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Replication and the Expansion of Benefits: Lessons from Two ATI Projects

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After describing ATI's replication strategy this article presents two case studies to illustrate different approaches to replication. The first documents what was initially the spontaneous replication of a sunflower seed oil press in eastern and southern Africa. Subsequently ATI launched an active marketing/information dissemination strategy to expand the diffusion of the press. The second illustrates a more directed effort by ATI to replicate a low-cost wheelchair in several countries in Latin America.

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P<sub>N</sub>-ABE-650

**REPLICATION AND THE EXPANSION OF BENEFITS:  
LESSONS FROM TWO A.T.I. PROJECTS.**

By: Paul Bundick, Arleen Richman and John Skibiak

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## I. ATI AND REPLICATION (Introduction)

### ATI's Mission and Program Strategies

ATI was established in 1976 as an experimental not-for-profit organization to develop and disseminate technology appropriate for small farms, micro enterprises and small-scale rural industries in developing countries. ATI's mission is to create employment and income-generating opportunities for low-income people by furthering technology-based small enterprises. The often repeated slogan at ATI of "putting technology into the hands of people" underscores the organization's intention of directly benefiting the poor in its projects and technology interventions.<sup>1</sup>

ATI carries out its mission by means of three interrelated program strategies-- technology development and demonstration, replication, and macro-policy reform.

### Replication

ATI defines replication as "the dissemination or diffusion of the innovative element(s) of a demonstration project beyond the objectives and implementation plan of the original project itself."<sup>2</sup>

Replication is ATI's main strategy for expanding economic impact and making its overall program cost-effective. Since demonstration projects are, by definition, high risk undertakings, their success rate tends to be lower than projects that employ already established technologies. It is, therefore,

essential that successful technologies be widely replicated to multiply benefits thereby reducing the cost per beneficiary.

ATI's replication strategy distinguishes between three modes of replication. At one end of the spectrum is **active marketing**. In this approach, ATI assumes a high degree of influence over the process and actively supports the replication efforts by providing training, financial and/or technical assistance. To accelerate the dissemination of a technology, ATI often initiates and funds the direct replication of a demonstration project in another area or country. Direct replication clearly increases the chances of a technology being disseminated, but it can be costly.

A second mode of replication is through **targeted information dissemination** in which little or no financial and/or technical assistance is provided to back up the process. This might include the promotion and distribution of published articles, project monitoring reports, evaluations, video tapes, newsletters and/or technical manuals. A strategy that emphasizes information dissemination may result in fewer documented replications but the costs of this approach are considerably less than active marketing.

The third category is termed "**spontaneous**" replication. This refers to a diffusion of technology that results from the interplay of market forces without direct ATI support. Of course, replication is never really spontaneous because it always

requires some form of information dissemination, even if only by "word-of-mouth". The term, however, is useful since it designates the least amount of ATI involvement in the replication process.

The three modes of replication are by no means mutually exclusive, since any successful replication effort usually entails some element of all three. For instance, ATI might begin a replication effort by disseminating information. Once demand has been demonstrated, it may move on to more active marketing. This may, in turn, foster a spontaneous replication outside the boundaries of the initial target area. Likewise, as spontaneous replications are discovered, attempts may be made to understand and document the expansion process. In such cases, information, training, and/or more direct forms of financial and technical assistance may be provided to speed up spontaneous replications.

The two case studies presented here illustrate different approaches to replication. The first documents what was initially the spontaneous replication of a sunflower seed oil press in eastern and southern Africa. Subsequently ATI launched an active marketing/information dissemination strategy to expand the diffusion of the press. The second illustrates a more directed effort by ATI to replicate a low-cost wheelchair in several countries in Latin America.

## **II. THE DIELENBERG RAM PRESS**

### **The Demonstration Project<sup>3</sup>**

In November 1984, ATI launched a demonstration project to

help Tanzanian village groups establish, own, and manage small-scale sunflower oil extraction industries, using locally manufactured, hand-operated oil presses. Funding for this project was provided by ATI, Lutheran World Relief (LWR), and the Government of Tanzania. Because of its strong development program in Tanzania, the Arusha Synod of the Evangelical Lutheran Church of Tanzania (ELCT/AS) was selected as the local implementing organization.

Initially, two presses were selected for demonstration, a 20 and 80 ton scissor-jack press, both of which were developed by the Institute of Production Innovation (IPI) at the University of Dar-es-Salaam, and manufactured under a separate ATI project with Themis Farm Implements of Arusha. The presses were less expensive than most comparably sized diesel or electrically powered oil expellers (occasionally used in towns) and more efficient than the traditional extraction method which involved many hours of manual threshing, crushing and boiling the seed.<sup>4</sup>

The project was designed to benefit rural people in at least four ways. First, new jobs were to be created through both the manufacture and commercial operation of the presses. Second, the project was to provide an incentive to farmers to grow sunflower as a cash crop on marginal land. Third, village based pressing operations were to enable rural producers to retain the value added by locally extracting the oil. Fourth, press dissemination was expected to increase oil production, thereby increasing the local supply of edible oil.

The project was developed at a time when edible oil was virtually unavailable in Tanzania. Government policies prohibited the import of edible oil. On the other hand, the government set artificially low prices for sunflower seeds, which discouraged farmers from either growing sunflowers or processing oil. In the cities, sunflower seed oil would occasionally appear in shop windows, but at prices few could afford.<sup>5</sup>

The Arusha and Mbulu Districts of northern Tanzania were selected as the focus for project implementation. Both had large tracts of underutilized, semi-arid land, well-suited to the cultivation of sunflower seed. Moreover, population growth in Arusha and surrounding settlements provided an expanding market for sunflower seed oil as well as an abundant labor reserve for seed production.

The project was designed to be implemented in two phases. During the first phase, three oil pressing enterprises were to be established. This involved selecting three village sites, carrying out seed field trials, developing implementation and financial plans for the three enterprises, training villagers in the use of the presses, installing the presses and starting up the enterprises in the village sites. In the second phase, six additional village pressing enterprises were to be established.

During the first year of the project, the local implementing organization was to set up a not-for-profit development finance company to provide potential press owners -- either village groups or individuals -- with loan capital as well as managerial,

agricultural, financial and engineering assistance. Because ATI believes that the dissemination of appropriate technology should continue on a self-sustaining basis after donor organizations cease their financial involvement, the finance company was intended to become self-sustaining within four years. Interest bearing loans and a 25 percent profit-sharing scheme were intended to replenish the company's revolving capital fund and cover administrative costs.

Early in the life of the project, three decisions were made that significantly altered the course of implementation. First, just before project activities got under way, the Tanzanian government decided to lift restrictions on imported cooking oil. Once again, vegetable oils became readily available in most urban centers and market towns. Prices dropped to more affordable levels. With the increased supply of oil, the commercial viability of oil production became less dependent on the urban consumer market. Consequently, the ELCT/AS, the implementing organization, decided to focus exclusively on improving the supply of oil in the rural areas to assist "poorer, subsistence farm families who may not be consuming enough oil to maintain good health".<sup>6</sup>

Second, the ELCT/AS decided to abandon the idea of a development finance company primarily because they felt uncomfortable with the establishment of an overtly commercial business undertaking. Instead, a seven member project Steering Committee assumed responsibility for local operations and

overseeing the work of the project manager and other personnel. The Committee was made directly accountable to Lutheran World Relief (LWR), which was responsible for disbursing ATI funds to the project.

Third, and most important, a decision was made to change the type of press promoted by the project. The IPI presses did not prove as "appropriate" as originally thought. They were heavy, difficult to transport, and a high degree of skill was required to manufacture them. Mechanical problems slowed initial production. Moreover, the scissor jack press, especially the 80-ton model, required substantial supplies of seed and ample managerial capacity on the part of villagers to operate it efficiently. This placed serious limitations on the viability of the IPI press in remote areas.

In late 1985, ATI staff engineer Carl Bielenberg came to Arusha to provide technical assistance to the project. In a matter of days, Bielenberg had invented a smaller ram press that was cheaper, lighter, easier to construct, and had an extraction efficiency comparable to the IPI presses. Unlike the scissorjack presses, the ram press did not require ancillary pre-processing equipment such as a scorcher and decorticator (dehuller).

The Bielenberg press is now the only press being promoted by the project. As shown in Annex 1, the design utilizes a hand-operated lever arm to move a small piston back and forth inside a cylinder. As sun-warmed sunflower seed is fed into the cylinder

from a hopper, it is compressed by the piston and pushed through a conical cage, from which the oil is extracted and pressed seed cake is discharged. The seed cake is rich in protein and, when mixed with local grasses and feed grain, makes an excellent animal feed. Since it was originally designed, the ram press has undergone a series of modifications and improvements, but the basic design has remained the same.

Substituting the ram press for the large scissorjack press expanded the geographical scope of the project by making sunflower seed oil processing feasible on a smaller scale, and thereby more accessible to a wider range of socio-economic groups. Because of its lower throughput, the ram press requires only 150 acres of sunflower seed to operate at full capacity - 1/5 of the 750 acres required to sustain an IPI press.

The press has proven to be an efficient, low risk, and highly profitable technology that has enabled press owners to realize substantial returns on their investment. Although devaluation of the Tanzanian shilling and increases in the price of steel have raised the price of the press to approximately \$625 to \$650, an owner can still expect to recover his or her investment in one 6-month pressing season given the availability of seed and a high capacity rate utilization.<sup>7</sup> The income generation potential of the press is considerable in a country where the per capita GDP is under \$275.

Technology dissemination and the expansion of benefits increased rapidly once the project began working with individuals

in addition to organized groups and village-level associations, the first targeted beneficiaries. Because individual farmers rarely grow enough sunflower to keep the machine operating full time, they began encouraging their neighbors to also plant sunflowers as a cash crop.<sup>8</sup>

To introduce the press into a new village, project staff generally demonstrate the ram press at the beginning of the planting season. Interested farmers are sold a quantity of high oil content seed for planting. At harvest time, the project staff return to the village and offer short term loans to people or groups interested in purchasing a press. Loans are only made at the beginning of harvest when the sunflowers can be seen in the field and the project team sense that people will be able to repay the loans. Once the owner(s) is trained to operate the press, he (they) is ready for business.

Since adoption of the Bielenberg press, the project has exceeded most of its initial expectations. As of March 1989, 37 production units has been established in 25 villages -- more than 4 times the original target. Even though the ram press requires only 2 operators versus the 5 people needed to operate each IPI press, the overall increase in the number of pressing enterprises has created \_\_\_ seasonal jobs, as opposed to the original target of 45. Jobs are seasonal because sunflower seed only is available for pressing six months a year.

Income from agricultural lands has increased substantially. In areas where sunflower seed has not been a traditional cash

crop, the press has increased the demand for seed. Enterprising farmers have turned unused land into a source of cash income, by selling sunflower seed to oil producers who will pay twice the amount offered by marketing cooperatives. Press owners also pay cash on the spot--not in vouchers to be redeemed two or three months later as is the standard practice of marketing cooperatives. In countries where inflation is high, such as Tanzania, paying farmers only after a cooperative's stock has been sold effectively penalizes the producer since payment is always made in a devalued currency.<sup>9</sup>

The project has also enabled local oil processing enterprises to retain the considerable value added by oil extraction. Processing one 50 kg. bag of standard black seed can increase its value by roughly 125 percent. In addition, the seed cake, used as a fodder ingredient, will undoubtedly increase in value as new products and uses are developed, adding even more value in the pressing process.<sup>10</sup>

The distribution of value added, of course, depends largely on whether the oil press is used to process seed purchased from other farmers (commercial pressing), or to process seed as a service to other growers (service pressing). In theory, commercial pressing provides seed producers with little or no value added since the oil remains in the hands of the press owner. Nevertheless, farmers in the Arusha area are receiving a better price for their seed.

Service pressing, where a fee is charged (in cash or kind)

to process the seed, permits farmers to retain a share of the value added because they maintain ownership of the oil. Typically, farmers leave a portion of their oil and/or seed cake with the press owner as payment. Fees charged for service pressing vary from T.Sh 20-30 per liter, to half of the total oil and seed cake produced. The majority of seed producers involved in this project have obtained added value increments in the range of 70 percent.<sup>11</sup>

Another major benefit of the project has been the increase in the local supply of oil. As of March, 1989, 30 months after the ram press was introduced, approximately 35,000 liters of sunflower oil had been produced from about 2,930 bags of seed. Interviews conducted with producers in November, 1987 suggested marked increases in household oil consumption. The scarcity of edible oil is no longer a serious problem in the Arusha region. This is due primarily to the relaxed import restrictions but also to the increased supply resulting from project activities.<sup>12</sup>

Dissemination of the ram press continues to benefit local communities by generating employment, income and value added opportunities. Despite the profitability of the oil pressing itself, the project has not managed to achieve financial sustainability. The early decision to abandon the concept of the development finance company and the reluctance on the part of the implementing organization to charge interest rates on the loans, has undermined the financial viability of the project as a dissemination mechanism. Unless sufficient interest income is earned by the project through its loan program or other revenue

generating activities are quickly undertaken (such as the originally proposed profit sharing scheme) the revolving loan fund will continue to rapidly decapitalize.<sup>13</sup> However, because more and more machine shops are beginning to manufacture the press and sell it to local entrepreneurs, and because a regional replication project (see page 15) contains a credit component, the "project" no longer will be critical in the successful dissemination of the technology.

### Replication Experience

The diffusion of the Bielenberg press started in the early phases of the demonstration project when presses began to appear in other African countries. For the most part, this dissemination was not the result of a controlled and deliberate effort by ATI or the Tanzanian project, but resulted from the informal process of exchanging information between organizations and traveling development professionals. The Village Oil project consultants also helped spread the technology on their travels to other eastern and southern African countries.

In 1986, mechanical drawings of the original Bielenberg design were brought to the University Development Technology Centre in Zimbabwe by an ATI staff person. A Canadian volunteer found the plans and had a press built by a local machine shop. After testing the press, he persuaded the Canadian High Commission to fund several more, all of which were built by a local manufacturer of farm equipment.

Although the manufacturer produced and sold more than 30

presses by mid-1988, reduced demand had caused production to come to a virtual standstill. To directly facilitate replication of the press in Zimbabwe, ATI launched a project in March, 1989 to provide management assistance, extension services and loans to groups or small farm families wishing to start pressing enterprises. Skilled workers in three small machine shops will be trained to manufacture the presses, while technical assistance to the shops will focus on quality assurance. A soon to be published technical and operations manual will help ensure the quality/standardization of the presses.

Around the same time the Bielenberg design was introduced to Zimbabwe, the press began to appear in several other countries including Kenya, Uganda, Rwanda, Zambia, Malawi, and Mozambique. For the most part, this inter-regional dissemination has entailed little direct involvement on the part of ATI. Responses to a recent ATI survey indicate that development agencies learned of the ram press as a result of purely fortuitous circumstances. Frequent communication among development agencies was a critical element of the dissemination process. In contrast to intra-regional dissemination, which usually results from direct contacts among press owners, interregional dissemination of the press almost always results from personal and/or professional contacts among development agencies. Sometimes the catalyst was a regional conference; at other times it was an aside to collaborative discussions between two NGOs on another topic.

This spontaneous replication of presses to other countries

has raised several important issues. For one thing, modifications made in metal workshops without benefit of engineering drawings or a manual, sometimes have reduced the press' durability or efficiency, or increased its cost. This in turn has damaged the credibility of the technology itself.

Another problem that has impeded replication is the press's variable performance with different varieties of sunflower seed. The ram press performs most efficiently on seeds with a lower fiber and high oil content. In areas where only hard shelled varieties are grown, the performance of the press has been poor. Under such conditions, partial dehulling of the seeds can increase extraction efficiency but it also tends to increase labor and/or capital costs.

To address these problems, ATI has recently launched a regional project to expand the benefits of the ram press throughout eastern and southern Africa and better control its dissemination. The first phase of the regional project, which began implementation in spring, 1989, will standardize the design and manufacture of the press. A set of jigs and fixtures will be fabricated and a parts list and assembly drawings will be prepared. By late 1989, ATI plans to have a complete replication package including engineering drawings, instructions for production of jigs and fixtures, a technology manual and a commercial assessment of pressing enterprises in several countries. By the end of the three-year regional project, it is expected that 30 manufacturers in 7 African countries will have

been trained to manufacture the press. Later, a Regional Information Center will be established to keep practitioners informed of developments in sunflower oil processing technologies, including information on sources of raw materials needed to manufacture the press.

Country programs supported by this regional project will provide technical assistance, training and/or financing so that low-income families can purchase a ram press and pay for it out of proceeds generated from its operation.

### III. THE ATI-HOTCHKISS WHEELCHAIR

#### The Demonstration Project

Many disabled persons in Third World countries who need sturdy, affordable wheelchairs -- suited to the world in which they live -- must do without. High-quality, state-of-the-art imported wheelchairs are available, but at prices few poor people can afford. Foreign-built chairs, designed for use under hospital conditions, usually are not strong enough to withstand the rough conditions and poor roads commonly found in Third World countries. Imported chairs also tend to lose traction while traversing uneven terrain. Often it is difficult to repair imported chairs since many of their parts, such as hubs and caster forks, are produced from heavy sheet metal by expensive press-forming techniques. In some developing countries, inexpensive wheelchairs are made from old bicycle parts and scrap wood. All too often, however, these chairs either restrict the rider's mobility or tend to break and bend out of shape with

daily use.

Although the lack of affordable wheelchairs is a problem throughout developing countries, the situation appeared to be particularly serious in Nicaragua in the early 1980s. Thousands of disabled Nicaraguans, many victims of the civil war, sought the mobility required to seek employment, and pursue an education -- in short, to live more independently.

In 1980, ORD, The Organizacion de Revolucionarios Desabilitados (an advocacy and self-help group), asked ATI for financial assistance to establish a wheelchair manufacturing and repair business. ATI's grant of \$107,000 enabled ORD to not only repair existing models but manufacture a new ATI prototype wheelchair, suitable for local conditions. This wheelchair was based on the design of an ATI consultant, Ralf Hotchkiss, an engineer who had been a wheelchair rider since a motorcycle accident in 1966.

The ATI-Hotchkiss chair is a strong, folding chair, which weighs only 2/3-3/4 as much as a standard chair. It is not only very maneuverable and well-balanced, but can be adapted to fit an individual's body size and disability. It cost 25 percent less than imported chairs available in Nicaragua at that time. Almost all production materials and components, such as electrical tubing (conduit) for the frame, canvas for the seat, and automotive bearings and bicycle tires for the wheels, are available in most developing countries. Its design incorporates innovations such as a swing-away footrest, lockable parking

brakes, a curved armrest and rear-wheel drive that allow easy transfer in and out of the chair, and enhanced maneuverability.<sup>14</sup>

Thirty to forty hours of work are required to fabricate one ATI-Hotchkiss wheelchair. Welding skills and routine mechanical aptitude are the principal labor skills required. When ATI involvement in the ORD project ended in January 1983, the workshop employed seven disabled workers to manufacture four ATI-Hotchkiss wheelchairs and repair about 100 others per month.

### Replication Experience

To disseminate the ATI-Hotchkiss wheelchair on a broad scale, ATI undertook an active replication strategy that involved sponsoring training workshops and technical exchanges, producing and disseminating a wheelchair production manual and sets of jigs and fixtures, and providing financial and technical assistance to small manufacturing enterprises.

Between November 1983 and July 1986, ATI sponsored eight two-week wheelchair training workshops which provided 41 participants with hands-on training in ATI-Hotchkiss wheelchair production technology. Ralf Hotchkiss organized and led the workshops which were held in California, as well as in several countries in Central and South America. The participants, many of whom were disabled, were predominately workshop managers and included mechanics from small businesses, vocational centers, social service agencies and rehabilitation organizations. Some trainees had no experience in wheelchair production but all had

some experience in light metalwork and welding. During the workshops each trainee built one wheelchair prototype to take home after the training. Participants in the training came from Brazil, Colombia, Costa Rica, Dominican Republic, Guatemala, Guayana, Honduras, Jamaica, Malawi, Nicaragua, Paraguay, Peru, Sri Lanka, Trinidad, and Zimbabwe.<sup>15</sup>

The first three workshops, held in Costa Rica, Jamaica and Peru, emphasized the fabrication of jigs which are used to guide tools and hold in place difficult-to-make parts. Because the participants were able to draw on their own experiences, the workshops resulted in a number of technological innovations, the most important of which was a new welding jig to help maintain accurate alignment of the wheelchair frames, thereby speeding up the production process.

In subsequent workshops, ATI provided participants with basic tool kits consisting of jigs, special hand tools, bending dies, and frames. These kits and the prototype wheelchairs constructed at the workshops enabled participants to return home and begin wheelchair production almost immediately. Instruction in the fundamentals of managing a small business was included in later training sessions.

In addition to the workshops, ATI sponsored a series of technical exchanges between Mr. Hotchkiss and wheelchair manufacturers in Latin America and Asia. These have resulted in a number of improvements to both local designs and Hotchkiss' original prototype.

In November 1984, ATI published the manual: Independence Through Mobility: A Guide to the Manufacture of the ATI-Hotchkiss Wheelchair. The manual contains illustrated step-by-step instructions for building an ATI-Hotchkiss wheelchair based on the prototype designed by Hotchkiss and members of the Tahanan Walang Hagdanen wheelchair factory in the Philippines. The manual includes guidelines for starting a small manufacturing business, detailed lists of tools, parts and equipment, jig making techniques, and guidelines for quality control and wheelchair maintenance. To date, about 400 copies have been distributed worldwide. In late 1988, a Spanish edition of the manual was printed. The manual is sold at cost for \$15.00. Although manuals are occasionally provided to potential producers free of charge, this practice is discouraged because ATI believes that anyone unable to afford a manual, would be unlikely to obtain financing for a production facility.

A more directed replication strategy began in December 1984, when ATI designed a regional project to replicate wheelchair production facilities in Colombia, Peru, Honduras, Guatemala and the Dominican Republic. ATI provided funding, technical assistance, and training to establish 12 wheelchair production units over a four year period.

ATI's financial assistance was channeled through intermediary implementing organizations that ranged from well-established NGOs involved in small enterprise development (Colombia), to religious and social development organizations (Peru), to private rehabilitation centers for the disabled

(Honduras and Guatemala). Organizations and microenterprise production units were selected to participate in the project on the basis of their performance at earlier training workshops, their existing product lines, their employment of disabled workers, geographical distribution, and their access to rehabilitation organizations that could serve as major marketing outlets.

In each country, efforts were made to adapt the wheelchair and production process to local conditions and to establish procedures for quality control. Hotchkiss and ATI Washington staff assisted in resolving specific production and sourcing problems. Training in small business management often was provided by the intermediary organization or another local microenterprise support program.

Revolving loan funds were established in Peru and Colombia to provide the production units with lines of credit for tools, equipment, and other start-up costs as well as with working capital for raw materials and component parts. In these two larger projects, consumer credit was to be made available so that low and middle income families could purchase the chair.

By June 1986, at least 14 organizations in 12 countries were producing ATI-Hotchkiss wheelchairs. In addition to Colombia, Peru, Honduras, Guatemala, Nicaragua, and Dominican Republic, where ATI had directly provided training, financial and/or technical assistance, wheelchairs were being fabricated in Bolivia, Mexico, Malawi, Paraguay, the Philippines and Zimbabwe.

At the same time, seven new wheelchair businesses were about to begin production in Colombia, Sri Lanka and Brazil.

Most replications not involving direct ATI participation were undertaken by entrepreneurs who had attended ATI's training workshops and then obtained the financing needed to set up production facilities on their own. Unfortunately, ATI only has limited information on all the wheelchair enterprises established -- either by workshop participants or by individuals who purchased the manual and "took it from there."

The results of the ATI's replication projects varied greatly. In the Dominican Republic, a small enterprise-oriented NGO was instrumental in helping an entrepreneur, who had attended an ATI-sponsored training session, to start a wheelchair production enterprise on his own. Through its regular credit program, this NGO was able to provide a working capital loan to the new business. (ATI's only direct expense was to finance the entrepreneur's initial training.) The small enterprise is reportedly doing well producing a high quality chromed chair in addition to its regular production of bicycle wheeled vendor carts.

In Honduras, by contrast, wheelchair production has not developed into a viable enterprise. The implementing organization, a rehabilitation center for the disabled, saw the shop not as a small business but as a training activity within its larger rehabilitation program. This workshop has continually experienced technical and financial problems. Although ATI's

involvement in this workshop has ended, limited production continues as a subsidized component of the training center.

In Guatemala, the implementing organization was also a rehabilitation center. As of June, 1988, it had produced 24 high quality wheelchairs. Unfortunately, shortages of raw materials limited production and resulted in relatively high costs that priced the wheelchair beyond the reach of the target population. The Guatemalan firm has not succeeded in developing the networks and marketing strategy to make the enterprise self-sustaining.

In Peru, the organization initially selected to implement the project was a religious-based, social development organization with projects in agriculture, health-care, reforestation and education. Unfortunately, it had no experience in operating commercially viable projects and lacked management and marketing capability. Because it failed to ensure that the production workshops were complying with specifications, the implementing organization soon found itself with a sizable stockpile of unsaleable chairs. <sup>16</sup>

In early 1988, ATI changed its project partner in Peru. The new group, CIPDEL, an engineering and technical organization, had some experience in managing small manufacturing projects. It launched an extensive advertising campaign to try to sell the inventory of 79 chairs it had "inherited" from the former project partner. This campaign yielded valuable information on consumer preference. CIPDEL discovered, for example, that the wheelchair seat was too narrow for many potential customers. Most of the

chairs had been produced in a single batch, and all had identical seats so it was difficult to accommodate different sized customers. Several other design features, such as the arm rests and the brakes, made the chair difficult for older people to use.

To remedy the situation, CIPDEL developed an improved chair that features a better braking system, padded removable armrests and sells for 8-12% more than the original design. It signed a contract with a local metalworking shop to produce 30 of these new model wheelchairs and to widen the seats on the existing inventory. By reducing the price of the chairs in inventory, and by advertising in the newspaper, CIPDEL was able to sell 52 chairs from the previous inventory and 6 new model chairs.

Forty of the chairs have been purchased by individuals or families and 18 by hospitals, clinics and charitable service clubs. Aside from the institutional purchases, all the chairs have been bought by middle income families, because their price is beyond the reach of most low-income families. Twelve-month consumer loans have been offered to wheelchair purchasers at interest rates that are indexed to the domestic inflation rate. About a third of the chairs were sold under the credit scheme.

Peru's hyperinflationary economy and the declining purchasing power of the average family make prospects for the commercialization of the wheelchair appear bleak, at least for the short term. After CIPDEL sells its inventory, the project will be closed. The metalworking workshop will continue to produce Hotchkiss chairs (including the CIPDEL version) to meet

individual orders.

Several other workshops in the Lima area also are producing the Hotchkiss chair. The owners of at least two of the workshops have attended previous ATI-sponsored wheelchair production training. The shops are clustered near a local hospital and all manufacture items other than wheelchairs. Since the wheelchairs are their most expensive product, however, they are only produced to order.

The Colombian case is the most successful wheelchair replication project to date. The implementing organization, the Carvajal Foundation (CF) has years of experience in small enterprise development. Its multi-disciplinary staff includes people with marketing and project management experience. The wheelchair project, however, represented a new challenge, particularly because of the difficulties associated with marketing an expensive product targeted toward the disabled poor.

In the CF's business plan, the wheelchair user is not considered a charity case but rather someone with special needs. The Corporacion Regional de Rehabilitacion del Valle del Cauca (CRRV), a not-for-profit corporation involved in social services, was chosen to organize and implement the marketing and credit component. CRRV has an established network among columbian social services agencies and organizations working with the disabled.

In the initial stages of the project, CF signed contracts with several existing metal workshops. These producers received

training in the Hotchkiss technology as well as start-up and working capital loans. The project staff maintained regular contact with the producers and provided technical assistance when necessary. Quality was emphasized at all levels. CF also helped organize joint sourcing of materials for the production units.

Currently two workshops make high-quality Hotchkiss chairs in Colombia, one in Cali and the other in Bogota. The producer in Cali has been manufacturing wheelchairs and other hospital products for many years. Indeed, it fabricates a wheelchair model designed by the owner himself, in addition to the Hotchkiss design. The Bogota workshop is a smaller enterprise and is producing slightly less expensive chairs than the Cali workshop. From September 1986 to November 1988, 381 ATI-Hotchkiss wheelchairs were sold in Colombia, most of them in the Cauca Valley region.

CRRV markets the wheelchairs produced by the workshops. Taking advantage of CF's access to a newspaper and radio station, and CRRV's links with most of the nation's social service agencies, they launched an aggressive advertising and marketing effort, which included a campaign to locate sponsors for needy consumers. In this program, the CRRV, with the aid of groups such as the Catholic Church, identifies disabled children from needy families; the family pays 50% of the purchase price and the sponsor pays the remainder.

Key support for the sponsorship program has come from businesses and industries in the private sector, disabled

advocacy groups and sporting clubs. While the sponsorship program has succeeded in subsidizing the purchase of a few dozen Hotchkiss chairs for low income people, the average purchaser of the Hotchkiss chair is from the low/middle class and pays the full price for the wheelchair, usually taking advantage of the consumer credit fund.

Age and disability determine the customer's preference for type of wheelchair. In Colombia, older people who prefer a hospital type chair, constitute the largest share of the market. Therefore, CF and CRRV suggested that the Cali producer make two models of Hotchkiss wheelchair--the classic Hotchkiss design which is the standard semi-sports model that appeals to younger people who desire maximum mobility, and the more comfortable hospital version with padded armrests and flat footrests.

(Photos are in Annex 3)

The Hotchkiss model chairs are competitive with other designs available in Colombia, but because they are not the cheapest, selling them presents a real marketing challenge. Unlike the ram press, which will generate income by producing oil, the wheelchair, in and of itself, is not a source of income. The wheelchair is expensive and those who need it usually lack the purchasing power.

Availability of consumer credit has been instrumental in the success of the wheelchair in Colombia. CRRV, with support from CF, manages the project's consumer credit fund; only purchasers of Hotchkiss wheelchairs are eligible for loans. No other firm in

Colombia offers credit to purchase a wheelchair. Availability of credit appears to give the Hotchkiss chair its competitive advantage, especially the hospital version which competes directly with other brands.

The loans provided by the ATI-funded project require a 20% downpayment and are issued for a maximum of 15 months at a 26% interest rate. Repayment schedules are structured so that larger installments are concentrated in the first three months. There have been very few defaults to date.

At present 21% of the repayments are returned to the fund with 5% of the interest earned going toward CRRV's operating costs. Given an inflation rate of about 25% and rising administrative costs, prices will have to be increased and/or interest rates raised to maintain the viability of the fund. Because this would price the chair even further beyond the reach of the low-income consumer, it may be necessary to devise some kind of sliding interest rate and price scale, based on a family's ability to pay. If the revolving loan fund can be made self-sufficient, the replication effort in Colombia will likely continue for years to come.

#### **4. LESSONS LEARNED**

##### **Modifying the Technology**

These two case studies--the active marketing of the ATI-Hotchkiss wheelchair and the initial spontaneous dissemination of the Bielenberg ram press point out the choices involved in selecting a replication strategy. Does one choose a tactic that

disseminates a technology as quickly as possible or one that best protects the integrity of the technology?

As the use of a technology spreads, the product design and production process will be adapted to local conditions. Some modifications may improve the product; others may result in an inferior product which may hinder further efforts to disseminate the technology.

In the case of the ATI-Hotchkiss wheelchair, several modifications in both the prototype design and assembly process were made during workshops and technical exchanges as well as during the course of the replication projects in Peru and Colombia. Because these modifications were made in a controlled environment, most changes tended to improve the product. In the case of the Bielenberg press, however, there were no engineering drawings or production manuals and the changes had both positive and negative consequences. Some press manufacturers, in an attempt to lower production costs, began using thinner metal, which resulted in an inferior press prone to frequent breakdowns.

Clearly, a balance must be struck so that there can be genuine innovation and improvement in cost or performance, as well as rapid diffusion of the technology to ensure that benefits accrue to the target population. ATI's experience in both cases indicates the importance of standardizing the design and establishing a workable system for information collection and exchange to "protect" the integrity of the technology as it is disseminated.<sup>17</sup>

### A Combination Of "Replication Modes" Should Be Used

ATI's experience suggests using a combination of tactics to disseminate a proven small-scale intermediate technology. Initially, efforts should be made to improve and adapt the technology to specific locations and eventually standardize the design as improvements are incorporated. Once the best design is selected, production manuals, containing engineering drawings and production guidelines, should be prepared. Although a manual can ensure a more standardized product, it alone cannot guarantee the quality of the product. ATI's experience shows that providing designing jigs, fixtures and training are equally critical. But even under the best of circumstances, mishaps in quality control do occur, as in the case of ATI's initial experiences in Peru. Perhaps patenting or licensing a product or instituting some type of franchising arrangements may solve many problems involved in quality control. As of yet, ATI has no experience in this area.

Later, as the technology and product become established in the market place, greater reliance on the pull of the market is possible.

### The Need for a Market-Oriented Approach

There is a marked tendency in technology dissemination efforts to emphasize production over marketing and to conceptualize the problem in terms of "pushing" the technology onto a target group rather than aligning the product with the

demand "pull". This "technology-push" orientation should be resisted. Dissemination is first and foremost a marketing challenge.

A business attempting to introduce new product into the market must assess consumer demand, price elasticity, advertising and promotional strategies, the state of the economy, its competitors, and trends in consumer preference. Marketing experts claim that the key to any successful marketing program is access to distribution channels, whatever form they may take. However, the best marketing strategy is useless unless the customers are able to afford the product. Thus innovative financial mechanisms, such as credit subsidies or a lease/purchase plan may often be an indispensable part of an overall marketing strategy.

In Colombia, greater market awareness led to the production of two different wheelchair models, each of which responded to different user needs. Specialized marketing tactics were utilized to reach the identified target group, the disabled poor. Even though there is a tremendous need for wheelchairs, that need alone does not automatically translate into thousands of customers if such customers are unable to afford the product. Locating third parties to pay half the cost of a wheelchair for a poor disabled person has proved to be an effective marketing approach to reach the target group. Under this approach, it is the poor consumer and not the producer who is subsidized.

Three other marketing factors have played an important role in contributing to the success of the Columbian project. First,

the implementing organization (CF) delegated the marketing of the chair to CRRV, an organization that had an extensive network of contacts among the social service agencies. Second, the media was used to promote the product. Third, and most important, offering credit to customers gave the Hotchkiss chair a competitive edge in the Colombian market. Customer credit has also proven to be an important factor in rapidly disseminating the ram press in Tanzania.

From a marketing perspective, replication begins not with the development of a technology but when people's needs and interests are determined and incorporated into the design of the technology itself. The widespread demand for the Bielenberg press can be attributed to the fact that it was designed specifically to fit the needs of the poor rural farmer with no means to grow large quantities of sunflower seed. Designing a project or developing a technology from a marketing standpoint, is essential if widespread spontaneous dissemination is to occur.

#### The Importance of Sustainability in Expanding Benefits

A common shortcoming of many development projects is their inability to continue on a self-financing, self-sustaining basis once external funding comes to an end. All too often projects are forced to limit services or cease activities because project revenues are unable to cover project expenses. For this reason, ATI attempts to establish economically sustainable mechanisms in projects that will support the dissemination of technologies after outside sources of funds inevitably "dry-up".

As originally designed, the sunflower seed oil project in Tanzania was to incorporate a self-sustaining development finance company. As discussed earlier, the decision of the implementing organization to abandon the profit sharing scheme and to not charge interest prevented the project from establishing itself as a commercially viable entity. Assuming project overhead expenses remain at current levels, the revolving loan fund is expected to be depleted in the early 1990s.

The Regional Sunflower Press replication project discussed on page 15 should solve this problem by expanding dissemination of presses throughout sunflower growing regions in Tanzania. In addition to working directly with a number of manufacturers to produce the press, this project will operate a credit program.

In the wheelchair project, several implementing organizations approached production as a charitable operation rather than as a sustainable enterprise. The most commercially successful replication effort (in Colombia) consciously assumed a business orientation from the start.

#### The Priority of Reaching Agreement on Project Goals

Ideally, all organizations involved in a replication effort should agree on project goals in advance. If differences in philosophy are not addressed during the design stage, confusion may result. In the Tanzanian village oil project, for example, ATI emphasized commercial viability; the ELCT/AS preferred a less market-driven approach.

In the wheelchair project, the ideological viewpoint that

wheelchairs should be produced by the handicapped may well have adversely affected the goal of getting low-cost durable wheelchairs into the hands of users. However laudable in theory, selecting workshops on the basis of having disabled employees may have compromised the overall goal of commercial viability and technology dissemination. Enterprises must have personnel (disabled or not) who have both technical and business expertise. This is as important an ingredient for success as proper equipment, financial and marketing networks. It is, therefore essential to clarify one's objectives and goals before embarking on a replication effort.

#### The Dangers of the Blueprint Approach

Although common agreement on project goals is essential, there is also danger in rigid adherence to "blueprints" during project implementation. Flexibility is very important. In the Tanzanian project, for example, the willingness to learn from error and change the technology, rather than continue with dissemination of the scissorjack presses, enabled the project to create more jobs than originally planned and expand benefits to more people.

#### The Positive Role of Private Entrepreneurship in Replication

Many NGOs prefer to work with groups rather than individuals since they believe that any individual with the financial resources necessary to become an entrepreneur does not merit or need help in the first place. However, ATI's experience has shown that individual entrepreneurs and small

enterprises can often be as instrumental - and sometimes even more instrumental - in promoting technologies than community-based organizations. The critical variables appear to be the nature of the group, its purpose, and how benefits are distributed. During the initial phase of the ram press project, for example, the implementing organization decided to restrict financing of the press to congregational and other village-based groups on the grounds that congregation members were among the most educated and motivated community members, that pastors had experience in leadership and dealing with funds, and that group ownership would spread both the risks and profits of press ownership.

As it turns out, the supposed advantages of group ownership were not as clear cut as originally expected. For one thing, group-owned presses were often managed by individuals and organizations not directly dependent on the success of pressing activities. Moreover, no evidence was found to support the argument that group ownership spreads the financial risks of press ownership. Among nearly every press owning group, there was generally one "prime mover" who, as a result of having invested more, stood to lose or gain the most should the enterprise fail or succeed.<sup>18</sup>

In addition to being more business-oriented, individual owners also tended to reinvest their profits locally. While it may be true that collective ownership spreads profits among group members and limits the concentration of wealth, individual press

owners have been more likely than groups to reinvest their profits in local enterprises. Since group ownership reduces the amount of capital accumulated per person, it may even reduce investment in other small enterprises. The following anecdote of one Arusha entrepreneur supports this argument:

" Abdi Eli Minja, a school teacher in Gichamedia village, purchased a ram press with modest financial support from two fellow teachers.... The result is that in less than three months, profits from the small enterprise have enabled Minja to start up a small dry goods shop that generates up to T.Sh. 900 in gross sales per day" <sup>19</sup>

It is essential to point out, however, that group ownership does not by any means preclude the successful operation of an oil pressing enterprise. In the first year of the project, the most successful oil pressing enterprise was operated by a group, Kiru Six. Two secondary boarding schools now are successfully operating pressing enterprises; sunflower seed is grown on school property and the oil is used to prepare the students' meals.

#### The Important Impact of Policies on Commercial Viability

In many less developed countries, macro-economic and sectorial policies artificially favor technologies that are large-scale and capital-intensive. As we have seen in the Tanzanian oil project, however, such policies may also create new opportunities to introduce "appropriate" technologies. Under these circumstances, however, it is essential to assess how long such "window of opportunity" will remain open. Because the situation may only be temporary, to reduce risk, it is important

that the technology be low cost and have a relatively short payback period. Once the technology has been mastered, the next stage of commercial development would be to increase understanding of the macro-policies affecting businesses and develop strategies that respond to them.

### The Importance of Replication Planning

A final lesson concerns the importance of planning for replication in project design and implementation as well as the importance of setting up systems to develop and implement replication strategies for individual technologies. The dissemination of each technology requires an individualized strategy adapted to its unique features and market opportunities

The replication process at ATI begins with project development. Project officers select technologies that have strong replication potential, both in initial target area and in other regions. In ATI's final project plan, a section is devoted to analyzing replication opportunities and identifying a preliminary list of replication agents. The "agents" of replication can be private enterprises, NGOs, government organizations, AID or even ATI. Replication, therefore, is incorporated into the planning of every ATI demonstration project.

Once a project is funded and implemented, ATI attempts to keep potential replication agents informed of the project's progress. Technology letins are produced and disseminated. Technical, commercial, and socioeconomic evaluations are shared

with potential replication agents, as are Annual Project Status Reports. These reports provide annual updates on the benefits of a demonstration project--employment created, income generated and backward and forward linkages. Commercial assessments provide potential replicators with insights into business operations and market strategies pertinent to the technology. Depending on the demand, technology manuals, videos, and/or training programs may also be developed.

The two cases described here illustrate different approaches ATI has taken to replication. Initial dissemination of the sunflower seed oil press in Africa was a result of market forces -- a spontaneous replication. In contrast, the introduction of the ATI-Hotchkiss wheelchair to several countries in Latin America was a more directed effort, which involved ATI financial and technical support from the outset. In both cases, a critical element was communication, whether planned and directed or simply a result of fortuitous circumstances.

It is clear that in order to maximize the impact of individual development efforts, NGOs and PVOs need to share ideas and experiences and to assess what works and what doesn't. This information needs to be documented and distributed throughout the development community. We believe this paper is a modest start in this direction.

## NOTES

1. For a discussion of the definition of appropriate technology see: Hyman, Eric, "The Identification of Appropriate Technologies for Rural Development" in Impact Assessment Bulletin, Vol. 5, No. 3 (1987); pg.35-55.
2. This definition of "replication" was formulated by ATI in its Replication Strategy Addendum to the Long Term Strategy completed in May 1985 and incorporated in the contractual relationship between ATI and the Agency for International Development in Modification #4 of the AID/ATI Cooperative Agreement, finalized in September 1985.
3. Information contained in the Annual Status Reports of the Village Oil Project by John Skibiak and Jeff Rasmussen, and I have also used information from the project's unpublished mid-term evaluation conducted by Tim Mooney and John Skibiak.
4. The 20-ton and 80-ton figures refer to the rated force each model was capable of generating.
5. Tim Mooney relates that between 1980 and 1984, the regional market for sunflower seed in Arusha declined 80%, from 400 tons to 80 tons. At the same time the official price for sunflower seed oil jumped almost 93%, from \$13.33 to \$25.70 per imperial gallon. Government policies that gave priority to cotton and other crops, import restrictions, a decline in local processing capacity due to machine breakdown and the lack of spare parts also contributed to the decline.
6. Steering Committee. (1986, April) "Minutes of the Village Oil Seed Project Steering Committee Meeting". Unpublished manuscript, pg. 5.
7. Based on Tim Mooney's commercial analysis of the Oil Project in 1988 using exchange rate of 96 TSh = US\$ 1. His assumptions were: (1) a high grade seed is used--50 kg of seed yields 12 liters of oil; (2) 75 bags (50 kgs. each) are processed per year during the six month pressing season; (3) the price of raw seed is 800 TSh (US\$ 8.30) per 50 kg. bag; (4) cost of labor is 23 TSh (US\$ 0.24) per liter (a wage 60% higher than the minimum wage); and (5) the selling price of oil is 200 TSh (US\$ 2.08) per liter. He concluded that if these assumptions hold true, the press will generate a net income of 82,350 TSh (US\$ 857) in a normal six month pressing season. The press could be even more profitable if oil yields are higher (yields as high as 16 liters per 50 kg. bag have been recorded) or if the press is operated at full capacity (150 bags of seed can be processed annually). Full capacity use, of course, depends on the availability of sunflower seed.

8. Transcribed comments of Lynn Schlueter, the project director of the ELCT/AS Village Oil Project, at the Regional Oil Press Meeting in Nairobi held February 20, 1989.
9. Skibiak, J. (1989) "Annual Status Report: Village Oil Processing in Tanzania" Unpublished document: ATI, pg. 6-7
10. Ibid. pg. 8
11. Ibid. pg. 8
12. Ibid. pg. 9
13. Based on observations by Tim Mooney contained in the Mid-Term Evaluation of the Village Oil Project.
14. Smith, J.G. and others, (1984) "Wheelchairs for the Third World". Washington DC: ATI.
15. Martin, R., (1988) "Background on ATI/Wheelchair Project". Unpublished memorandum: ATI.
16. This section draws heavily on an unpublished report authored by Mike Goldberg, former ATI project officer for the Latin American region, entitled " A Comparison of the Peruvian and Colombian Hotchkiss/ATI Wheelchair Experiences".
17. Patents may be very important in safeguarding technologies and at the same time, provide an incentive for private sector R&D expenditures.
18. Skibiak, J. (1987) "Tanzania Village Oil Project: Mid Term Evaluation", unpublished paper: ATI.
19. Anecdotal statement from the Mid-Term Evaluation, op.cit.

ANNEX 1

Diagram of Ram Press

ANNEX 2

Photographs of Ram Press

ANNEX 3

Three Models of Hotchkiss Wheelchair Made in Colombia

ANNEX 4

Background to the Development of an ATI Replication Strategy