community organizer active in forming women's cooperatives in the area, introduced hand-driven mills to these "societies." Women could own and operate these mills as a group; in their spare time they could attend literacy classes or participate in other activities to increase agricultural production and improve their standard of living.

While this hand-driven mill helped village women to become more efficient, imported diesel-powered plate mills were being introduced in large maize-producing areas in the early 1970s. The new machines reduced the required labor even more significantly. But this change was not without its price—higher initial investment costs, problems with replacement parts and a scarcity of trained mechanics to maintain or repair these imported mills. Ironically, while the majority of potential users of these mills were rural, low-income households, generally only local traders could afford them. Without a credit system to assist in getting these mills into the

hands of village women, the effectiveness of this advance was severely limited.

Some entrepreneurs realized that this situation held the seeds of a profitable business. Mr. Barnabas Anguh, managing director of a small-scale private enterprise located in Bamenda, the capital of the Northwest Province, had long ago recognized the need for a local industry that could manufacture and repair farm and agricultural product processing equipment. In 1972 he established the Cameroon Agricultural Tool Manufacturing Industry (CATMI). Today, the company employs 15 full-time laborers, including one woman and both skilled and semi-skilled metal workers.

Convinced of the marketability, performance and reliability of diesel-powered plate maize mills, approximately ten years ago Mr. Anguh constructed a prototype maize mill based on a locally available imported model. Because of his personal "anxiety and pride in producing implements that are practical and very useful for the community at large," he wasn't satisfied with the original model and set the machine aside. Anguh's satisfaction comes from his ability as a manufacturer to develop unique products combined with, he says, ". . . a natural gift for knowing what agricultural tools are needed and what people are willing to pay for." Several years later, with assistance of a Food and Agriculture Organization (FAO) consultant, he modified his original design.

In Anguh's mill, components have been redesigned so that they can be made from locally available mild steel plate, sheet and angle bars. Only bearings, grinding plates and springs need to be imported.

A recent design modification recommended by an ATI staff member has significantly increased the mill's marketability. A vibrating feeder trough that eliminates trough overflow and manual sifting of the maize is now incorporated in the device.

Another plus of Anguh's design is that *wet* maize may be ground without machine jam, which saves the substantial amount of time normally wasted in drying. Production capacity, originally anticipated to be 105 kilograms per hour, has been measured at 140 kilos per hour, during the initial test phase.

Anguh's mill competes favorably with the wide range of imported mills available

ENTREPRENEURIAL spirit of Barnabas Anguh led to his establishing Cameroon Agricultural Tool Manufacturing Industry (CATMI) in 1972. Today his company employs 15 people

throughout Cameroon. Its affordability — at about 80 percent of the retail price of other imports — combined with its tested reliability and streamlined design make it a viable alternative.

ATI's grant is supporting CATMI, under APICA's administration, in the form of a working capital loan to finance the fabrication of five trial production mills and forty mills intended for commercial use. APICA is offering the loan on commercial terms corresponding to those of the local development banks over a period of five years. ATI is also funding a revolving credit scheme to enable women's and other groups and private individuals in the Northwest area to purchase these maize mills.

The Boyar Group plans to use the loan fund but they "wish to pay for this machine quickly and get another one with future profits," explains Dorothy Gwe, as the group's President Hana Yulah nods in approval. They believe that the milling fee they charge, which is slightly lower than the fee charged at an imported model a 10-minute walk away, should give them the competitive edge.

Members of the Boyar Group actively market the milling service, sometimes through an age-old sales gimmick, — "specials." Reduced fees are offered if the service is used during a specified time period. "When we do this, we get mostly all the customers," Dorothy says.

APICA's Project Coordinator, Joseph Moutsi, views the technology and the project focus as a major accomplishment in helping to meet the development needs of women in Cameroon.

"They (women) are interested in doing something that's useful for them. From their interest in the mill, we are seeing their interest in expressing their own development needs, things that are useful in helping them become independent. Mill operation is one of the important ways they can do this," he says. He knows that, traditionally, mechanized technologies are usually produced for or taken over by men. He believes that by marketing the mill technology to women, "We are helping women to carry their own weight. These women don't like to be indebted."

The potential gains are not limited to the economic side. According to one Peace Corps volunteer, a lot of prestige is accorded women involved in mill operation. This social recognition probably accounts for the fact that mill houses tend to be meeting places. Women now have a little more free time to socialize, as well as to devote more attention to their family responsibilities and farm production.

Mill manufacturer Anguh believes that there is a potential annual demand for 100 maize mills or more in the Northwest area alone. The Agricultural Credit Agency in Bamenda agrees. The moderate price, simple and quick processing capability, and minimal downtime performance make his mill attractive to women operators. He anticipates being able to maintain the price at or near the current level to enhance its marketability.

As the project nears the end of its second year, the positive results have left their mark on project participants. Mill producer Anguh, Project Coordinator Joseph Moutsi and the women of Boyar all agree that this project can fundamentally redefine the women's role in the community. They are now the mill purchasers, users and the ones who stand to make the profit. The days of stonegrinding are coming to an end.

Pigs Get Fatter Faster in the Dominican Republic Cafeteria

By Arleen Richman

SANTIAGO, DOMINICAN REPUBLIC—Maria Rivas pointed with pride to her seven hefty, healthy-looking pigs, penned in two separate enclosures, on her modest one hectare farm. "I'm getting three times as much money for my pigs now—even counting the cost of the special feed I bought—than I did before," she explained. "Three years ago, before this program, my family had nothing . . . we never ate meat except when we killed a turkey or a pig for a fiesta. Now we have shoes, food, meat. These pigs, which I take complete care of, are like a bankbook," she added with a smile.

Señora Rivas is just one of approximately 850 small-scale farmers in the Cibao region in the northern part of the Dominican Republic who are fattening their pigs faster and more efficiently by combining locally available agricultural feeds with high protein feed supplements. CIMPA, the Centro de Investigación y Mejoramiento de Producción Animal, a non-profit organization which fosters improved animal husbandry in the Dominican Republic, developed the technology and the system to implement it, supported by a $160,000 30-month grant and technical assistance from Appropriate Technology International.

Marco Antonio Disla, who lives down the dirt road from Señora Rivas, recently sold a pig for 728 pesos and put most of this money into a bank account—the first savings account he has ever had in more than 25 years of subsistence farming. "I put 500 pesos in the bank for bad times," he said. "I still can't really believe that I have a bankbook, just like 'los ricos'," he added.

He walked to a nearby shed to show Pedro Azcona, the manager for CIMPA's Small-Scale Swine Raisers Program, the supply of pig feed he had on hand. There in three labeled sacks were mixed feed for piglets (starter feed), growing pigs and finishing feed, used for the last 100 pounds. "I never had any money before to buy feed . . . but with this feed, and the ramie I grow, and the molasses, plus the yucca leaves and scraps I've always fed them, the pigs seem to be full grown in half the time," he said.

The cafeteria approach advocated by CIMPA's program still includes as an entree the pigs' traditional diet of home-grown feeds, such as greens, tubers of all their root crops, sweet potato vines, yucca, nuts of the Royal Palm, platanos, and table scraps. This is supplemented by ramie, a high-protein green fodder native to Asia which was introduced and promoted by CIMPA, molasses and the formulated swine feed. The formulated feeds, produced locally in cooperative mills, contain a mixture of corn, soya, sugar, rice-bran and minerals.

PIGS are like a bankbook, believes Señora Maria Rivas.

Feed supplements have always been available in the Dominican Republic but Ing. Azcona explained that "these small-scale rural farmers—most of whom raise between 5 and 35 pigs per year—thought that the enriched feed was only for U.S. pigs—or for large-scale commercial producers, not for poor rural farmers like themselves." Then in 1979, African Swine Fever broke out throughout the Dominican Republic. In the next two years, the government was forced to slaughter the entire national herd of approximately 1,600,000 head of swine.

Because pork is a favorite food in the Dominican Republic and an important element in the domestic agricultural economy, the government launched an intensive effort to repopulate the swine. Initially, attention was directed at large production units resembling U.S. style operations. What was to be done for the small-scale producer? By mid-1984 breeding stock (imported pigs more resistant to African Swine fever) was sold locally at prices most small-scale farmers could afford. But these imported, U.S.-style pigs were very large, twice the size of the previous native or (criollo) animal. Farmers were told these pigs had to be fed exclusively on imported feeds—an approach they could not afford. But could the use of some imported feeds and other less capital intensive features of modern swine production systems combined with their traditional swine raising methods help them maintain their previous market share of pork products?

"CIMPA realized it needed a strong education program if the farmers were to accept the new feed ideas," explained Azcona, who has been Project Manager since the Swine Feed program started in June, 1984. CIMPA hired an education

specialist, and made presentations at many meetings of farmer groups and Provincial Development Associations (PDAs). It took farmers out to the demonstration farm and showed them how easy it was to grow ramie. Traditional greens, such as sweet potato vines and yucca leaves, are only available in the D.R. following seasonal cropping operations. CIMPA also impressed upon the farmers the need to use veterinary supplies and demonstrated how inexpensive locally-manufactured equipment, such as automatic waterers, feed troughs, and farrowing crates could improve sanitation, reduce feed wastage and reduce crushing of piglets.

The project plan also incorporated a distribution system for molasses, a by-product of the sugar industry and the then cheapest commercial feed ingredient available in the Dominican Republic. Molasses, considered a delicacy by pigs, makes the protein-enriched greens more palatable, in addition to providing a high-energy feed. When the swine feed project began, the government was practically giving away molasses but it was only available in tank-car lots, not in small quantities. The farmers, through their district associations, decided to purchase the molasses in bulk. CIMPA provides the large storage tanks. Trucks owned by the district associations (PDAs) carry the molasses in barrels to local shops, called "pulperías," which sell the molasses and mixed feed.

The pulperías are very small stores, which sell nonperishable foodstuffs in remote rural areas. The pulperia operators have been trained by PROAPE, the small business development agency associated with the project, to keep simple records of sales of mixed feed and molasses by type, quantity and name of purchaser. Molasses, available in small quantities for animal feed for the first time in rural areas of the Dominican Republic, became a very popular part of the hogs' diet. In fact, local farmers coined the term "ensalada con salsa"—salad with dressing—to describe the molasses/green combination. Then in late 1985, the government began exporting molasses and the price of molasses tripled. At present, the swine farmers only purchase the costly molasses during the dry season. During the rainy season, many tasty (to pigs) greens are available and the pigs willingly eat the available greens without the "salsa" inducement.

Farmers purchase the feed mixes and the molasses on credit. When the project

PIGS in Dominican Republic like the taste of ramie, with or without "salsa."

was organized, money was set aside in a credit fund, allocated by CIMPA to the Provincial Development Associations. Initially, profits earned by the pulperías which are owned by the associations, remain in the store and serve as working capital. After two years, profits are spent according to the needs of the group. For example, members of the PDA in Salcedo plan to use the profits to construct a better road.

The project plan estimated that small rural farmers could increase their income (from pigs) by approximately 18% per year (an additional $83 average) by lowering their feed costs and increasing the feed conversion efficiency. The intermediate system—using all readily available local feed resources with a few outside feed inputs—was to generate an additional 5 centavos (2 cents U.S.) per lb. of pork produced compared to the traditional system, and an advantage of 9 centavos (3.6 cents U.S.) per lb. compared to the complete, formulated feed system.

Ing. Azcona and the local farmers believe that on the average, their profits from swine raising have increased by approximately 30%. But the benefits to these small rural land-owners cannot only be described in terms of extra pesos earned. Ramona Isabel Herman, of Salcedo, recently sold one pig for 975 pesos and now is finishing fattening three other mature pigs. On her 7-hectare plot, she also raises coffee, cocoa, and yucca. With the profits from her pigs, she is building a new house in town. She says the pigs "protect her from fluctuations in other crops." Sometimes, she explains, "if there is bad weather, or pests, the crops are worth nothing or very little. But the pigs, the pigs are more constant."

In Moca, one of the richest agricultural regions in the D.R. (the land is so fertile there that it is said fertilizer is not needed to get bonanza crops) Luis Alvo is one of the area's most "comfortable farmers." On his 18.8 hectares, he raises yucca, platanos, oranges, cocoa, avocado and pigs and chickens. Chickens are his major source of income. The profits from his pork sales finance some of his purchases of chicken feed. He uses bank credit extensively in his chicken-raising operations. Señor Alvo says his chickens are more profitable than the nine pigs he had but the "pigs provide an additional hedge against other market fluctuations."

Ing. Azcona praised Señor Alvo as "very dedicated to his work and very interested in innovations." He pointed out that Señor Alvo was the first person to grow ramie in the Moca area. "I heard it mentioned in a general presentation CIMPA had on this project," Señor Alvo says. "I went to CIMPA to find out more about it." To day, his very small plot of ramie, which is cut every 30-45 days, produces enough green fodder for his pigs, plus leftover ramie which he gives as a gift to his neighbor.

Even those farmers who have had a bad experience with their pigs say they are committed to the project. Juan José Abreo, and his wife Alicia own 26 pigs and farm platanos and yucca on their 4.5 hectare plot. They recall "always raising pigs... before the epidemic and now." They continue to be convinced of the profitability of swine raising—despite the fact that this past year 11 pigs died of poisoning from contaminated water. CIMPA helped find the cause of the contamination and took corrective measures to ensure that this would not recur.

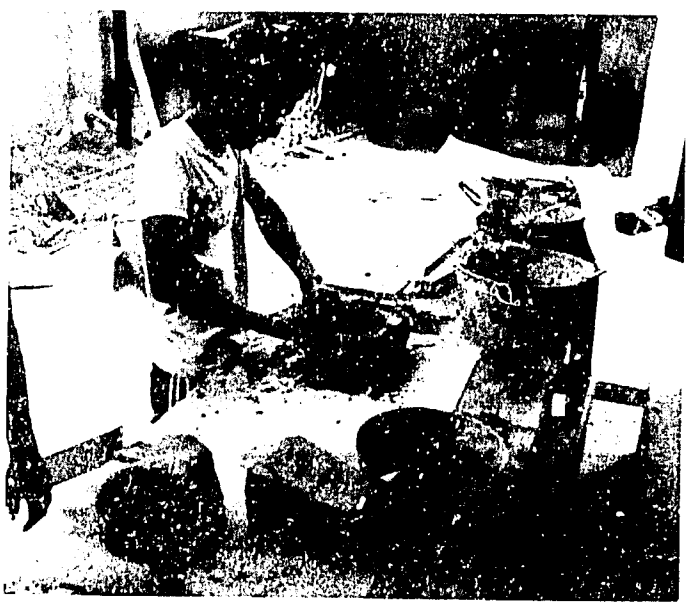
Señor Abreo commented that platanos fetched a very good market price this year. "But this may not be the case next year. The pigs are more certain. And under this project, fattening them is so much easier. I used to try to feed them different supplements, and this was very difficult to do economically," he continued. "Now I just purchase the mixed feed and add some to the ramie and yucca tops. Don't they look healthy?" he asked, pointing directly to two sows that would soon go to market. What will he do with the profits? "I'll put the money in the bank. Ultimately I may buy some more land . . . and I definitely will buy some more pigs."

ATI Field Program Activities 1984-1987

WHEELCHAIRS produced in several small workshops in Colombia and Peru are sold on credit.

BAMBOO GRASS is carefully selected for weaving into place mats by villagers in Thailand.

KNOWLEDGE OF MARKET determines products produced. In India, one rural potter discovered that customers in the Pondicherry area preferred Japanese brush type decorations. (ATI support for this project ended in 1983).



JIKO LINERS are made by local artisans in Kenya.

The information contained in the project descriptions in this Report, except for the section on Achievements/Findings, is the same information published in ATI's Annual Reports for 1984 and 1985. For projects begun in 1986-87, descriptions have been written. The Achievements/Findings section reports on the progress made against the original expectations and on any adjustments in expectations, technology, etc. It also notes if the project has been terminated.

AFRICA PROJECTS

Animal Driven Pumps, Botswana

Project Partner:

Rural Industries Promotions (RIP) Rural Industries Innovation Centre (RIIC)

Purpose:

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

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 40-50%. If water is used to irrigate cash crops, their incomes should increase by 20% or more.

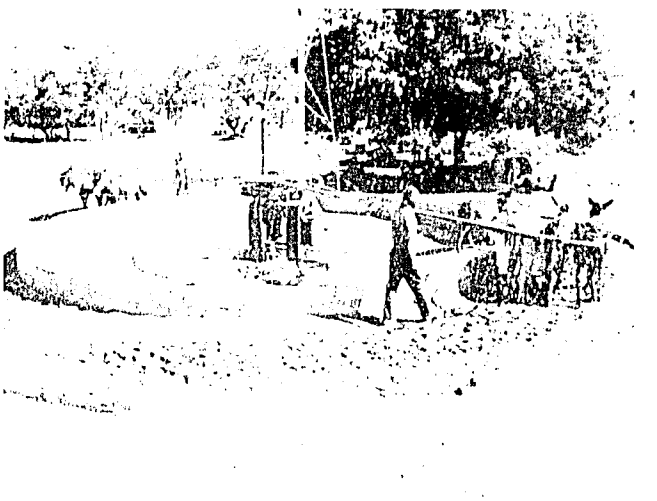
Technology:

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 50% 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 (it does not use costly imported fuel for its operation) and, under certain conditions, decreases pumping time by 30 to 40 percent compared with diesel pumps.

Achievements/Findings:

Five Mark I Animal Driven Pumps have been installed. The sixth has been sold and will be installed in mid 1987. An internal technical evaluation of the first Animal Driven Pumps resulted in an upgraded version of the pump, called the Mark II. Performance testing of the Mark II is nearing completion and manufacturing will begin during the second half of 1987.

Revised project expectations call for installation of 8 ADPs in a four-year period. RIP B is formulating a market strategy which should be completed by the end of 1987. Several Botswana government-sponsored agricultural projects have become enthusiastic supporters of the ADP and are purchasing them for horticultural and cattle syndicates. The U.S. Ambassador's Self Help Fund in Botswana also purchased an ADP to be used by a newly formed horticultural syndicate.



ANIMAL-DRIVEN PUMP in Botswana reduces the cost of water in rural areas.

Brick Production, Botswana

Project Partner

Southern Rural Development Association, Minerals Holding Trust (SRDA/MHT)

Purpose:

To establish two small-scale, commercially viable brickyards which produce a high-quality brick that is less expensive than imported brick and affordable by low income people.

Expectations:

After three years, two brickyards will be in operation with a joint production capacity of 3 million bricks. This will double the supply of low-cost building materials in the area and enable 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 similar businesses.

Technology:

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

Achievements/Findings:

The compressive strength of a brick from the Moshaneng brickyard is consistently above the government building code standard of 70 kg/cm². Prior to the start-up of the project, a Moshaneng brick averaged 25 kg/cm². Now a Moshaneng brick averages 72 kg/cm².

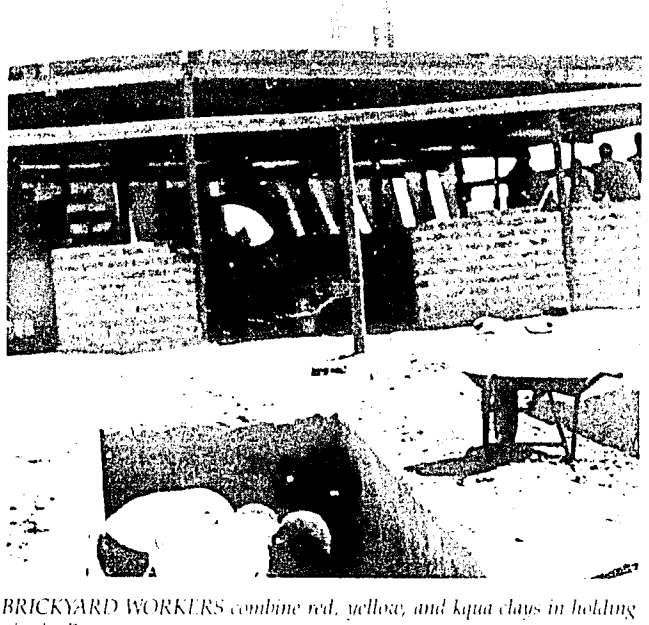
The wastage rate from deformed, cracked, underfired or overfired bricks has dropped from 15 to 20% of production to 5% of production.

Fuel consumption has decreased about 60% from 15,000 MJ/1000 bricks to about 5858 MJ/1000 bricks.

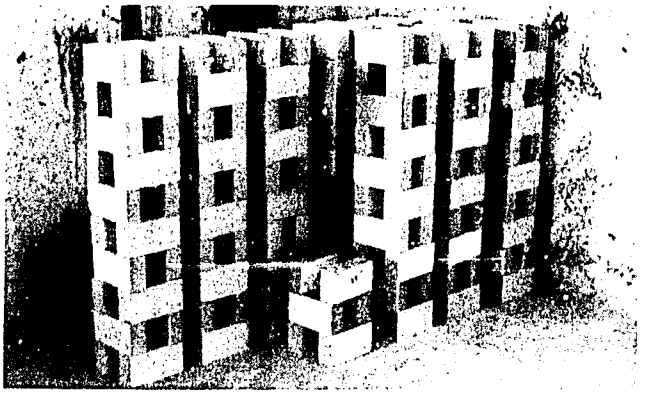
Water use has decreased by 20%.

The firing and cooling time for bricks has been reduced from 10 to 7 days.

This project has demonstrated that upgraded bricks can successfully compete with imported bricks. However, the price the enterprise must charge for the upgraded bricks puts this product out of reach of the rural poor. Thus the project is expected to realize only one of its objectives.



BRICKYARD WORKERS combine red, yellow, and kqua clays in holding pits in Botswana.



PRESSED CLAY BRICKS in Botswana and Tanzania can be stacked to dry; this reduces the drying-space requirements.

Grapple Processing, Botswana

Project Partner:

Thusano Lefatsheng (TL)

Purpose:

To demonstrate commercial opportunities in wild plant processing by establishing a profitable enterprise which produces high-quality grapple products for export and employs inexpensive and simple production technologies.

Expectations:

By the third year of the project, more than 280 grapple gatherers will increase their incomes by as much as 25% over current levels as a result of higher prices paid for the raw material. By adding value to a local material through in-country processing, capital formation in rural areas will increase significantly. In addition, the project will create five full-time jobs in a rural area.

Technology:

Grapple (*Harpogophytum procumbens*) is a wild plant found in great abundance in the Kalahari desert. Currently, its large, tubular roots are gathered, sold, and exported to Western Europe for processing. Using a simple, low-cost, labor-intensive, and high yielding technology, this project will dry and grind the roots locally to produce grapple tea which will then be packaged and exported. This represents the first processing for export of this type in Botswana.

Achievements/Findings:

The unique nature of the organization and the project has attracted a great deal of attention. As a result of ATI's demonstration project, a new donor (HIVOS), awarded a $600,000 grant to Thusano Lefatsheng for a greatly expanded plant production and processing project. Thus far, the project has processed and sold about 1300 kg. of grapple. The number of villages participating in wild grapple collection has expanded from 3 to 10.

Lime Production, Botswana

Project Partner:

Southern Rural Development Association, Minerals Holding Trust (SRDA/MHT)

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 the price of 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 (using coal) 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.

Achievements/Findings:

One kiln, the slaking platform, packing machine, storage facility and water supply system have been built and are in operation. If the kiln is charged continuously, output of quicklime averages about 3 tons over a 24 hour period. Fuel consumption of the kiln has dropped from 210 kg of coal per ton of limestone to 190 kg per ton, a result of a new inner lining and better kiln control. This is a thermal efficiency of approximately 40%. A recent technical mission proposed changes to further improve the efficiency of the kiln. Now that the technical soundness has been demonstrated, the commercial viability of the enterprise will be assessed. All lime produced at present, approximately 20 tons per month, is sold to the Botswana Meat Commission.

Anguh Maize Mills, Cameroon

Project Partners:

Association for the Promotion of African Community Initiatives (APICA), B.A. Anguh Agricultural Tools Manufacturing, Northwest Development Authority (MIDENO), Northwest Cooperative Association, and Peace Corps.

Purpose:

To locally manufacture an adapted maize plate mill primarily for sale to women's groups and other village groups in rural areas of Cameroon, thereby increasing labor productivity.

Expectations:

Over a three-year period, more than 85 mills will be manufactured locally and sold on the local market. A revolving loan fund created by the project will facilitate the purchase of these mills by over 20 village groups. Labor productivity in approximately 8,500 households will increase, due to significant reductions in labor time and arduousness relative to traditional hand grinding and hand milling methods. In addition, 85 new jobs will be created in rural areas.

Technology:

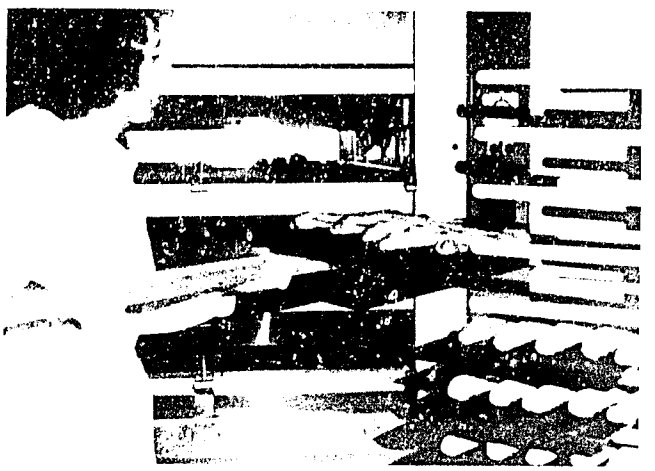
This project will manufacture a modified version of a locally available, diesel-powered plate mill for maize. Imported plate mills are almost entirely made from cast-iron parts. The major strength of the Anguh mill is that components have been redesigned so that they can be made from mild steel plate, sheet, and angle bar, enabling all mill components, except the bearings, grinding plates, and springs, to be manufactured locally in established rural workshops. The Anguh mill is simple in design, durable, and can be marketed for approximately 70% of the retail price of imported mills. Output of the mill is 150 kg/hour assuming two millings of shelled maize, a rate roughly equivalent to the capacity of imported motor-driven plate mills and far superior to the hand-driven mills or the traditional process. The Anguh maize mill is the first locally manufactured, motor-driven, plate mill in Cameroon.

Achievements/Findings:

Four Anguh maize mills have been manufactured and field-tested. These are being used by approximately 200 households. Four jobs have been created. Tests have determined that the Anguh mill is equivalent or superior to locally available imported plate mills in technical performance, ease of operation, user acceptance and potential commercial viability. Based on this conclusion, preparation for full production and commercial dissemination of the mill has begun. Manufacturing is expected to start in July, 1987.

Because the market potential was analyzed to be less than originally anticipated, production and marketing figures were halved. Revised expectations call for manufacture and sales of 40 maize mills. These mills will service 4,000 households.

Composite Flour, Cameroon



COMPOSITE FLOUR baked goods are being market tested in Cameroon.

Project Partners:

Ecole Nationale Supérieure des Industries Agro-Alimentaires du Cameroon (ENSIAAC) and Institut de Technologie Alimentaire (ITA)

Purpose:

To develop and perform consumer acceptance tests on bread and other baked products made from composite flour and produce such baked goods and local non-wheat cereal flour on a commercial basis.

Expectations:

As a result of this project, employment will be created for 15 persons and extra annual income of $31,300 will be generated. Depending on the amount of non-wheat material incorporated in baked goods and on the type of cereal, annual capital formation for the mill enterprise will vary between $5,200 and $25,200. Foreign exchange savings in 1991 due to the substitution of locally produced cereal flour for imported wheat will total as much as $123,700. In addition, the establishment of a mill enterprise will guarantee a market for the hinterlands' surplus cereal production, benefiting approximately 200 farmers.

Technology:

All baked items currently consumed in Cameroon are composed of all-wheat flour causing a drain on foreign exchange and reducing the market for local cereal grains. Composite flour is a combination of wheat flour and local non-wheat flour used to make leavened bread and other baked goods. This project will test consumer acceptance of composite flour baked goods and establish a milling enterprise to produce composite flour for sale to local bakers. The processing unit consisting of an abrasive disk dehuller and a roller mill has been designed to produce high quality sorghum and maize flour on a scale corresponding to the estimated market demand. Local bakers, using equipment currently available (i.e., ovens, kneading-trough, dough shaper, divider, water cooler and scales) will produce composite flour goods after receiving supplementary training in blending and baking processes. This is the first commercial production of composite flour baked goods in Cameroon.

Achievements Findings:

After sensory testing, five types of composite flour baked goods—three types of bread, cookies and cakes—were designated for market testing, beginning in May 1987.

Palm Oil Extraction Unit, Cameroon

Project Partner:

Association for the Promotion of African Community Initiatives (APICA)

Purpose:

To create a commercially viable enterprise that 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.

Achievements/Findings:

After discovering that used Colin presses were not readily available, ATI supported the development of cost-effective highly efficient alternative presses. The project has concentrated on manufacturing and maintaining the Caltech press, in both the manual and motor-driven versions.

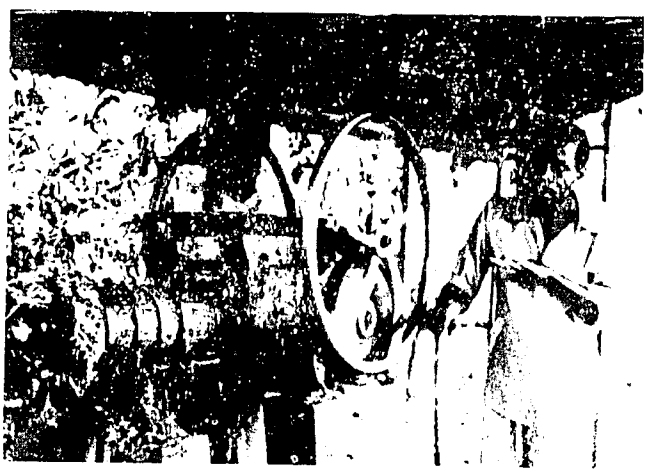
The Caltech palm-oil press is more efficient than the traditional method or alternative village-scale technologies. It depulps and presses palm nuts in one operation; its rate of extraction is between 18 and 20 percent; and it can press between 125 and 310 kgs. of fresh fruit bunches per hour, depending on the version.

Revised Expectations:

Over a five year period, 57 presses will be manufactured and sold to local village groups and private entrepreneurs. Of this total 25 will be leased sold through the use of a five-year revolving loan fund established by the project. More than 1,000 households will benefit through increased palm oil production and labor productivity. In addition, approximately 200 new jobs will be created in rural areas through the operation of oil extraction units.

Achievements/Findings:

To date, 35 presses have been sold, 30 in Cameroon and 5 in Zaire. The manufacturing enterprise TOOLS is expected to show a positive cash flow for 1986-87. The development of a vertical axis version of the Caltech press will make it possible to manufacture an oil press for one third the cost of the currently available Caltech hand-driven press.



CALTECH PRESSES in both manual and motor-driven versions are being manufactured by TOOLS in Cameroon. This enterprise expects to show a positive cash flow for '86-87.

Ceramic-Lined Jikos, Kenya

Project Partner:

Kenya Energy Nongovernmental Organizations Association (KENGO)

Purpose:

To initiate production of ceramic-lined, charcoal-burning stoves by as many as 20 informal sector manufacturers of traditional stoves in areas of high demand throughout Kenya, and to field test the 'Kuni Mbili', a ceramic-lined portable wood burning stove.

Expectations:

Many of the estimated 1,000 metalworking artisans who presently spend ¼ of their time manufacturing jikos are expected to adopt this technology. The major benefits will be cash savings to consumers; the aggregate household savings will total $470,000 over a two-year period. A market share of 10% would prevent the clearing of 11,250 hectares of natural forest and plantations for fuelwood. In addition, if successful, this project will generate annual gross profits of $64,000 in the informal manufacturing sector, and an additional $31,000 per year after the loans have been repaid. The project will provide work for 25 rural individuals.

Technology:

The improved technology promoted by this project involves the addition of ceramic liners to an existing traditional technology for metal stoves. The ceramic liners are held in place by an insulating layer of a cement/vermiculite mixture. The ceramic liner and attached grate extend only to the narrow half-way point of the metal casing and are manufactured in one piece with a perforated floor acting as the grate. This modification reduces cracking and weight (an important concern in urban Kenyan households where stoves must be easily portable). These ceramic liners have a normal lifetime of nine months when used intensively, compared to three months for a metal grate in a conventional jiko. This technology reduces fuel consumption by 25-30% compared with the traditional metal stove. Local artisans will manufacture and market the jikos in small townships and trading centers.

Achievements/Findings:

A jig (Jiko Jolly) for more rapid and accurate molding of ceramic stove liners was developed by ATI staff, and is now being introduced into other countries by other stove programs. Sales of improved stoves have surpassed targets, largely because of deliberate efforts to build upon existing informal sector stove producers and markets, instead of creating new firms or subsidizing distribution by government.

Biogas Refrigeration, Mali

Project Partner:

Groupe de Recherches et d'Application Techniques (GRAT)

Purpose:

To field test a locally lab-proven biogas technology by running two refrigerators to keep animal vaccines cold.

Expectations:

Kerosene costs for the refrigerators are expected to be reduced by 50-75 percent resulting in a savings of approximately $700 per year per installation.

Technology:

Two biogas generators, generally referred to as "Chinese-type" drumless digestors will be constructed at ODEM sites in the Mopti Province. The digestors are capable of processing the collected dung of five to six cattle at a projected loading rate of 11 kgs of raw material diluted with 100 liters of water per day, under normal operating conditions. The resultant gas yields are estimated to be 3.6 cubic meters per day, of a variable pressure of 100-900 mm water gauge, with a methane (CH_4) content of 55-65 percent. Two new top-loading kerosene refrigerators will be modified so that methane may be used as the primary fuel.

Achievements/Findings:

Due to a lack of raw material (cow dung) and high acid content of the digestor slurry, the digestors were never able to produce sufficient biogas to fuel the two refrigerators. ATI has concluded that the utilization of biogas for this purpose is not viable.

Mini-Dehullers, Mali

Project Partners:

Compagnie Malienne de Développement des Textiles (CMDT), Division du Machinisme Agricole (DMA)

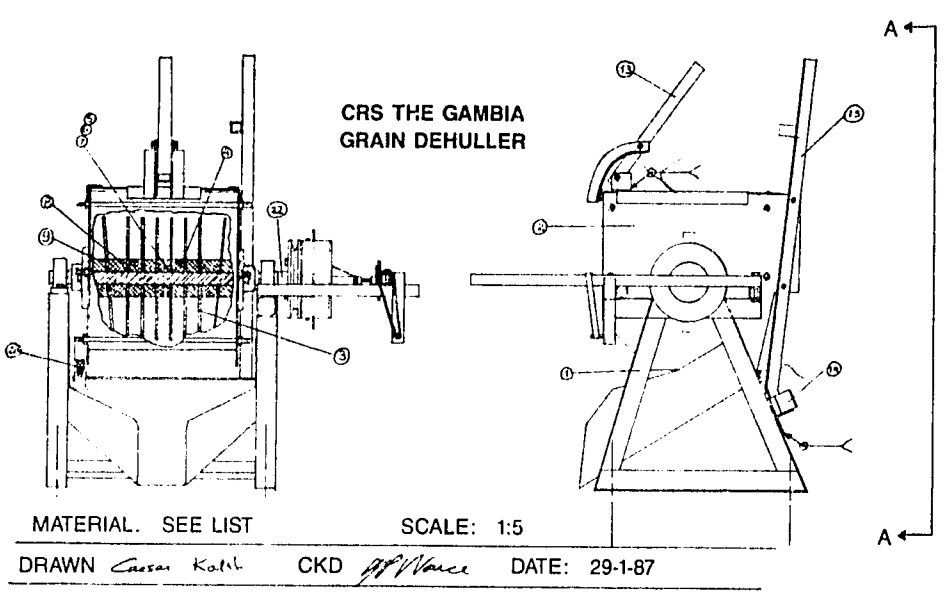
Purpose:

To test the technical and commercial viability of a modified version of the IDRC mini-dehuller and manufacture it locally for sale to village associations and private individuals in Southern Mali.

Expectations:

By the fourth year, this project is expected to have led to the manufacture and installation of 100 mini-dehullers in rural Mali. Capital formation in rural areas will increase by approximately $340 per dehulling enterprise operating at 80% capacity. One hundred jobs will be created in rural areas and labor productivity will be significantly improved relative to traditional methods. In addition, the mini-dehuller will significantly reduce the labor time and strenuousness of grain processing for rural women, and may thereby increase the attractiveness of local, drought-resistant grains relative to imported foods, that require little or no preparation.

MALI DEHULLER is based on the grain dehuller shown here.



Technology:

The Prairie Regional Laboratory of the National Research Council of Canada, with the support of the IDRC, has developed a simple, efficient, dry-process mini-dehuller that significantly reduces labor requirements while increasing the recovery rates and storability of local cereals. The proposed mini-dehuller is a local modification of this design, which is considerably less expensive and uses less energy than the majority of mechanized dehullers in use. The modified mini-dehuller is the first grain processing equipment to be manufactured in Mali. Its simple design lends itself to replication in other regions of Africa where millet, sorghum, and maize are grown.

Achievements Findings:

Three modified mini-dehullers have been manufactured. Field and laboratory testing began in July, 1987.

Shea Butter Extraction Units, Mali

Project Partners:

Division du Machinisme Agricole (DMA), Compagnie Malienne de Développement des Textiles (CMDT), and Centre d'Echanges et Promotion des Artisans en Zones à Equiper (CEPAZE)

Purpose:

To commercially manufacture two types of shea butter extraction equipment that will enable increased rates of extraction, and to test the technical and commercial viability of the ownership and use of this equipment by village groups.

Expectations:

As a result of this project, approximately 850 households will increase their incomes from shea butter production. In addition, the supply of shea butter, an important source of calories in Mali, will be increased. The technology will dramatically reduce the use of firewood and the arduousness of work for rural women, the primary producers of shea butter. Two shea butter extraction units will be established, and the groundwork laid for wider dissemination of the improved extraction units. There is potential to install at least 100 of these units in West Africa over the coming years.

Technology:

The project will test two shea butter extraction processes developed and tested by CEPAZE, one motor-driven and the second hand- or animal-driven. The latter is better suited to more sparsely populated shea nut producing areas and to populations accustomed to using animal traction. The improved extraction technology produces shea butter of a similar taste, appearance, and composition to traditional processing. The improved method employs simple solar dryers, a manual or motor-driven decorticator winnower, an animal- or motor-driven shea nut grinder, and a centrifuge. Extraction rates of the CEPAZE technology are comparable to the GATE-KIT technologies.

RURAL WOMEN IN MALI will benefit from commercial production of shea butter extraction equipment.

Achievements Findings:

The project was amended to incorporate a second phase, to further develop and test the centrifuge for the motor-driven unit. The motor-driven shea butter extraction unit has a processing capacity of 16 kg of oil per hour and an oil extraction rate of between 35 and 40%. This improved technology reduces considerably the time and physical effort required to process shea nuts into butter.

To date, two kinds of shea butter extraction equipment have been manufactured and field tested; village groups have been trained in their use. The interim evaluation concluded that only the motor-driven version has the potential to be commercially and technically viable. In a four-month period in 1986, the motor-driven extraction unit was used by 250 women living in 12 villages. CEPAZE is building a modified version of the centrifuge to correct the technical imperfections identified in earlier testing. Field testing of this improved version will begin in September, 1997. If the test results are satisfactory, commercial dissemination of the technology will begin. Because only the motor-driven unit is in operation, the number of households served has been reduced to 600.

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 high strength and regular size that will meet the quality requirements of the urban market.

Expectations:

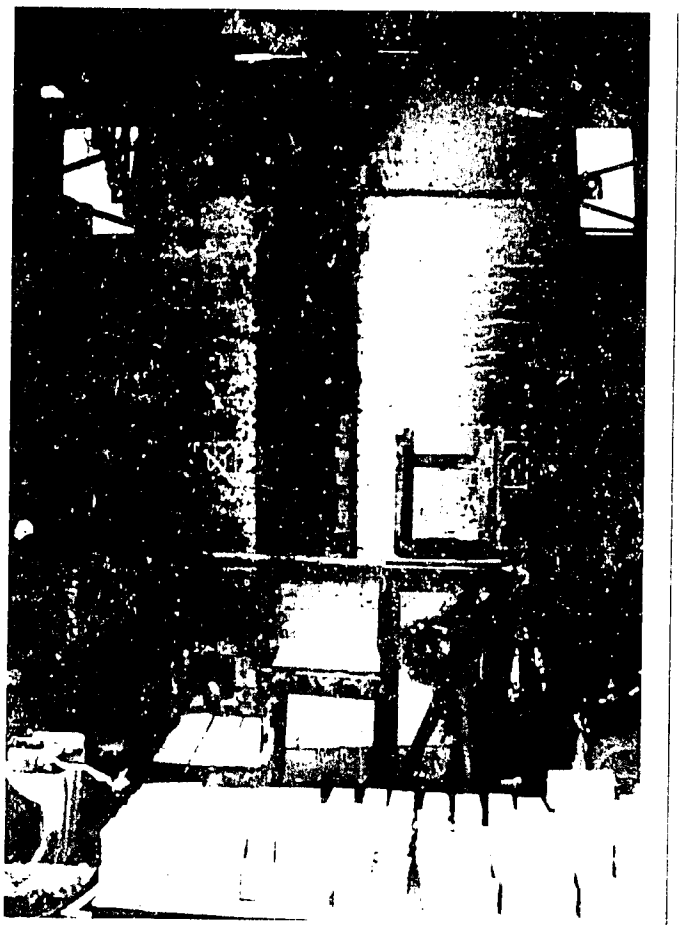
During the project period one to three rural brickyards will be established. One such plant, operating at 60% capacity, will be able to supply material for the construction of between 170 to 200 low-cost houses annually, directly creating work for 130-140 artisans. Between 550-1,200 people will be housed 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 that can 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 determine the most profitable use in small enterprises. The projected annual output of the technology is 1.4 million bricks.

Achievements Findings:

The first phase of the project has documented the output rates, strengths, and weaknesses of several models of clay crushers and block presses. The results are being used to define a commercially viable brickmaking operation. In addition to testing the equipment, clay from several sites has been analyzed to locate a clay with desirable characteristics that is available in sufficient quantity.



IMPROVED FIREBRICKS are used to build small-scale pottery kilns in Tanzania.

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 commercial viability of small-scale village potteries.

Expectations:

During the three-year project period, this project will create 45 jobs in rural areas and result in capital formation of $34,000 in village pottery industries.

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 marketability and value of pottery products.

Achievements Findings:

The project successfully produced firebricks from locally available material. Orders for the firebricks have come from as far away as Zanzibar and the Seychelles. The Tanzanian Ceramics Association, organized by the project, has trained four new rural pottery producers in glazing techniques using the firebricks. These potters are buying their materials from Sheriff Dewji.

Oil Press Production, Tanzania

Project Partners:

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

Purpose:

To capitalize a private factory in Tanzania to enable the manufacture of affordable, hand-operated sunflower seed 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, more than 5,000 families will increase their income by a total of $172,000 annually through the increased cultivation of sunflowers on idle or under utilized land and the sale of sunflower seeds at higher prices.

Technology:

Two types of oil presses, initially developed and tested at the University of Dar-es-Salaam, will be manufactured. The presses are made from common mild steel and can exert 20 to 80 tons of pressure, producing 1½ and 2 gallons of oil per hour respectively. The press is the first practical, easily maintained oil press to be manufactured in Tanzania at an affordable price.

Achievements/Findings:

Based on market assessment, a smaller, less expensive hand-operated press was developed by the project partner and AFI staff to complement the two larger presses. Rural oil pressing is now being carried out by low-income groups who otherwise would have been unable to process their own cooking oil. Twenty-five oil presses of all three types have been produced by Themi, and are being used for oil extraction in rural areas.

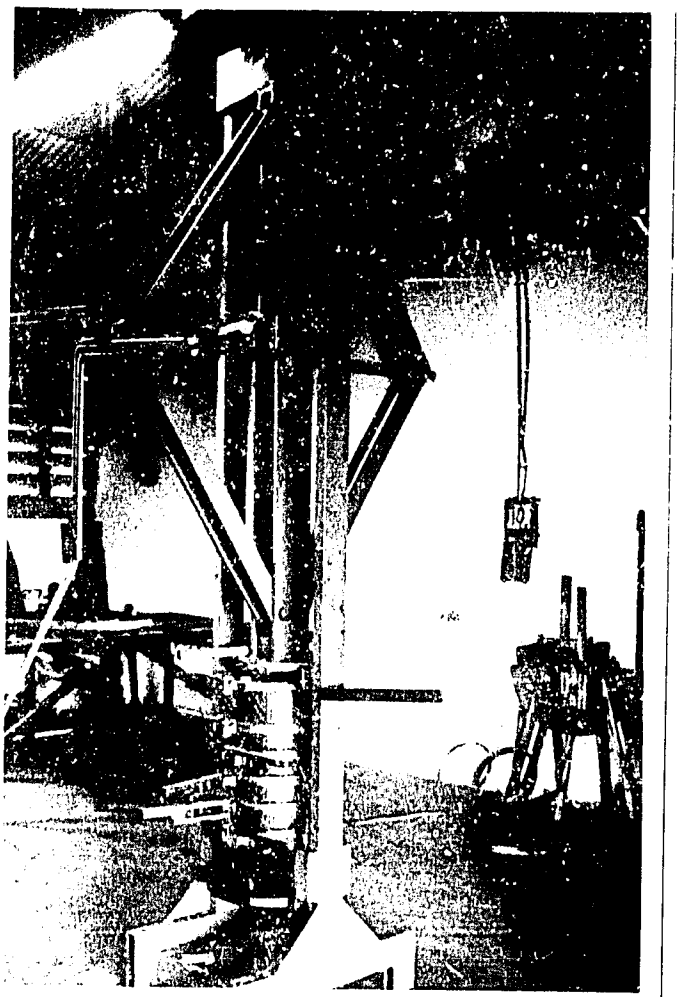
Village Oil Processing, Tanzania

Project Partner:

Evangelical Lutheran Church in Tanzania,
Lutheran World Relief

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.



THEMI FARM IMPLEMENTS & Engineering Co. is manufacturing three types of sunflower oil presses in Tanzania.

Expectations:

Nine oil extraction enterprises 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 more t. an 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 Tanzania Oil Press Production project described earlier.

Achievements/Findings:

During the first six months of processing, 3,346 liters of high quality sunflower oil were extracted in 8 villages. Most of this was for home consumption.

Hydro-Powered Grain Mills, Zaire

Project Partner:

Société de Développement Rural du Zaire (SODERZA)

Purpose:

To introduce hydro-powered milling using crossflow turbines, by (1) constructing two experimental installations, (2) consolidating and upgrading two existing systems, and (3) establishing the commercial manufacture and installation of turbines and mills.

Expectations:

Each of the ten mills is expected to provide indirect income and consumers' surplus benefits to peasants from family sales of milled cassava totaling $12,480 per year, if only 17% of the output is marketed. In addition, each mill should save a minimum of 1,000 labor hours per week normally devoted to the traditional milling of cassava. During the three-year life of the project, 35 jobs and capital formation totaling $107,060 will be created in rural areas. If the technology proves commercially and technically viable, it will have positive implications for energy use in the region.

Technology:

This project will test the use of hydro-technology as a power source for milling through direct drive, a technology that has not been extensively developed or applied in rural areas of the country. The technology employed in this project is a combination of a locally-made hammer mill linked to a cross-flow turbine. The proposed technology is low-cost, produces high quality flour on a single pass, and is easily manufactured, maintained, and repaired. The cross-flow turbines have a medium head capacity and are adaptable to a wide range of flows.

Achievements/Findings:

Two experimental installations were constructed and two existing sytems were consolidated and upgraded. The initial cost of producing the turbines was higher than anticipated. However, by replacing imported bearing housings with its own aluminum castings from scrap, SODERZA has significantly reduced the cost of turbines. SODERZA and ATI developed a hand-operated punch press, also made from scrap, to manufacture the turbine rotor disks, a crucial part of the turbine. This improves the quality of the turbine and saves considerable time. An interim evaluation concluded that many families in areas where the mills have been installed have increased their incomes by selling cassava.

CANAL which carries water to power the mill has been constructed in Miti village, Zaire.

Agro-industries, Zimbabwe

Project Partner:

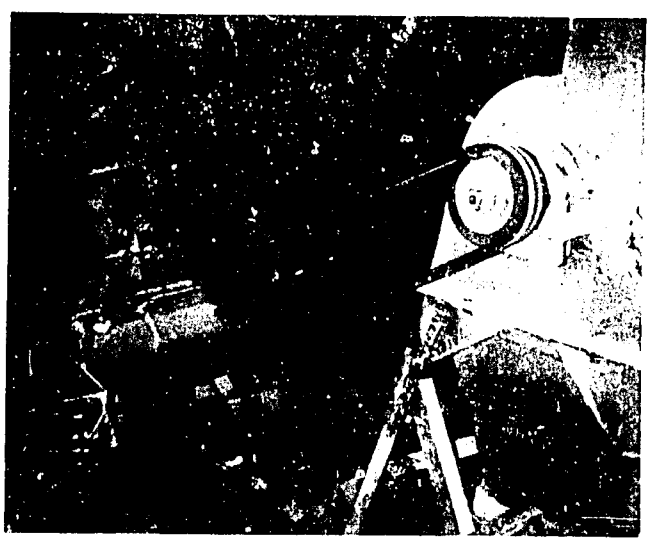
Foundation for Education with Production (FEP)

Purpose:

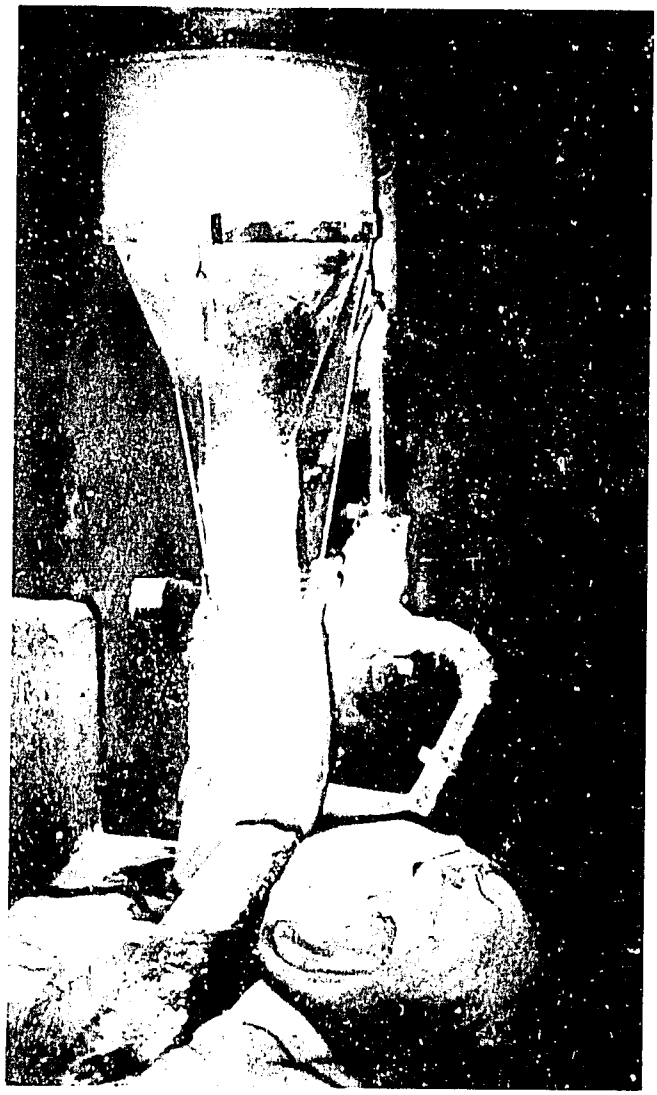
To diversify and expand the economic base of a farming cooperative in Zimbabwe by establishing agro-industries that provide direct and indirect income and employment for the rural poor.

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%.



TURBINE and HAMMERMILL are technologies employed in the hydro-powered grain mill project in Zimbabwe.



MAIZE mill is one agro-industry which is expanding the economic base of a farming co-op in Zimbabwe.

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.

Achievements/Findings:

A maize mill and a general store are in business and report strong sales. A third unit, a bakery, has been closed due to lack of flour, but may soon reopen. A fourth, a replication of the ATI Sunflower Oil Press from Tanzania, is expected to be under way in 1987. The quality of management and bookkeeping in the production units rose substantially during the year.

ASIA PROJECTS

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 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 linkages 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.

Achievements/Findings:

One venture was established—a shrimp hatchery. YDD invested $35,000 in this venture. Within nine months after operations began, the venture partner purchased all outstanding shares.

After exploring other possible ventures, it became apparent that administrative requirements of small-scale ventures in Indonesia needed to be adjusted to conform to Javanese culture. Traditional customs view written contracts with suspicion. Agreements are made verbally before a village headman or in a mosque. Based on these and other experiences, the project has been redesigned to use venture capital to promote a single technology—shrimp production.

Revised Purpose, Technology, and Expectation statements follow:

Purpose:

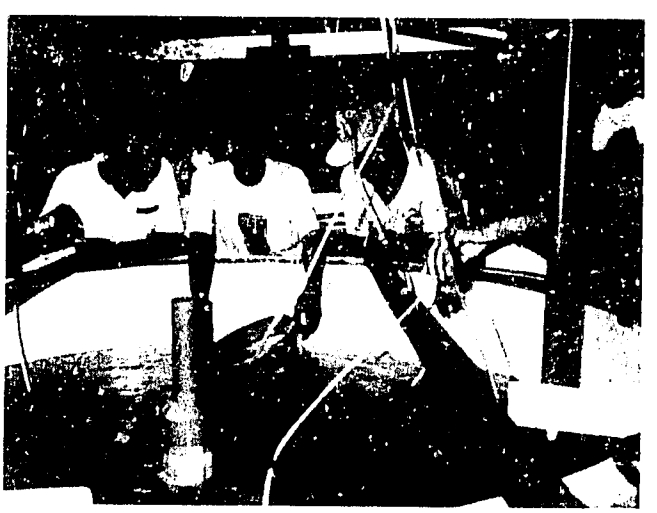
To demonstrate a delivery mechanism using small venture capital investments and a vertically integrated service company to promote YDD-tested shrimp raising technologies. Small pond (tambak) owners will increase their incomes by producing quality products for the domestic and international markets.

Expectations:

Upgraded pond management may increase production by as much as 100%, thereby benefiting the 40 small pond owners. A shared profit/risk financing arrangement should attract many small pond owners to adapt the upgraded pond management technology. Laborers will be hired to assist each participating farmer; thus more than 40 jobs will be created.

Technology:

The project will test the economic and social impact on small pond owners of a vertically integrated approach combining a hatchery, financing through profit-sharing, technical assistance, and a feed production unit. Technology dissemination will include initial introduction of the medium-density improved shrimp culture and management techniques developed by YDD; funding through a shared profit/risk arrangement with small pond owners; marketing and technical assistance; and a continuous supply of quality shrimp fry and feeds.



SHRIMP RAISING TECHNOLOGY, developed and tested by YDD in Indonesia, will be promoted via venture capital investment and vertically integrated service company.

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 invested 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 boiling methods and, if successful, expand to other products including soap, dried fruits, vegetables, and spices. Although water turbine technology has been widely and successfully tested in the hill region 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.

Achievements/Findings:

Water turbine and complementary milling and oil expelling equipment were installed. A village cooperative consisting of 300 families in the project area has been established. The heat generator unit has been manufactured and is undergoing testing and modification.

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 provide a reliable supply of high-quality yarn at a competitive price to the hand-knotted carpet industry.

Expectations:

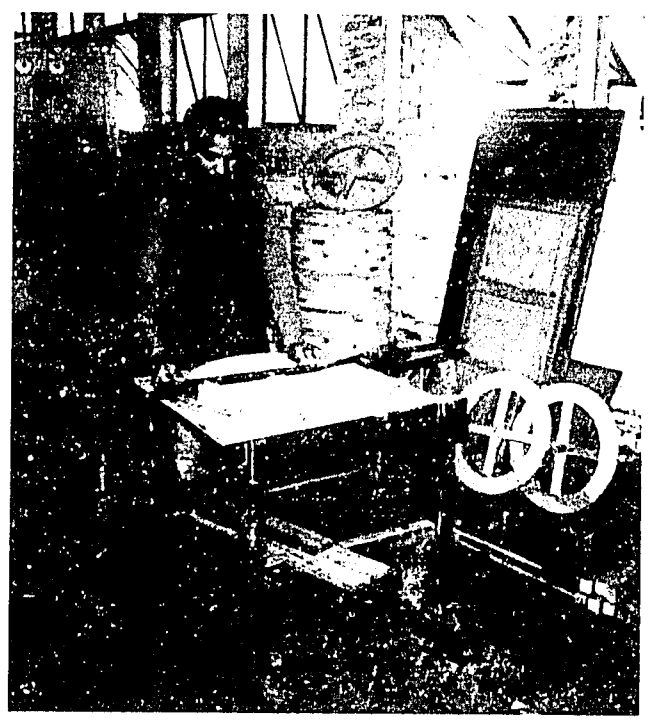
If successful, the project will establish 40 wool spinning enterprises, employing over 800 cottage industry producers. After three years, annual income of the 800 women employed will amount to $117,572, which compares favorably to total annual income of $52,000 using traditional methods of spinning.

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.

Achievements/Findings:

A mid-term evaluation of the project indicated that the projected small-scale spinning enterprises would not be commercially viable. This finding, when combined with the difficulties that emerged in relations between ATI and ACP, led to the early termination of the project.



IMPROVED SPINNING WHEEL was built by Nepalese carpenter.

Industrial Salt Production, Philippines

Project Partner:

Filipinas Foundation, Inc. (FFI)

Purpose:

To demonstrate that small producers, using improved solar salt production techniques, can substitute costly imports with locally produced, high quality salt products and basic chemical by-products for household and industrial consumers.

Expectations:

This project will demonstrate the potential foreign exchange savings to be gained from development of the local solar salt industry in order to produce local products which can substitute for imports. The yield per hectare of salt works will increase from 15 to 27.5 tonnes/hectare. Incremental income increases to industrial salt producers are expected to be about $1,280 per hectare, assuming a price difference of $1.60 per 70 kg bag between crude and industrial salt, and about a 50% per hectare yield increase. Two additional jobs can be created for each hectare used in industrial salt production due to anticipated higher yields per hectare. In addition, the costs and benefits of processing marine chemicals from waste bitterns will be examined.

Technology:

This project will introduce an improved method of small-scale salt-making into the Philippines. The improved method is more economical and results in a salt product which is cleaner and more dense. In addition, compact crystals with a purity of 95% and above are achieved. Major differences between the improved method versus traditional methods include: (1) a rigid process control in which the flow of water is channelled through successive ponds so that the salt concentration rises in controlled stages, thereby reducing the percentage of magnesium and potassium salts in the final product; (2) the use of the more economical "multiple irrigation system," i.e., the repeated flooding of brine onto the crystalizers to make up for evaporation loss and the release of bittern at regular intervals; (3) the release of brine onto the crystalizers at deeper levels (5-6 cms. vs. 1-2 cms.); and (4) the possibility of processing marine chemicals from waste bitterns.

Achievements/Findings:

A technology assessment, conducted prior to beginning the project, indicated that the proposed technologies would not achieve their intended purpose. Therefore, this project never materialized.

Organic Fertilizer, Philippines

Project Partner:

Filipinas Foundation, Inc. (FFI)

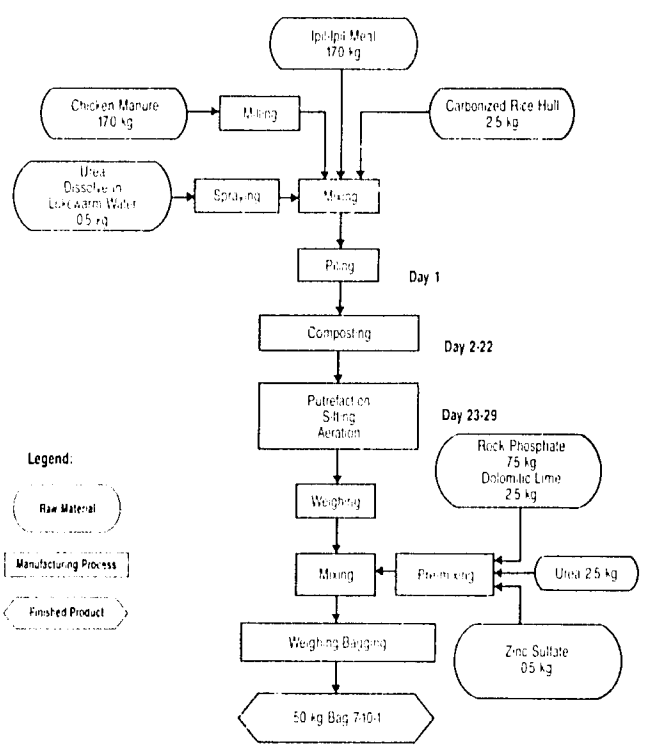
Purpose:

To demonstrate the commercial viability of decentralized, small-scale production enterprises, which deliver a stable organic fertilizer product of consistent quality and at a reasonable cost. The intended market is small-scale rice and corn farmers seeking to lower production costs and increase yields.

Expectations:

This project will generate additional income benefits to small poultry farmers, Ipil-Ipil (*Leucaena leucocephala*) leaf gatherers, and rice and corn farmers. Rice and corn farmers can realize between $14 - $24 savings per hectare through reduced fertilizer costs. Yield increases of up to 20% can be realized over the short term, increasing gross revenues by approximately $86 per hectare. Each of the 40 proposed fertilizer plants will employ at least 10 people, thereby creating at least 400 jobs in rural areas. The project will also stimulate foreign exchange savings by decreasing the need for imported chemical fertilizers.

PROCESS FLOW FOR 7-10-1 FERTILIZER



Technology:

The project will verify the production technology for "Anihan 2000" fertilizer and test the efficacy of the resulting organic fertilizer products. The least-cost formulation of the product will be developed through (1) strict quality control of the raw materials used at present, and (2) the substitution of various agricultural wastes which have little or no commercial value. The Anihan fertilizer technology depends on the composting of specified animal waste, plant biomass, and minerals under controlled conditions to ensure a reliable product of consistent quality. The technology overcomes the major problem associated with organic fertilizer manufacture — variable nutrient composition — by standardizing the raw materials used and tapping a single source of dolomite and rock phosphate minerals, the quality of which will be monitored through chemical analysis.

Achievements/Findings:

The plant has been commissioned. FFI has developed three new least-cost fertilizer formulations for use primarily with corn and rice crops. New products are being test marketed. Farm trials utilizing new products have been undertaken to determine efficacy under field conditions.

Rural, Small-Scale Industries Development, Philippines

Project Partner:

Filipinas Foundation, Inc. (FFI)

Purpose:

To test a rural small-scale industries strategy designed to create jobs and increase incomes of poor people. Manufacturing enterprises will be established 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 more than 30,000 farmers would increase their incomes through raw materials supply or through reduced cost of commodities produced. If such outputs are achieved, preliminary estimates indicate that $1.46 in direct and indirect economic benefits will result from every $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 10% decrease in their transport and milling costs. Company profits over a 5-year period will total $19,086.

MUSHROOM ENTERPRISE in Philippines employs 14 full-time and 5 part-time workers, such as Edite Geneyani, part-time mushroom packer. Business expects to enter contract grower stage shortly.

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.

Achievements/Findings:

Feasibility studies indicated that agar-agar processing and village rice milling would not be commercially successful. The mushroom enterprise has achieved a positive cash flow after one year of operation. It projects a net profit of $4,500 for 1987 and could begin paying dividends by the end of year three. The mushroom and spawn substrate production enterprise employs 14 full-time and 5 part-time workers and expects to expand to the contract grower stage shortly.

Wet coconut processing is the newest small-scale rural enterprise financed by the project. This enterprise uses an improved version of the traditional wet processing method to produce coconut oil, soap, charcoal, animal feeds and vinegar for local consumption. Expectations are that 15 jobs will be created in each village-scale coconut processing plant; annual profits of each plant will range between $12,000 and $15,000. At the end of five years, coconut farmers employees will own at least 30% of the stock in the plant. The Philippine Ministry of Agriculture has committed Government funding for three village coconut processing plants.

MOTOR-RUN spindle graters scrape coconut meat from shell in wet coconut processing plant in Philippines. Each village coconut plant creates 11 jobs for unskilled labor plus four technical/administrative positions.

Cinnamon Processing, Sri Lanka

Project Partner:

Appropriate Technology Consultants (ATC)

Purpose:

To increase incomes of small-holder cinnamon producers by strengthening their competitive advantage in producing and selling processed cinnamon products. Traditional technology will be upgraded, marketing techniques will be improved and quality assurance procedures will be introduced.

Expectations:

ATC and the Ambalangoda Cinnamon Growers Association will establish a small-scale cinnamon processing company to commercially test the improved technologies. Improvements in extraction efficiencies will earn leaf oil producers $25 more per acre harvested per season. The incomes of 150 cinnamon growers/producers will increase 5-25%. Each plant will create 8-10 jobs; some of the small-holder cinnamon producers are expected to elect to take equity participation in the plant.

CINNAMON BARK is trucked to market in Sri Lanka.

Technology:

The traditional technology for distilling cinnamon bark and leaf oil has a low overall extraction efficiency, wastes fuelwood and results in a final product of inconsistent quality. Serious problems include inefficient condensation systems and poor firing techniques. The project will manufacture and test an improved still. An improved condensor will be introduced, increasing extraction efficiency 250% compared to the traditional bark oil stills and 27% higher than modern, stainless steel models. Firing techniques will be revised to reduce scorching and control the still's internal pressure and temperature. A number of additional design features will be improved to facilitate loading and unloading, oil collection and increased capacity.

Achievements/Findings:

A technical evaluation of the traditional cinnamon bark oil still is under way. A baseline data survey of cinnamon producers in Ambalangoda is being conducted.

IMPROVEMENTS in traditional cinnamon processing will benefit 150 small-scale growers/producers in Sri Lanka.

Computer-Video Training, Sri Lanka

Project Partner:

Dasuna Enterprises, Ltd.

Purpose:

To develop, test, and evaluate the application of computer and video-based training for the transfer of technical skills to rural villagers in Sri Lanka. The project will test the cost-effectiveness, sustainability, and impact of computer-video training on increasing the incomes of small-scale spice growers in 10 rural villages in the Matale, Kegalle, and Kandy districts.

Expectations:

If successful, this technology will have major implications for the transfer of needed technical skills to rural populations in other developing countries. This project will add value to the resources of more than 3,000 rural families by increasing their ability to produce higher yields and better quality spices. A spice-trading scheme will also increase the incomes of small-scale spice growers.

Technology:

This project will adapt an innovative education and extension methodology to the educational levels, skills, and conditions found in rural villages in Sri Lanka. The technology enables local specialists in spice cultivation, extension, village education, and communication to design and extend high quality education and training programs to rural areas of the country. The technology employed by the project consists of a series of training videos and computer-based lessons that teach basic skills in spice cultivation, harvesting, and drying. This method has proven very successful in transferring technical skills in a cost-effective manner in the U.S. This project represents the first attempt to test its effectiveness in transferring technical skills directly to rural populations in a developing country.

Achievements/Findings:

After a trial period, the spice-trading component of the project was dropped from the project plan. Experience showed that it was difficult for a new company to enter a market already controlled by established spice-trading firms. The project now devotes full attention to the training component. A Sinhala character set was developed using PLATO software for use on the computer. Computer lessons on spice processing and cultivation have been prepared to use in combination with videos and training manuals. Four educational video films on cultivation and processing of cloves, cardamom, pepper and nutmeg/mace were produced in Sinhala. Baseline data has been collected from 22 villages.

Mahaweli Rural Industries, Sri Lanka

Project Partner:

The Mahaweli Authority of Sri Lanka

Purpose:

To establish a private investment company to finance and operate joint ventures in small- and medium-scale industries which use innovative technologies to create jobs, build equity, and increase incomes of the rural poor.

Expectations:

Based on an analysis of the first four investments under consideration, the planned 12 investments will directly create 270 jobs. The effects of the project are estimated to be at least $2.00 in direct and indirect economic benefits for every $1.00 invested by the company during the first five years of operation. Owners' equity will also accrue to many rural producers who will own shares in the industries financed by the project.

Technology:

The Mahaweli Authority of Sri Lanka and ATI will jointly establish a private, limited liability company which will seek out venture partners (individual entrepreneurs, people's companies, producer associations, etc.) to establish industries related to agricultural product and waste processing, farm equipment, and local mineral resource utilization. The company will promote the commercialization of innovative technologies, balancing high risk projects with less risky ventures to assure the company's profitability. Investments will be made on the basis of comprehensive technical, commercial, and market feasibility studies.

Achievements/Findings:

The Mahaweli Venture Capital Company (MVCC) was incorporated and the first Board of Directors meeting was held. A manager of the investment company has been appointed. Business plans for initial investments in small-scale chili grinding, vinegar production and dairy products processing are being prepared.

Protein-Enriched Cassava, Thailand

Project Partner:

Population and Community Development Association (PDA)

Purpose:

To develop and commercialize a biotechnology, 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 low capital requirements and its labor intensity.

MOISTENING CASSAVA chips is the first step in protein-enriched cassava technology.

Achievements/Findings:

Consistent fermentation has been realized using a Koji-type bioreactor with yields of 11-12% (true protein) of protein enriched cassava. Protein contents of 25%+ achieved under laboratory conditions could not be duplicated in the field. The final product is a feed supplement rather than a complete stock feed. Extensive feeding trials with swine indicate no toxicity, and a good feed conversion ratio. Due to currently unfavorable market conditions for cassava in Thailand, the results of this research will be used in a commercial enterprise to be established in another country.

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 need for 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 to serve difficult to reach rural markets.

Achievements/Findings:

800 small farmers participating in this project have achieved 25-30% increases in soybean productivity. Some farmers report increases in soybean productivity of 70% ranging to a high of 167%; increased profits from soybean production in 1987 ranged from $100 to $300 per farmer. The technical feasibility of small-scale decentralized production of rhizobium inoculant has been successfully demonstrated.

MALEE SUWANA-ADTH, SVITA's Executive Director, examines bags of aseptic growth medium inoculated with rhizobium that are ready to be sold to local soybean farmers.

Rural Small-Scale Industries Program (RSSI), 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 by 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 benefit from 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.

Achievements/Findings:

Feasibility studies for powdered pepper processing and shrimp paste manufacturing indicated these ventures could not be commercially successful. Additional feasibility studies resulted in establishment of the following small-scale industries:

Bamboo grass mat production: 300 rural subsistence-level farm families are participating in the project; Thai Bamboo Plait Industries (TPI) has diversified the product line to include place mats and window blinds.

Environmental Sanitation Materials Plant: This joint venture among village associations, the PDA-owned Ban Pai Development Company and RSSI Co., will manufacture mortar blocks and other components used in construction of pour flush latrines. Majority equity ownership in the company will gradually be transferred to local village groups and/or individuals. Plant installation is complete and production is ongoing at 98.9% of target. During the first six months of production through 31 March, 1987 this company posted net operating profits of US $2,694.

Bamboo Shoot Processing: The business plan has been approved for small-scale processing and canning of bamboo shoots for export and domestic markets. More than 150 rural households will benefit from a stable market for produce and from earnings of equity shares held in the company. Annual company profits are expected to be $12,000 - $15,000.

LATIN AMERICA / CARIBBEAN PROJECTS

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 Linares Pump (cost $400) will irrigate one-third of an acre of land 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 in Ubaque, Colombia, and successfully tested in several other Latin American countries. 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 second.

Achievements/Findings:

Jesus Linares' pump was awarded first prize for product innovation by the Colombian Association for Small Industries in April, 1986. Nine of the 27 pumps manufactured by the Ubaque metal working shop were shipped to four Latin American countries. Señor Linares trained local teams on site in the assembly and installation of these pumps, which are serving as demonstration centers for local farmers.

LINARES PUMP, a stream-powered water pumping device for irrigation, is being demonstrated in four Latin American countries.

QUALITY OF LIFE improves for thousands of people in developing countries once they gain access to a wheelchair.

Wheelchair Production, Latin American Region

Project Partners:

Fundacion de Educación Superior (Colombia), Fundación Hondurena de Rehabilitación e Integracion del Limitado (Honduras), Centro de Rehabilitación Vocacional (Guatemala), Programa de Ayuda a Pequenas Empresas (Dominican Republic), CIPDEL (Peru), Ralf Hotchkiss & Associates (USA)

Purpose:

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

Expectations:

This project will establish at least 12 small-scale wheelchair production enterprises in 5 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 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.

Achievements Findings:

Ten small-scale wheelchair production enterprises have been established in five countries in Latin America. This project has been replicated in Sri Lanka and Zimbabwe and small-scale production facilities are expected to be established world wide. Four hundred chairs will be produced in 1987 in Colombia and two hundred chairs are expected to be produced in Peru. In Colombia Carvajal Fundación and the Corporación Regional de Rehabilitación del Valle de Cauca instituted a consumer credit system that enabled more than 150 low-income individuals to purchase the chair in 1986. An entrepreneur in the Dominican Republic who only received training has been able to finance a small production facility. Smaller projects in Guatemala and Honduras will continue to produce in accordance with local market needs. The wheelchair manual, *Independence through Mobility* is being translated into Spanish.

Lime Kiln Technology, Costa Rica

Project Partners:

Instituto Tecnológico 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:

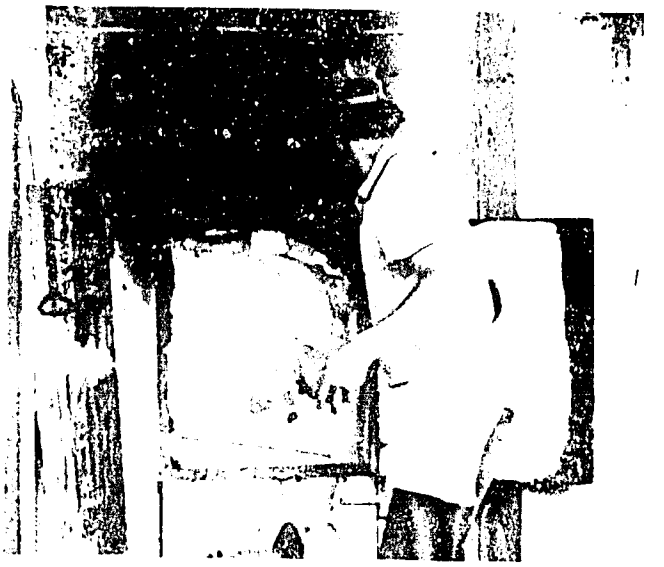
More than a thousand people who work in the industry will increase their incomes due to a higher sales volume of good quality lime and direct savings in energy costs from a reduction in the consumption of firewood and imported lime. Results of the project will be documented and disseminated to enable replication of the technology in other parts of Central America and the Caribbean.

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.

Achievements Findings:

The ITCR has developed an innovative kiln design that enables batch and semi-continuous lime production. A prototype kiln was constructed in Patarra using the structure of an existing shaft kiln, and an experimental mechanized hydration facility was built. Based on results of production trials and a technical evaluation, modifications are being made to the prototype. Commercial production, using the new design, is expected to begin by the end of 1987. In 1988, ATI will finance four small-scale lime enterprises which will use the improved design. This project has already resulted in improved lime kiln designs in another ATI project in Botswana.



FIRING TRIALS have been conducted in prototype kiln in Costa Rica.

Swine Feed, Dominican Republic

Project Partner:

Centro de Investigación y Mejoramiento de Producción Animal (CIMPA)

Purpose:

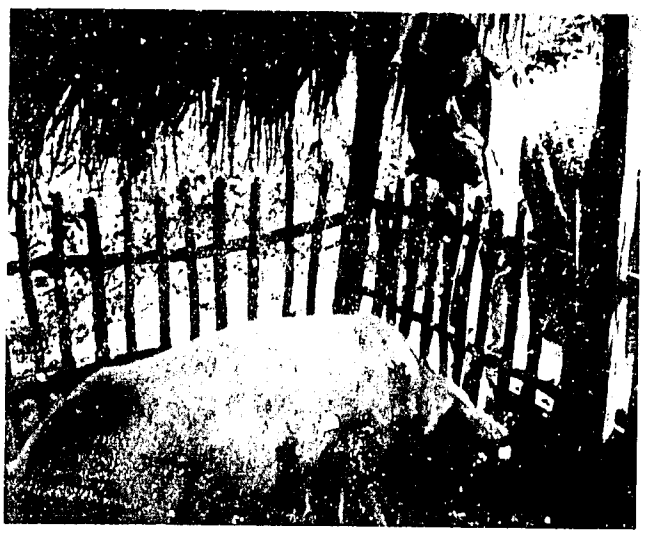
To establish a commercial system to improve the availability of specific feed ingredients and related inputs to small-scale swine producers.

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 such as farmer cooperatives and agricultural supply stores, 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, ramie



IMPORTED PIGS are being profitably fattened by 900 small-scale farmers participating in the DR Swine Feed project.

introduced from Asia), 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.

Achievements/Findings:

To date, 900 small farm families have increased their income by an average of $125/yr., exceeding project expectations by 66%. Small farmers are planting ramie and view this as an additional locally grown nutritious pig feed component. The number of small rural shops selling feed (20) is double the original project goal — an indicator of both demand and profitability. The farmers report a weaned pig average of 8 — approximately the average in developed countries.

The project has proven conclusively that the large exotic pigs, imported after the swine fever eradication program, can be profitably weaned and fattened by large numbers of small-scale farmers using a selection of locally produced feed components.

Wool Production and Processing, Guatemala

Project Partners:

Fundación Para El Desarrollo Integral de Programas Socioeconómicos (FUNDAP). The project has been funded as a joint venture by ATI and U.S.A.I.D./Guatemala.

Purpose:

To demonstrate the effectiveness of a system of improved small-scale wool production and processing technologies which will increase the quantity and quality of wool supplied to the weavers of export quality artisanal wool products. The wool products will be marketed through a commercial enterprise owned by the artisans.

Expectations:

One thousand Guatemalan highland families who depend on sheep for their livelihood will increase their incomes from sale of wool from $90 to $250 per year. Wool production in the highlands is expected to double; 100 wool spinners will double their output and triple their incomes; 300 weavers will triple their incomes, a result of increased output of export-quality products sold by the new marketing enterprise. In addition, more than 20,000 subsistence farmers who raise sheep in addition to grain will increase their incomes because of the improved sheep and available technology.

Technology:

Twelve technical assistance centers will be established in the highlands. Through the introduction of improved breeding stock, establishment of artificial insemination technology, selection practices, and improved feed technology, the quality and quantity of the wool obtained from the sheep will be increased. Improved shearing technology, the introduction of a wool classification system and scouring technology will enable farmers to deliver a better product. Drum carders to replace laborious hand carding will be introduced and produced locally. The traditional hand-operated spinning wheel will be modified with a flyer bobbin to enable spinners to increase yarn output. Market assessment and strategy formulation, marketing techniques, and a quality control system will be incorporated into the artisan enterprise.

Achievements/Findings:

Implementation of this project has just begun, so it is too soon to list achievements and findings.

WOOL PRODUCTION in Guatemalan highlands is expected to double as a result of ATI/U.S.A.I.D. Wool Production and Processing project.

Cassava Processing, Haiti

Project Partner:

Société 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, (1) at least 200 hectares of marginal lands will come under cassava cultivation (2) 300 to 400 small-scale farmers in the area of the plant will have a new market outlet for cassava, and (3) 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 village-scale production plant envisaged by this project was designed to incorporate an improved mechanical peeling device, a mechanical chipper, a small hydraulic press, improved solar drying chambers and a hammermill.

Achievements/Findings:

ATI terminated this project when the enterprise failed to materialize; the equipment was acquired but never used. The major problems resulted from lack of management and lack of organization. The project participants, living in a remove rural village, did not understand nor share the project goals, set by the implementing organization located in the Haitian capital. This project outcome points out: 1) village technology projects such as this one must be consistent with the economic development goals of the participants; 2) on-site project management is essential for successful project implementation.

Farm Support Enterprises, Mexico

Project Partners:

Centro de Enseñanza, Investigación y Capacitación para el Desarrollo Agrícola Regional (CEICADAR) and Colegio de Postgraduados de Chapingo

Purpose:

To establish 21 rural micro-enterprises in the temperate zones of Mexico. These businesses will provide the equipment, supplies, and services required by small farmers to support improved farm production technologies.

Expectations:

Ten feed distribution enterprises will be established to provide a high-protein feed to small farmers engaged in milk production. Each enterprise will serve an average of 30 farmers, each of whom owns from three to ten milk cows. Six nurseries will provide 28,000 budded certified fruit trees annually to 750 farmers. A medium-sized manufacturer will be contracted to produce 400 animal-drawn corn planters for sale or rental through the project. In addition, two machinery service stations will be established to provide mechanized forage harvesting and processing services to small farmers. Two small cheese production plants will also be established. In total, over 1,000 farmers will increase their incomes through the improved production practices made possible by the sale of necessary inputs. In addition, 48 jobs will be created in rural areas and $82,000 in profits will be generated annually by the 21 micro-enterprises.

Technology:

This project links an effort to develop and disseminate improved farming systems with the rural based enterprises required to sustain these systems. The enterprises to be established by the project are based upon the improved farm production technologies developed by CEICADAR's farming systems group. These production technologies include:

One-row animal drawn corn planter/fertilizer: Per season, this planter saves eight days of planting labor per hectare and two days of fertilizing labor compared with hand planting and fertilizing. Fertilizer is more evenly placed and higher plant populations are achieved.

High protein feed for dairy cows: The Colegio has developed a high protein feed for dairy cows that are usually fed on rations containing a high cornstover content. This feed uses molasses and carriers of nitrogenous waste materials, such as chicken manure, as protein substitutes. The supplement

MULTIBAR'S MANY USES make it an invaluable tool for Mexican farmers.

reduces feeding costs by 45 cents per cow per day relative to traditional rations.

Achievements Findings:

The Bank of Mexico, which is managing the project farm support enterprise loan fund, has agreed to add its own funds to the loan pool if the lending experience during the first part of the project is successful. The Bank was persuaded to change its lending criteria: it now grants loans to individual farmers whereas previously loans were made only to cooperatives.

The corn planter has been significantly modified into a multipurpose field tool, called a multibar, with attachments for a reversible plow, a harrow, a corn planter fertilizer applicator and a wheeled cart for animal drawn transport of the attachments to the field. The prototype multibar has been enthusiastically received by the small farmers in field trials and is now ready to be manufactured. The multibar costs the equivalent of the average revenue from sales of half a hectare of one year's corn yield.

The first fruit tree nursery has been established and has exceeded targets to date: 12,000 seedlings germinated, 5,000 improved pear stakes rooted and 500 grafted high quality young fruit trees are ready for sale.

The pilot dairy feed plant has been established and is selling chicken manure mix and molasses to 45 small farmers who own an average of three cows each. Pilot tests of rations show animals maintaining or increasing volume output during dry season (the main purpose of the feed). In addition, butter fat content of the milk is increasing slightly due to more efficient processing in the rumen.

Annatto Production, Peru

Purpose:

To (1) establish a commercially viable achiote processing plant that produces export-quality annatto food colorant, (2) introduce new techniques for cultivating achiote trees from which annatto is obtained, and (3) introduce a newly developed technology for hulling achiote seeds for processing.

Expectations:

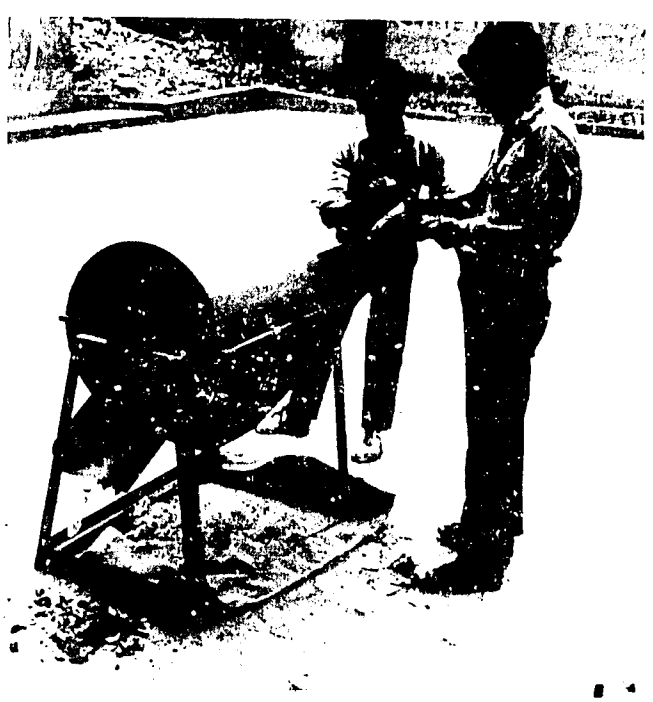
By the third year of the project, more than 1,800 small farmers in Cuzco will increase their yearly incomes by approximately $150 through a 35% increase in the prices paid for raw achiote seed. By the third year $330,400 in profits will be available for reinvestment and dividend payments to small farmers who are shareholders in the processing plant. The project will create a total of 20 full-time and part-time jobs in the first three years. Reflows from the project will be used to establish a fund to promote subsequent economic development projects with the rural poor in the Cuzco region.

Technology:

This project introduces an annatto processing technology into the Cuzco region of Peru which will increase the incomes of the rural poor from sales of achiote. Relative to processing plants located in Lima, this plant will benefit from a guaranteed source of raw seed and lower transport costs for seed. In addition, the improved process design allows for an increased extraction efficiency, and an improved filter captures one-third more colorant than existing designs. This is the first attempt in Peru or elsewhere in South America to locate an achiote processing plant in a rural area so that a greater proportion of the benefits accrue directly to the small farmers who grow the seed.

Achievements Findings:

The dehuskers have been installed in several communities, and appear to be helpful in speeding up achiote husk removal. The critical element of annatto, the bixin, has been recovered in increasingly higher concentrations, raising the output's market value substantially. Improvements have been incorporated at the processing plant in Cuzco, especially in the filtering and drying stages. Because they have a ready market for an increasingly valuable crop, some of the co-op members are dedicating more of their arable land to achiote production. Thus far, management difficulties have prevented sale of the pigment from reaching its full potential. ATI looks forward to working with a new project partner to continue the project and to replicate the technology in several areas in Peru as well as in other countries in Latin America.



DEHUSKERS speed removal of achiote shell. Achiote is source of annatto, a food colorant used primarily in the dairy industry.

Placer Mining Equipment, Peru

Project Partner:

Comité de Economía y Desarrollo de las Comunidades Campesinas de Acora (CEDCA)

Purpose:

To introduce new ore processing technologies for recovering minerals and to improve the mining infrastructure of the Mining Cooperative Santiago de Ananea.

MINING CO-OP MEMBERS in Peru are expected to increase their incomes by an average of $225/year as a result of the placer mining project.

Expectations:

The mining cooperative will process five times its present capacity of ore per day. The 65 members of the mining association will increase their incomes by an average $225 per year from increased wage payments and dividends. The project will also create up to 60 new mining jobs within the Cooperative. CEDCA will establish a Technology Assistance Fund, comprised of an information center and loan fund, to help disseminate mineral processing technologies and to assist small-scale miners in Southern Peru to purchase new mining equipment.

Technology:

This project will employ trommels, sluices, riffles, and monitors. The equipment, initially developed in the United States, has been adapted to meet the specific requirements of the project area. The small-scale trommels will be the first to be adapted for use by small-scale mining concerns and introduced for commercial application in Peru. Small-scale monitors and riffles will be significantly improved over existing models. The improved processing technology will increase the mineral recovery rate from 60% to 90% and increase the daily throughput fivefold. Improvements will also be made in the Cooperative's hydrological infrastructure. This technological package will be tested and disseminated to other parts of Peru.

Achievements/Findings:

The recovery rate at the first mine has increased between six and ten times, doubling the value of the shares held by the 50 mining co-op members. Much of the proceeds have been reinvested in additional equipment to expand the site, and a larger mining concession has been granted by the government ministry involved. The cooperative members, many of whom had previously worked in individual, isolated sites, now work together as a true co-op. A number of neighboring communities have visited the site and expressed interest in replicating the technology.

Potato-Based Foods, Peru

Project Partner:

Centro Ideas

Purpose:

To demonstrate that it is commercially and technically feasible for small-scale rural enterprises to produce potato-based foods for low-income urban consumers.

Expectations:

Four processing plants which produce a variety of potato-based foods will be established in rural areas. Using production levels established during the first three years of operation, each plant will generate profits of approximately $11,000 by adding value to potatoes and other agricultural products such as barley, broad beans, corn, wheat, and quinoa. Introduction of potato-based products into the diets of low income urban residents will deliver substantial nutritional benefits at a lower cost than alternative sources. The project will enable low income urban consumers to save approximately $332,000 by purchasing potato-based foods in place of comparable substitutes. Forty-eight new jobs will be created in rural areas. In addition, the project will increase the incomes of 120 producers of potatoes and grains by approximately $97 a year by providing guaranteed, easily accessible markets for their products and by reducing transport costs.

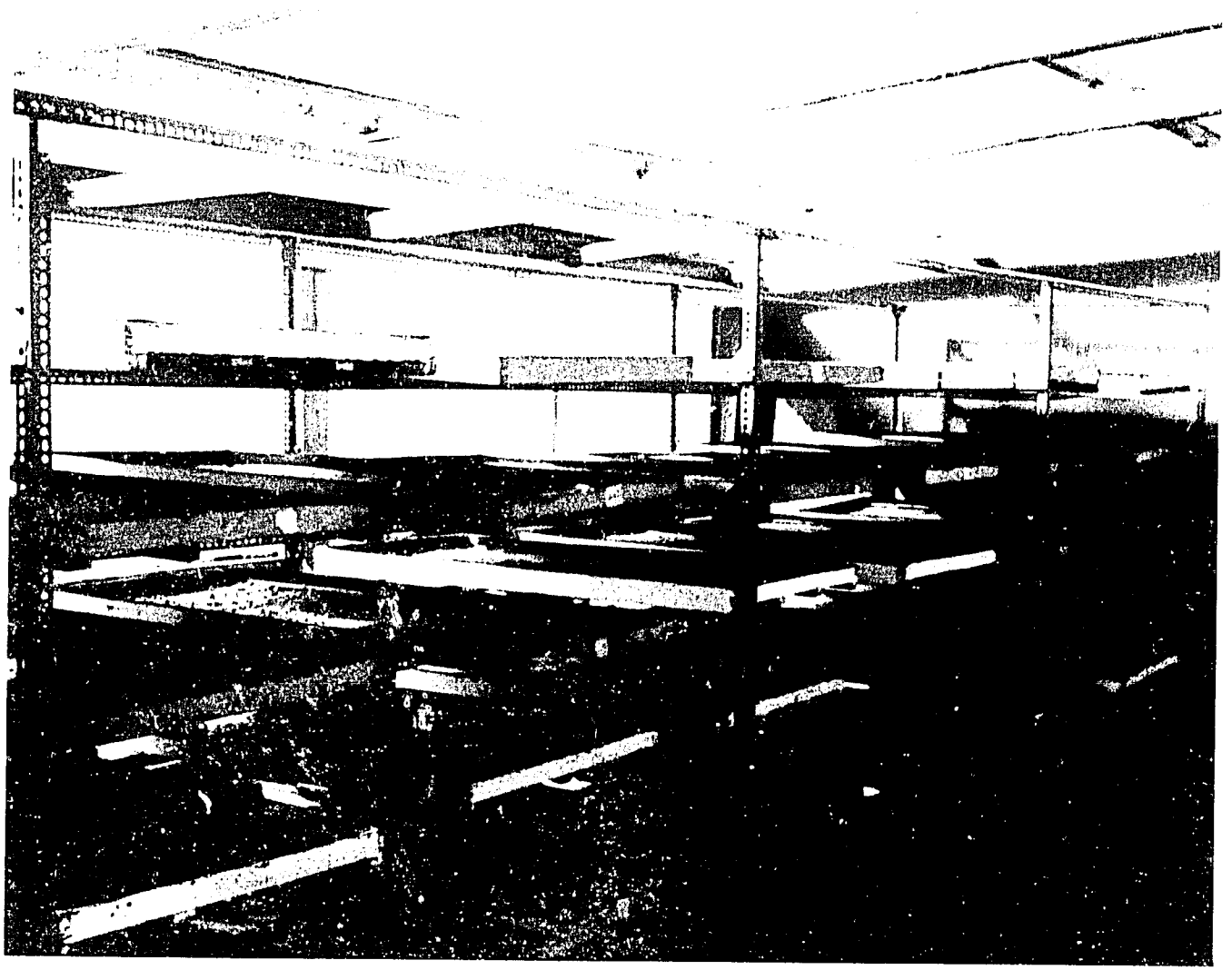
Technology:

The project will introduce commercial potato processing technologies to different regions of Peru. The specific technology, which combines the processing of potatoes with other grains and legumes, was developed by the Centro Internacional de la Papa (CIP). CIP simplified the processing equipment while maintaining efficiencies and reducing investment costs. The basic potato-based food to be produced is known as the M-6 formula. This product has a high protein and calorie content, supplying up to one-third of the

major nutrients required daily by children. This dehydrated product can be used in the preparation of puddings, desserts, soups, stews, and beverages.

Achievements Findings:

A thorough review of the International Potato Center (CIP) experimental plant was conducted. The land on which the factory is located was acquired, licenses were obtained and infrastructure required was developed. The pilot plant in Huancayo was completed, equipment was installed, and test runs were conducted. Following extensive taste tests, a variety of final products and recipes were selected. Neighboring rural communities were incorporated into the raw materials supply system. The plant will begin commercial operations by the end of 1987.



PROCESSING PLANT in Peru produces a shelf-stable, pre-mix food made from potatoes, legumes and cereals.

Mini-grants Play Vital Role in Project Planning

Mini-grants—small grants for amounts usually less than $5,000—are a critical part of ATI's development process. Before ATI commits itself to supporting a major development project, it often issues these mini-grants to determine the economic, commercial and technical feasibility of a particular appropriate technology. Mini-grants may be used to manufacture a prototype, to test and evaluate a particular technology, to determine the need potential market and or applicability of this technology, to collect data, both financial and socio-economic relevant to a current technology. Sometimes, although a technology has proven commercially viable in a particular geographic region, ATI requires an assessment of the technology's applicability in another locale, proposed as a replication site. Finally, ATI issues mini-grants to support workshops to assess interim and final results of a specific project, to further refine or alter technology within an already funded project, and to support short-term technical and/or managerial assistance.

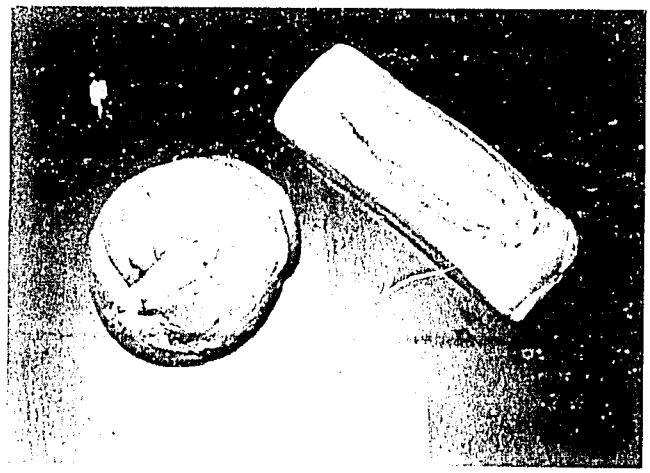
A brief description of selected mini-grants issued during the last year follows:

Barangay Teknolohiya (BATEK), Philippines, $4,778

Purpose: To investigate the technical, commercial, and organizational feasibility of establishing five rural food processing industries known as the Integrated Food Processing System (IFPS) in the Philippines.

The IFPS emphasizes the 100% utilization of raw material inputs and multiple product outputs produced or partially processed either by household producers or in small-scale plants. This study was undertaken prior to developing a project involving a number of alternative modules for different crops which will test the IFPS approach.

Although the final report presented five separate feasibility reports on specific processing modules—coconut, fish, banana, pineapple and mango—it did not analyze the IFPS concept for 100% utilization of raw materials input in small-scale food processing industries. ATI was not provided with sufficient information on which to base an informed judgment as to whether to proceed further with the IFPS concept.



A MINI-GRANT which funded a feasibility study on producing baked goods made from composite flour resulted in a grant.

ENSIAAC, Cameroon, $4,790

Purpose: To conduct a feasibility study on the viability of making bread from composite flour and producing it on a commercial basis. The encouraging results of this study, along with specific recommendations for commercial application, and voluminous data, were incorporated in the project plan to produce composite flour goods.

Environment Development Activities, Zimbabwe, $5,000

Purpose: To determine the economic, commercial and technical feasibility of having small artisans in the informal sector produce mini-grain dehullers for sorghum.

This grant would have replicated, in Zimbabwe, the mini-dehuller demonstration project being implemented in Mali. After four dehulling machines were fabricated by a local workshop, ATI concluded that the proposed project partner's interests were not centered on commercializing the technology and catering to the demands of Zimbabwean consumers.

Botswana Technology Center, Botswana, $5,000

Purpose: To determine the economic, commercial and technical feasibility of very small-scale (less than 20 tons per day) portland pozzolana cement production in Botswana.

At present, pozzolana cement is produced in Botswana and mixed with imported portland cement. The study concluded that it was not possible to produce on a small-scale in Botswana an ordinary portland cement equivalent at a price competitive with imported portland cement. However, it may be feasible, at another project site, to introduce a pozzolana cement with a high proportion of local ingredients. As a result of these recommendations, ATI decided not to support a follow-on project.

SODERZA, Zaire, $5,000

Purpose: To determine the economic, commercial and technical potential of low-moisture brick pressing technology for use by small-scale brick producers in eastern Zaire.

A Ceraman II brick press was imported from Belgium. The grantee was to train artisans in the use of this press and evaluate plans for a subsequent project which either would involve local manufacture and sale of the machines or construction of a more sophisticated factory.

The press was imported and demonstrated to informal sector brickmakers near Bishalalo village. Although the villagers recognized the superiority of the new bricks, they did not wish to commit themselves to a new approach to brickmaking which would require much more clay processing, organization of effort, and some additional capital investment. The grant was closed before its expected completion date; SODERZA transferred the press, at ATI's recommendation, to its hydropowered grain milling project.

Mennonite Economic Development Associates (MEDA), Haiti, $4,840

Purpose: To field test and determine the commercial viability of transferring the Colombian village-based sisal bagmaking technology to Haiti, by establishing a pilot plant.

MEDA's report stated that the transfer of the technology and the training of the Haitian villagers by Colombians to operate and manufacture the equipment in Haiti, went remarkably close to schedule. Production levels suggested that viability was attainable although runs were over too short a period of time to give definitive projections. The report concludes that "production has been of a consistently high quality, and the MEDA Cacao project in Haiti has had no hesitation in buying sisal sacks from these new units." ATI's Evaluation specialist has also concluded that long-term prospects are positive for small-scale sisal processing in Haiti.

CMDT, Mali, $4,785

Purpose: To manufacture, reproduce and test a hammer mill, an animal-driven mill and a groundnut press (including training a blacksmith in these skills) in Senegal, and then produce and test them in Mali. Results of the field tests will determine the potential for commercial dissemination of these technologies in Mali. Training of the Mali blacksmith began in June, 1987.

G. North & Sons Oil Press, Zimbabwe, $4,900

Purpose: To produce, test and evaluate the manual ram-type sunflower seed oil press developed by ATI in Tanzania to determine whether this press is suitable for use by the Zimbabwean peasant farmer. Information gathered will help determine whether full-scale commercial manufacturing of the press is justified, and if so, by what type of producer. Information on production, mechanical reliability, payback period and consumer acceptance will be needed for replication of this technology in other countries.

The first ram press tested in Zimbabwe processed 3.5 tons of seed in 3 months, yielding more than 1,120 liters of oil. Earnings from the sale of this oil paid for the cost of the press.

MEDA received a small grant to field test the commercial viability of transferring Colombian village-based sisal bagmaking technology to Haiti.

Filipinas Foundation, Inc., Philippines, $3,000

Purpose: To conduct microbiological and nutritional laboratory studies on the Bureau of Animal Industry's fermented copra meal hog feeds formulation to determine its safety and efficacy for commercial farm operations. Laboratory findings suggest that further quality control measures must be introduced before the fermented copra meal would be safe to use as pig food. ATI's Agricultural Products Processing Specialist will try to resolve the quality control issues.

IRRI Conduction Dryer, Philippines, $7,000

Purpose: To support the field testing of various small-scale rice dryers, prior to consideration of a possible project to commercially produce the most efficient rice dryer. Both the Director of Asia Programs and ATI's Evaluation Economist attended a planning workshop where the results of the tests were discussed. Because benefits to small rice producers appeared to be insignificant, ATI decided not to establish a commercial demonstration project based on this technology.

Centre Canadien d'Etude et de Cooperation Internationale, Senegal, $4,970

Purpose: To collect technical, financial, and socioeconomic data on current operations of multiblade windmills in Senegal.

In early 1983, 200 multiblade windmills were installed in Senegal, financed by the Government of Argentina. These windmills were to have provided drinking water for 10,000 people and more than 40,000 head of livestock cattle, goats, and camels—as well as irrigate vegetable gardens and seedlings for reforestation. Due to lack of maintenance and repair, this potential has not been achieved. Nevertheless the Fiasa multiblade windmill appears to be the most appropriate wind pumping technology, given the wind regime and low-lying lands in Senegal. Data from the study will enable the grantee to determine the potential commercial viability of a maintenance and repair service. This could lead to a larger project to establish a small-scale windmill repair and maintenance service in Senegal.

Ingepinturas Ltda., Colombia, $4,856

Purpose: To evaluate the technical performance of the Linares pump, developed, redesigned and tested under ATI Grant 79-26. This evaluation will serve as the basis for defining the pump's potential for replication on a worldwide level.

Sarvodaya Shramadana Movement, (SSM), Sri Lanka, $5,000

Purpose: To support prefeasibility studies on 15 small-scale rural industries that could prove commercially successful for SSM: brick manufacturing, lime and dolomite fertilizer production, production of dried tumeric, processing of milk products and cardamon processing. The grant resulted in SSM attracting other funds—$1 million/year for five years—to establish SEEDS (Sarvodaya Economic Enterprise Development Society). This consolidation of SSM's income generating activities under supervision of a professional manager is a prelude to establishing a large-scale rural industries program.

Appropriate Technology International

Publications and Videos

BOOKS

Macro-Policies for Appropriate Technology in Developing Countries
Frances Stewart, editor (consultant)
Westview Press, 1987. $29.85
(plus $2.50 postage)

Independence Through Mobility: A Guide to the Manufacture of the ATI-Hotchkiss Wheelchair
Ralf Hotchkiss
ATI, 1985. $15.00

WORKING PAPERS

Reorienting Export Production to Benefit Rural Producers: Annatto Processing in Peru
Eric L. Hyman and John P. Skibiak
ATI, 1986. $2.00

The Experience with Improved Charcoal and Wood Stoves for Households and Institutions in Kenya
Eric L. Hyman
ATI, 1985. $9.50

Biotechnology and Community Development for Food Production: A Case Study
John Slavics and Marshall Bear
ATI, 1985. $2.00

Upgrading Traditional Rural Technologies
Jeffrey James (consultant)
ATI, 1985. $5.50

High Impact Appropriate Technology Case Studies
Thomas Fricke
ATI, 1984. $5.00

Wheelchairs for the Third World
Ralf Hotchkiss et al.
ATI, December, 1984. $1.50

ADAUA Earthen Construction Techniques
Carlos R. Lola
ATI, 1983. $1.50

Macro-Policies for Appropriate Technology: An Introductory Classification
Frances Stewart (consultant)
ATI, 1983. $3.00

Manual for Commercial Analysis of Small-Scale Projects
Henry R. Jackelen
ATI, 1983. $6.50

TECHNOLOGY APPRAISAL REPORTS

(Technology Appraisal reports are available for $5.00 each)

Ram-Type Manual Oil Press
Carl Bielenberg
ATI, September 1986

Unconventional Refrigeration
Carl Bielenberg
ATI, February 1986

Fibre Reinforced Concrete Roofing Sheets: Technology Appraisal Report
Carlos R. Lola
ATI, September 1985

Mini-Cement Technology: Appraisal Report of the ATDA Mini-Cement Project
Marshall Bear (ATI), Frank Almond (ITDG), and Harro Taubmann (consultant)
ATI, July 1985

TECHNOLOGY PROSPECTUS REPORTS

(Available on request)

Placer Mining
LAC Team, December 1986

Mali Dehullers
Ed Perry, 1986

Upgrading Small-Scale Brick Making in Botswana
Catherine Fort, July 1986

Ceramic-Lined Jikos
Hugh Allen, April 1986

Hydro-Powered Grain Mills
Hugh Allen, April 1986

GENERAL INFORMATION

(Available on Request)

What is ATI?
An informational brochure in English, French and Spanish

Technology for Small-Scale Industry
Appropriate Technology International, Annual Report, 1985

Appropriate Technology as a Strategy for Development
Appropriate Technology International, Annual Report, 1984

APPROPRIATE TECHNOLOGY BULLETIN

The *Appropriate Technology Bulletin* reports on the design, technology focus, and implementation of individual ATI field projects. The Bulletin is published four to six times per year and distributed free of charge. Titles to date include:

No. 1. Palm Oil Extraction in Cameroon
No. 2. Delivery of Appropriate Technology: Venture Capital in Indonesia
No. 3. Improved Design for Lime Kilns in Central America
No. 4. Protein Enriched Cassava for Pig Feed in Thailand
No. 5. Annatto Production in Peru
No. 6. Shea Butter Extraction in Mali
No. 7. Potato Based Food Products in Peru
No. 8. Improved Charcoal Stoves (Jikos) in Kenya
No. 9. Upgrading Small-Scale Brickmaking in Botswana
No. 10. Village Coconut Processing in the Philippines

OTHER PUBLISHED WORKS BY ATI STAFF

Appropriate Policies Spur Development
Arleen Richman
Front Lines, (U.S.A.I.D.), May 1987

ATI Brickmaking Projects in Three African Countries
Carlos R. Lola
VITA News, April 1987

Comparative Merits of Ferrocement as a Substitute for Wood in Fishing Boats
Eric L. Hyman
Materials and Society Journal, Vol. 11, No. 2, 1987

A Pressing Need for Bricks
African Technical Review, March 1987

The Strategy of Decentralized Production and Distribution of Improved Charcoal Stoves in Kenya
Eric L. Hyman
World Development, Vol. 15, No. 3, March 1987

Quality Assurance Requirement for Foods Intended for Export to the USA
John J. Slavics
Sustain Notes, Vol. 1, No. 2, Fall 1986

Wheelchair Benefits Third World Disabled
Arleen Richman
Front Lines, (U.S.A.I.D.), August 1986

AID Grant Helps Create Self-Employment for Indians
Arleen Richman
Front Lines, (U.S.A.I.D.), June 1986

AID Funding Benefits Indian Craftsmen
Arleen Richman
Front Lines, (U.S.A.I.D.), May 1986

PAPERS PRESENTED BY ATI STAFF

Technology Transfer and Sharing Mechanisms: Small is Powerful
Ton de Wilde
Presented by Paul Bundick at the Enterprise and Entrepreneurship Development Conference, Technonet, Manila, Philippines, February 1987

Upgrading Traditional Food Processing Technologies in Africa
John J. Slavics
Paper presented at FAO Conference, Arusha, Tanzania, November 1986

Fibre-Reinforced Concrete Roofing Sheets
Carlos R. Lola
Paper presented at the Congress on Advanced Building Technology, Rotterdam, The Netherlands, September 1986

Appropriate Technology as a Strategy of Development for Rural Areas in Developing Countries
Eric L. Hyman
Paper presented at the American Planning Association Conference, Los Angeles, CA, April 1986

The Strategy of Decentralized Production and Distribution of Improved Charcoal Stoves in Kenya
Eric L. Hyman
Presented at the Conference on Sustainable Development of Natural Resources in the Third World, Columbus, OH, Ohio State University, September 1985

ATI's Projects, Purposes and Technologies
Ton de Wilde
Presented before BOSTID's Advisory Board, April 1985

FORTHCOMING

The Appropriateness of Ferrocement Boats for Small and Medium-Scale Fishing on Lake Malawi
Eric L. Hyman
Accepted for publication in *Agricultural Administration*

The Identification of Appropriate Technologies for Rural Development
Eric L. Hyman
Accepted for publication in *Impact Assessment Bulletin*

Pigs Get Fatter Faster in Dominican Republic Cafeteria
Arleen Richman
Accepted for publication in *Front Lines* (U.S.A.I.D.)

Mushroom Enterprise Spawns Opportunity for Filipino Rural Poor
Arleen Richman
Accepted for publication in *Front Lines* (U.S.A.I.D.)

FILM AND VIDEO

(All videos are available for $35.00)

Small Is Powerful
A 30-minute documentary, which depicts specific projects in Africa, Asia, Latin America and the Caribbean. The film is available in English, French or Spanish in 16 mm, VHS and PAL formats. A study guide accompanies the film. A ten-minute overview version of the film is available in English.

Ya Pek
English (15:00 min.)
Thai (15:00 min.)
A documentary that shows the fabrication of bamboo reinforced water tanks in Thailand.

Los Hornos de Cal
Spanish (15:00 min.)
Description of lime kiln project in Costa Rica.

Village Coconut Processing
English (28:00 min.)
Description of village level coconut processing in the Philippines.

Mushroom Growing in the Philippines
English (35:00 min.)
Examines the mushroom growing project in the Philippines, a part of the FFI-ATI Rural Small-Scale Industries Program.

Caltech Palm Oil Presses in Cameroon
English (12:00 min.)
Documentary that examines the innovative Caltech presses for palm oil processing.

PEAT MARWICK

Peat, Marwick, Mitchell & Co.
Certified Public Accountants
1990 K Street, N.W.
Washington, D.C. 20006

The Board of Trustees
Appropriate Technology International:

We have examined the balance sheet of Appropriate Technology International as of December 31, 1986, and the related statements of revenues, expenses and changes in fund balance and of functional expenses for the year then ended. Our examination was made in accordance with generally accepted auditing standards and the standards for financial and compliance audits contained in Standards for Audit of Governmental Organizations, Programs, Activities and Functions (1981 Revision) issued by the Comptroller General of the United States and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying financial statements referred to above present fairly the financial position of Appropriate Technology International at December 31, 1986, 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.

Peat, Marwick, Mitchell & Co.

Febuary 27, 1987

APPROPRIATE TECHNOLOGY INTERNATIONAL
Balance Sheet
December 31, 1986

ASSETS

Cash (note 3)	$ 69,662
Grants receivable (note 4)	4,458,295
Fixed assets, at cost, less accumulated depreciation and amortization (note 6)	188,911
Advances	17,085
Deposits	16,054
Other	40,907
	$4,790,914

LIABILITIES AND FUND BALANCE

Accounts payable and accrued expenses	65,894
Project grants payable	3,791,117
Deferred grant revenue (note 4)	932,193
	4,789,204
Fund balance	1,710
Commitments (note 8)	
	$4,790,914

See accompanying notes to financial statements.

APPROPRIATE TECHNOLOGY INTERNATIONAL
Statement of Revenues, Expenses and Changes in Fund Balance
For the year ended December 31, 1986

Revenues - AID grants	$3,340,162
Expenses, net of deobligations:	
Services to the field:	
Financial assistance (note 5):	
Agricultural product processing	824,251
Local mineral resources	(156,485)
Equipment and support for small farms	(61,896)
Other	57,021
	662,891
Project development and monitoring	684,060
Technical and evaluation services	334,057
Other project support	220,213
Total services to the field	1,901,221
Policy and information services	234,726
Replication and other program support	279,688
Total program services	2,415,635
Supporting services:	
Nonprogram costs	70
General and administrative	924,457
Total expenses	3,340,162
Fund balance, beginning of year	1,710
Fund balance, end of year	$ 1,710

See accompanying notes to financial statements.

APPROPRIATE TECHNOLOGY INTERNATIONAL
Statement of Functional Expenses
For the year ended December 31, 1986

	Program Services									
	Financial Assistance	Project Development & Monitoring	Technical & Evaluation Services	Other Project Support	Total Services To The Field	Policy & Information Services	Replication and Other Program Support	Total Program Services	General & Administrative	Total Expenses
Financial Assistance (note 5):										
Field operations	$670,998	—	—	—	670,998	—	—	670,998	—	670,998
Policy	(8,107)	—	—	—	(8,107)	—	—	(8,107)	—	(8,107)
Total financial assistance	662,891	—	—	—	662,891	—	—	662,891	—	662,891
Operating expenses:										
Salaries	—	330,251	166,193	163,401	659,845	116,329	153,632	929,806	227,306	1,157,112
Benefits	—	67,222	32,950	32,551	132,723	24,916	29,546	187,185	35,737	222,922
Employee development	—	—	—	—	—	—	—	—	4,258	4,258
Consultants	—	38,638	34,708	5,774	79,120	24,887	29,553	133,560	—	133,560
Travel	—	221,283	73,855	616	295,754	27,492	46,334	369,580	31,960	401,540
Occupancy costs (note 8)	—	—	—	—	—	—	—	—	192,215	192,215
Communication	—	268	314	841	1,423	315	—	1,738	106,036	107,774
Materials and supplies	—	—	—	—	—	650	—	650	18,663	19,313
Copying and printing	—	35	—	—	35	30,840	1,953	32,828	13,046	45,874
Publications	—	—	—	(805)	(805)	322	6,953	6,470	7,209	13,679
Recruitment and relocation	—	—	—	—	—	—	—	—	12,822	12,822
Professional services	—	3,159	76	5,270	8,505	—	2,340	10,845	104,119	114,964
Insurance	—	22,931	11,598	12,565	47,094	7,558	9,104	63,756	53,176	116,932
Miscellaneous	—	273	38	—	311	1,594	273	2,172	15,102	17,280
Equipment, equipment maintenance and rental	—	—	14,325	—	14,325	(177)	—	14,148	51,228	65,376
Depreciation	—	—	—	—	—	—	—	—	51,580	51,580
Total operating expenses	—	684,060	334,057	220,213	1,238,330	234,726	279,688	1,752,744	924,457	2,677,201
Total expenses	$662,891	684,060	334,057	220,213	1,901,221	234,726	279,688	2,415,635	924,457	3,340,092

See accompanying notes to financial statements.

APPROPRIATE TECHNOLOGY INTERNATIONAL
Notes to Financial Statements
December 31, 1986

(1) Organization

Appropriate Technology International (the Organization) is a private, nonmembership, nonprofit corporation organized for the development and dissemination of technologies appropriate for developing countries. The Organization obtains its funding primarily from the Agency for International Development (AID) under Section 107 of the Foreign Assistance Act of 1961.

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

(2) Summary of Significant Accounting Policies

(a) **Basis of Accounting**

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

(b) **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 revenue.

(c) **Fixed Assets**

Fixed assets are recorded at cost and are depreciated and/or amortized on a straight-line basis over the shorter of their estimated economic life or the lease term.

(d) **Financial Assistance (Grants Awarded and Policy Projects)**

Financial Assistance is obligated when an award is granted and is recorded as an expense and liability at the time the recipient is entitled to the use of the funds.

Deobligations, which are primarily due to subsequent cancellation of grants of projects or grantee projects costing less than originally budgeted, are recorded as a reduction of expense and liability in the period the deobligation occurs.

(e) **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 on a specific identification basis.

(f) **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.

(3) Pledged Assets

The Organization has $60,000 on deposit in an interest-bearing account pledged as collateral for a grantee's line of credit of $54,000 plus interest. Management is of the opinion that the grantee will service the line of credit satisfactorily.

(4) AID Grant Awards

Since its inception, the Organization has been awarded funding by AID under a Grant Agreement and a Cooperative Agreement both totaling $40,077,586, of which $2,277,000 was awarded during the year ended December 31, 1986. The Grant Agreement expired September 29, 1986. The Organization's Cooperative Agreement with approved funding of $3,000,000 from AID extends through September 30, 1988 subject to the availability of funds. Congressional approval is presently pending for an additional $3,000,000 to the Cooperative Agreement.

AID funding received as of December 31, 1986 has been disbursed or obligated as follows:

Grants awarded to projects:	
1985 and prior	$ 16,065,681
1986	662,890
	16,728,571
Operating expenses:	
1985 and prior	19,739,551
1986	2,677,271
Grant expenses to date	39,145,393
Deferred revenue as of December 31, 1986	932,193
Total AID funding received	$ 40,077,586

In addition, since 1980 the Organization has been awarded grants from various other enterprises totalling $188,112. No such awards were received in 1986.

(5) Financial Assistance

Financial assistance obligations and deobligations in 1986 were as follows:

	Obligations	(Deobligations)	Net obligations (deobligations)
Field operations	$ 1,237,337	(566,339)	670,998
Policy	25,155	(33,262)	(8,107)
	$ 1,262,492	(599,601)	662,891

(6) Fixed Assets

At December 31, 1986, fixed assets consist of the following:

Furniture	$ 72,191
Equipment	223,111
Leasehold improvements	68,250
	363,552
Less accumulated depreciation and amortization	174,641
	$ 188,911

(7) Retirement Plan

The Organization maintains a noncontributory defined-contribution retirement plan. Employer contributions are equal to fifteen percent of each participant's annual salary base. All full-time employees who signed employment contracts before 1987 participate in the plan upon employment and are fully vested after 3 years. Employees signing an employment contract after 1986 are fully vested after four years with no incremental vesting.

Pension expense included in the accompanying financial statements approximated $137,000. It is the Organization's policy to fund retirement plan costs as they accrue.

(8) Lease Commitments

The Organization leases office space under a five-year lease which expires in April 1989. The agreement provides for annual adjustments of the rental amounts based upon a consumer price index. Such amounts include costs and expenses for utilities, insurance, janitorial and cleaning services, maintenance and repairs and real estate taxes.

The Organization also leases equipment under operating leases. Following is a summary of operating lease commitments at December 31, 1986:

	Office space rentals	Equipment rentals	Total commitment
1987	$ 202,000	18,000	220,000
1988	208,000	14,000	222,000
1989	71,000	14,000	85,000
1990	—	14,000	14,000
	$ 481,000	60,000	541,000

Occupancy costs in 1986 are reflected net of $46,000 of sublease income.

CHILDREN PLAY at work done by adults—pounding cassava in Eastern Zaire.

THAI BAMBOO PLAIT INDUSTRY, which makes place mats and window blinds, was the first company to be established under the Rural Small-Scale Industries program in Thailand.

STAFF MEMBERS

Office of the Executive Director

Ton de Wilde
Executive Director

Arleen Richman
Asst. to the Executive Director/Publications Officer

Laura Brainard
Administrative Assistant

Scott Ripley
Word Processor

Department of Finance and Administration

Edward T. La Farge
Director

G.P. Varshneya
Manager/Budget and Accounting

Rosa Tayman
Grants & Contracts Administrator

Ida Williams
Senior Accountant

Vacant
Accountant

Gwen D. Wilson
Administrative Assistant

Sabra B. Breslin
Librarian

Mi' Chelle A. Blakey
Receptionist

Africa Program

Catherine Fort
Director (until 5/31/87)

Edward C. Perry
Project Officer
(Acting Director)

E.F. Swartzendruber
Project Officer

Carolyn L.H. Hairston
Administrative Officer

Asia Program

Paul L. Bundick
Director

Jack Croucher
Project Officer

Jovita Culaton
Philippine Representative

Judith Polsky
Operations Officer

Diana Ingraham
Operations Officer

Latin America/ Caribbean Program

William Gschwend
Director

Valeria Budinich
Project Officer

Richard Bowman
Project Officer

Lisa Stosch
Administrative Officer

Business Development & Replication Group

Michael G. O'Donnell
Director

Timothy Mooney
Business Development Specialist

Eric L. Hyman
Evaluation Economist

John Skibiak
Evaluation Specialist

Alene McMahon
Conference Coordinator

Jacqueline Logan
Administrative Assistant

Technical Resource Group

Glenn Patterson
Farm Equipment and Support Specialist

Carlos R. Lola
Minerals Development Specialist

John J. Slavics
Agricultural Products Processing Specialist

Kazem Oryani
Computer Systems Analyst

Vacant
Administrative Assistant

PROJECT REVIEW AND ADVISORY COMMITTEE (PRAC)

MEMBERS (6/18/87):

Milton Barnett, *Chair*
Cornell University

Mario Kamenetzky
The World Bank

Delbert Myren
The World Bank

Edgar Owens

Ralph Stephens
International Finance Corp

Robert Wilson
Africare

MEMBERS—Service Ended:

Michael Greene
National Academy of Sciences
(Chair '84-1/87)

Allen Inversin
National Rural Electric
Cooperative Association 4/87