BATTERY-OPERATED LAMPS PRODUCED BY RURAL WOMEN

BANGLADESH

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The project "Opportunity for Women in Renewable Energy Technology Utilization in Bangladesh" began in 1999 with funding from the Energy Sector Management Assistance Programme (ESMAP), a joint programme of the World Bank and UNDP. The project grew out of ESMAP's commitment to work towards poverty alleviation and gender equity by supporting sustainable energy solutions for people in rural areas.

Through consultations with community members and non-governmental organisations (NGOs) about energy needs in an area of remote islands outside the reach of the grid, electric lighting was identified as a high priority. The project identified a low-cost solution for improving the quality of indoor lighting of rural households by replacing the traditional kerosene lamps with modern battery-operated lamps. Using a unique approach, the project trained rural women to produce the lamps in a micro-enterprise manufacturing facility and distribute them through rural markets. By helping women shift away from traditional farm labour to skilled labour and gainful employment in the energy sector, the project has elevated the knowledge base of rural women and exposed them to mainstream commercial activities, while also meeting community needs for lighting.

At this point, through the micro-enterprise project, 33 rural women of Char Montaz are engaged in the construction and sale of efficient fluorescent lamps that use direct current (DC) batteries of 12 volts or eight volts. More than 600 lamps are being used with small batteries for lighting houses, shops, fishing boats, and mosques. The long-term target area of this project covers nearly 20,000 households within 300 square kilometres located outside the reach of grid electrification.

Bangladesh has an agriculture-based rural economy. Out of over 120 million people, 80 per cent live in rural areas. Per capita yearly commercial energy consumption is less than 100 kilogrammes of oil equivalent. The 20 per cent of the population living in urban areas consumes 80 per cent of the total commercial energy. The rural majority uses traditional forms of biomass energy, which account for nearly 70 per cent of the total energy consumption of the country. People in rural areas lack access to the commercial energy needed for economic prosperity. Apart from the need for a distribution system for commercial fuel, there is also a need for policy guidelines and an institutional framework for improving access to energy to promote economic development for the rural poor.

For lighting, people in rural areas currently use kerosene. Typically, poorer households use ***kupis***, which are small inexpensive cans of kerosene with wicks stuck into them. Because these have open flames, they create serious fire hazards. Households with greater resources purchase hurricane lanterns which surround the flames with glass enclosures.

So far very little attention has been focused on the relationships between energy usage patterns and women's development needs. NGOs have engaged rural women in successful micro-credit programmes, but these have not focused on energy services. Sporadic projects have been implemented in the past by different government agencies and NGOs to improve women's cooking conditions, and to reduce the time spent by women and children in collecting fuel wood for cooking. The overall impact of these activities on women has not been well documented, however.

Rural electrification has had a direct impact on the growth of the rural economy, especially when electricity has been used for irrigation and other agricultural applications. Household electrification also has direct and indirect income benefits for rural households, especially for women and children. Electricity can be used not only to pump water, but also to relieve rural women of the physical burden of milling grain, allowing them more time for other activities.

Grid-based rural electrification in Bangladesh is not likely to increase from the present low level of 18 per cent to a reasonably acceptable figure within the near or medium term. Nor will it be economical to supply grid access in areas of low population density. Due to low energy consumption patterns in rural households, new rural grid-based electrification projects require significant demand for electricity for commercial, industrial or irrigation uses. Hence, it is necessary to investigate alternate supply sources and delivery mechanisms for those living in sparsely populated rural areas.

Traditionally, entrepreneurs operate diesel generators for evening lighting and productive power in non-electrified rural marketplaces. This is not yet an economic solution for rural households, which are generally left in the dark. Culturally, in Bangladesh, rural women are barred from the public markets, hence they and their children mostly spend the evening hours around kerosene lamps or in partial darkness.

Given the disparities in the situations of men and women, this project was designed as an experiment intended to support progressive improvement of women's lives, economically, socially and environmentally. Although the economic empowerment and social uplift is limited to direct participants in the project area, the overall impact of an improved environment for women has far-reaching potential that expands with every new household that adopts modern lighting.

Women's Lamp-Making Micro-Enterprise Project

The location of the project is Char Montaz in the southern region of Bangladesh, surrounded by the endless waters of the Bay of Bengal. ("Char" refers to an island isolated from the mainland.) The people in this area of Bangladesh periodically experience the trauma of natural disasters, and continually fight against poverty. It is a five-hour motor boat ride from the nearest commercial centre, Golachipa, in Patuakhali District.

Electric grid extension to this area is not economically viable, and is not included in the national plan for the next 20 years. Alternative energy sources, therefore, are crucial to economic development of the region. Surveys showed that demand was high for battery-operated lamps that provide an alternative to kerosene for lighting.

The project has shown that with proper training rural women are capable of assembling and marketing electric lamps to meet local needs. The women involved in the project are certified by the local government to do business as a cooperative, and run the manufacturing plant that produces the lamps. Besides lamp construction, women are learning quality control, business development and marketing. The project is also establishing a sales network among the rural markets situated on six different islands.

If a woman constructs and sells two lamps a day, her daily household income increases by 100 Taka (approximately US $2). This brings a woman the equivalent of the daily wages of a skilled labourer, thereby raising her income and social status.

Through the project, the rural private sector is directly involved in the implementation of the project, manufacturing of the lamps, and marketing and sales of energy services. In a country where rural electrification is viewed as a public service, the project has identified a niche for private-based operations that support broader rural development. It is the first model of its kind.

There are a number of advantages that make the DC lamps popular:

- The lamps use small batteries, familiar to rural households, that can be charged with diesel generators, which are currently available, or with solar modules when they become available.
- The lamps are made locally in the region, therefore users are confident about availability of repair services.
- The lamps use fluorescent bulbs, which produce sufficient light for children's reading and other tasks of a rural home, and exceed the normal working life of incandescent lamps.
- The lamps are designed to operate with high efficiency and low energy consumption.
- The price is affordable in relation to the benefits achieved.
- The lamps reduce the risks of fires from kerosene lamps, as well as smoke and emissions that cause health problems, air pollution and climate change.

Site identification

Selection of the project site for the women's micro-enterprise project began with area surveys to determine the potential market demand for DC lamps. Pre-determined selection criteria concerned the existence of any foreseeable government plans for electrification, the level of household density in the villages without electricity, and the general economic situation of the area.

The target area of Golachipa thana was found to have enthusiastic women participants, as well as a number of other favourable factors relating to:

- The potential market for DC lamps.
- Household income distribution in the region.
- Commercial and rural markets for sales centres.
- Entrepreneurs interested in becoming agents for selling DC lamps.
- NGOs involved in other development activities in the area.
- Support for the project from elders and the local elite.
- Support of the local administrative bodies.

Char Montaz was chosen to be the site for the lamp manufacturing plant. The factory was completed in February 2000, in space rented from a local NGO. A three kilowatt diesel generator was installed and is being used three hours a day for soldering the printed circuit boards used in the lamps.

The total number of households in the target area that lack electricity is nearly 20,000, including those on the mainland. Overall household density in the target area is approximately 65 per square kilometre.

Because the islands are isolated from the mainland by rivers flowing into the Bay of Bengal, the only means of public communication is through small motor boats for river transport. There are very few roads and motorised vehicles are nearly non-existent. Although there are a number of primary schools in the area, there are very few high schools, and only a couple of health centres.

Most people in the project impact area are involved in the local fishing industry. A large portion of their annual income is tied to this seasonal activity. Agriculture and farming also provide alternate sources of income for the population. Education and literacy levels in the area are average for Bangladesh.

Stakeholder participation

The primary basis for development of this project came from previous studies done by the designers of solar electrification projects, including a 1998 Survey of Solar PV Applications in Rural Electrification conducted by Prokaushali Sangsad Ltd. and funded by the World Bank. These surveys focused on energy utilisation patterns by rural households. The team leaders supervising the surveys, who are women engineers, took a special interest in the voices of the rural women, their current energy usage patterns, and their expectations from future programmes. In response to candid remarks made by rural women, the project designers felt the need to utilise the potential of the rural women, in terms of skills and ideas, in designing energy service delivery mechanisms.

Local NGOs were consulted at the early stages of project implementation. The survey identified five local NGOs pursuing development activities in the islands, primarily related to health and sanitation, education, and micro-credit. Nearly 90 per cent of the beneficiaries of these programmes were rural women. Since rural energy was not a mainstream activity for the NGOs, they were hesitant about offering micro-credit for energy equipment, and had to be educated about the impact of improved lighting on poverty alleviation and health of rural people, as well as potential income generation opportunities.

During the consultation phase, women were invited to share their thoughts on establishing project objectives and developing a detailed execution plan. Prospects for electrification were found to be of primary interest to the community as a whole. Meetings were held with the women, the local market committee, the school teachers, the local elite and NGOs during preparation of the execution plan. Since it was clear that conventional grid electrification would remain uneconomical in the area because of its remoteness and inaccessibility, off-grid technologies were perceived as the optimum choice for household lighting. In addition to modern lighting, efficient stoves and fuel-saving technologies were of great interest to the rural women.

During the initial stages of the project the NGOs showed great enthusiasm and support, especially because of the possible employment opportunities for their members. Local NGOs provided logistic support for execution of the project on a con-

tractual basis. They also assisted in preparing the first tentative list of women participants, including non-NGO members.

Recruitment of potential participants in the micro-enterprise project was undertaken from September to November of 1999 through announcements and distribution of handbills in local villages. The staff members of the local NGOs also discussed the opportunity with their contacts. Out of nearly 100 interested applicants, 52 women were selected for interviews. In total, 35 women qualified for participation based on their interest in the potential activities, levels of education, present occupations and aptitude for business. Most of the women selected for the project (93 per cent) were between 16-30 years of age. Nearly 54 per cent of the selected women had attended school up to grades six to eight, while 46 per cent had completed primary school education. None of the women had been employed before, although many were experienced in handling micro-credit through local NGO programmes.

Training of women participants

Technical training for the women participants began on 1, December 1999. Two groups of 17 were formed for the total training programme, which included:

- Identification of electronic components.
- Identification of tools.
- Printed circuit board (PCB) assembly.
- Quality control and testing.

After training in the use of the tools, and experience with the electronic components, the women were examined to ensure that their technical skills were adequate for reliable construction of the lamps. Written instructions were also provided for reference.

Training in business operations began in April 2000. Then, in June 2000, extensive training in accounting and bookkeeping was initiated for the group leaders who were to manage the manufacturing plant. Through a series of 28 lectures, these women gradually acquired a firm understanding of accounting and business operations. Today, with minimum supervision, the women keep accounts relating to daily production, sales revenues, and costs of the factory operations.

Market development

In order to develop a market for the lamps, the project advertised them by organizing public meetings, distributing handbills, and setting up billboards and posters. In addition, demonstrations of the lamps were conducted at several locations, including shops and residences. The public meetings, and placement of posters at local markets, boat landings and administrative offices, created widespread awareness of the lamps.

A detailed marketing plan was developed by the women involved in the project, based on the business training they received concerning different aspects of marketing analysis and energy demand assessment. The marketing plan covers factors such as business location, customer characteristics, target markets, competition, electricity demand, marketing goals and strategies, and budget considerations. The women hold monthly meetings to discuss project operations and local issues relevant to business development.

FIGURE 1

FIGURE 2

As a part of their market assessment efforts, the women recently conducted a questionnaire survey of 488 households in villages located within the Char Montaz area. The information that they compiled about current use of hurricane lamps and kupis, shown in Figures 1 and 2, is being used to help develop marketing plans. Many of the households surveyed were spending significant portions of their income on kerosene for lighting. Households earning more than 2,000 Taka per month (60 per cent of the total) were generally interested in purchasing DC lamps to replace their kerosene lanterns and kupi lamps. Their willingness to buy DC lamps was affected, however, by the unavailability of reliable battery charging facilities and the high initial cost of batteries. Overall, only 47 per cent of the surveyed households were actually willing to purchase a DC lamp.

There are a number of outlet centres and retailers engaged in sales of DC lamps in the neighbouring islands, and overall sales of lamps are expected to increase progressively as a result of the project's marketing drive. Maintaining and expanding the existing marketing network in the region will be important for increasing lamp sales. Additional sales agents are being recruited, and distributors from the towns of Patuakhali and Barisal are interested in selling the lamps.

Lamp sales are closely tied to the availability of batteries and reliable battery-charging solutions. Recharging batteries is dif-

ficult when battery-charging stations are located more than two kilometres away. The project has set up the first diesel battery-charging station in Char Montaz so that local battery users do not have to carry batteries to Golachipa, a five-hour motor boat ride away. In addition to charging batteries, this station is the major outlet centre for the sale of lamps manufactured by the cooperative, as well as reliable batteries sold at affordable rates. The battery-charging station in Char Montaz is also meeting the lighting needs of about a 100 nearby shops and households using a diesel micro-grid.

In view of the need for battery charging, the women's cooperative is co-investing in two other battery-charging stations on two other islands. It is envisioned that solar panels will soon replace diesel as the power source for all the battery-charging stations. At that stage, the women's enterprise is also expected to function as an electricity service company (ESCO), renting out solar panels in response to local market demand. A trained group of technicians will be maintained by the cooperative for installation and maintenance of the solar panels.

Financing and access to credit

Despite the popularity of the lamps, sales are hindered by the lack of consumer credit for purchasing the batteries. In order to investigate the feasibility of selling batteries through credit, 30 participants in the project were offered batteries on credit. The women made the repayments in biweekly instalments over four months, after which they had full ownership of the batteries. Following this experience, the project successfully sold 122 batteries on credit to outside clients. Almost all the purchasers were known to the women in the project, and they repaid their loans in full. Extension of this sort of financing arrangement could make lamp purchases affordable for many more people, thereby expanding the lamp market.

Future project enhancement should build on the capacity of rural women in micro-credit management and focus on "energy credits." Wider availability of credit for batteries is already under consideration for the next phase of this project. The women's micro-enterprise would then offer the following energy services: cash sales of DC lamps; credit sales of batteries; battery recharging and leasing of solar panels for household battery charging.

With a suitable financing plan, service providers could offer solar panels for household battery charging. A World Bank funded market assessment survey conducted by Prokaushali Sangsad Ltd. in 1998 revealed that "fee for service" was the mode of payment most preferred by non-electrified rural households. This sort of arrangement spreads out payments on a monthly basis, thereby eliminating the high initial costs that prevent many people from purchasing solar systems. Even under this arrangement, however, using private commercial funds for financing solar lighting projects would generally result in monthly fees beyond the means of many rural end users. Hence, it is expected that some financial subsidies will be needed to reach a broader group, at least in the short-term.

Nearly 80 per cent of the surveyed households were willing to pay a monthly service fee of 160 Taka for a solar home system capable of lighting three lamps or a television. This possible market opportunity recently caught the interest and attention of the public sector, where long term plans are being investigated. Scaling up available credit facilities to any significant degree, however, would require involvement of local banks and financial institutions in micro-credit for energy products, as well as establishment of favourable government policies.

Benefits to women

Although the project is only operating on a limited scale, its impact can be seen, above all, in terms of the empowerment of women through acquisition of technical skills. Lamp production provides a new opportunity for women to earn a living, one in which their labour is highly valued. Non-farm labour among women was not significant in the area prior to the project. Now their employment prospects have increased.

Besides increasing the non-farm skills of rural women, the project has also allowed them to generate income, play a role in decentralised energy service delivery, improve their quality of life through better lighting, and raise their status in the household and community.

Income generation has been a key motivation for people buying the lamps. Among the women who purchased batteries with credit, six out of 30 used the lights for extending their business hours in the evenings. Women with tailoring businesses at home worked an additional four hours, which increased revenue by 30 per cent (especially during festival periods). Some women let their husbands use the lantern in a retail shop in the market, giving them three extra hours of sales beyond the four hours provided by the local diesel lighting service. Household income was found to rise with electric lighting in the work place, and adequate lighting was found to be a deciding factor in whether people opened a home-based business that could be managed by family members on a part-time basis to augment household income.

Families with school age children show significant interest in purchasing lamps with batteries. These families want their children to have better light for studying. Children even encourage their parents to save money for purchasing the lights. Increased hours of studying by children and reading by elders has a direct impact on the family's long-term well-being. Adults living in households with electric light are found to encourage higher education for their children, and it is

anticipated that a majority of the children in the area will use electric appliances when they become the decision-makers in their own households.

Women who are involved with lamp construction and, by extension, with addressing the overall energy needs of the region, are being heard more. Project participants and their associates now run meetings to discuss prospects and problems in micro-enterprise operations, regional sales and electrification issues.

The husbands of the project members offer assistance to the working team of women, especially in marketing and sales. Individually and collectively, the women are encouraged to bring their husbands to monthly meetings with the marketing manager in order to discuss potential business prospects. Such interactions have been found to build women's confidence, and interest in the project among the men. As a result, the project has been successful in removing some of the social and cultural discrimination experienced by women.

Regular participation in project activities requires women to spend time outside their homes, thereby overcoming a traditional social barrier. In addition, other family members are found to support the women by taking on household responsibilities in order to help them participate in training and production activities. With the electric lamps, housework can be done at night and women can restructure the time they spend on household activities. Women working on project activities have also shown interest in more energy efficient cooking equipment that would save time spent in cooking and allow more time for earning income. Such shifts in priorities of households in remote rural areas of the country are a sign of the social changes achieved by the project.

Environmental impact

The battery-operated lamps have replaced traditional hurricane lamps and kupis that use kerosene as fuel. Consequently, at the household level, there is significant reduction in indoor air pollution that is known to cause damage to health, as well as reduced risks of household fires. Large-scale use of batteries instead of kerosene could also reduce overall greenhouse gas emissions. In the long run, charging batteries with solar-powered equipment rather than diesel engines could eliminate emissions altogether.

LESSONS AND CHALLENGES

This women's micro-enterprise project is a pioneer effort testing the social and economic viability of using local producers to provide modern lighting equipment for rural households. Considering the prohibitive cost of grid-based electricity, the national rural electrification programme will not serve many remote areas of Bangladesh, even in the long term. Meanwhile, this project is establishing a sales network for an affordable off-grid lighting solution.

The women involved in the project have handled the challenge of setting up and operating the lamp factory. They have received moral support from the local people and have gained personal status because the lamps are valued consumer items within the region. Empowerment is evident among the group leaders and their associates. Typically, in Bangladesh, few women are encouraged to serve in supervisory positions, but this has begun to change through the ongoing training of women in business and leadership roles.

It is anticipated that in the near future the women's micro-enterprise will begin offering a pilot off-grid "fee for service" mode of electricity delivery using solar home systems to serve the dispersed households of the area. It is anticipated that in a favourable policy environment, a well directed "energy credit" to potential rural consumers will result in rapid adoption of this type of alternative energy option. This model for providing off-grid rural energy services through a micro-enterprise project could be replicated if the pilot is found to be economically and socially sustainable in operation.

Expansion of off-grid energy solutions will require financial resources as well as effective institutional models and financing mechanisms. Donors and funding agencies can support such innovative endeavours by contributions aimed at addressing the initial high costs of purchasing equipment which present barriers to equipment purchases by the rural poor. Finally, long-term benefits can be achieved from collaboration and partnerships among micro-enterprise projects, local governments, NGOs, formal financial institutions, and investors.

By helping women shift away from traditional farm labour to skilled labour and gainful employment in the energy sector, the project has elevated the knowledge base of rural women and exposed them to mainstream commercial activities, while also meeting community needs for lighting.

ENERGY FOR RURAL WOMEN'S ENTERPRISES

GHANA

SABINA ANOKYE MENSAH

UNIFEM has supported the economic empowerment of women in Africa and other regions for many years. One of the major lessons drawn from its work is that lack of reliable, affordable and locally-available energy supplies limit women's productivity. For this reason, UNIFEM designed a project on "Energy for Sustainable Women's Livelihoods: Gender Responsive Renewable Energy Systems Development and Application" (GRESDA). The goal is to demonstrate selected marketable and appropriate renewable energy equipment and energy efficient appliances that can be used to create sustainable rural industries.

The project focuses on food-related activities since the majority of rural women in West Africa are involved in agriculture, small and medium scale food processing, and trade in such commodities as palm oil, shea butter, cassava, millet, smoked fish, vegetables and fruit juices. Its objective is to contribute to women's economic empowerment and food security by introducing energy technologies and equipment that improve agricultural processing enterprises and reduce post-harvest losses.

The strength of the UNIFEM approach lies in its emphasis on letting women speak for themselves. Consultations with women have provided important insights into the actual needs of rural women with regard to improving their occupational opportunities. Women have also been actively engaged in appraising equipment and adapting it to meet their needs.

Activities initiated by GRESDA in Ghana include development of an improved press for shea butter processing and of a more efficient fish smoker. Continuation of the GRESDA projects, however, will depend on attracting additional resources.

While gathering information about women and food security, UNIFEM funded a comprehensive research project to analyse existing renewable energy alternatives and assess their availability and feasibility for application in rural areas of West Africa. Experience in Ghana and Nigeria had already shown that one of the main impediments faced by rural women entrepreneurs in optimising the efficiency of their food processing activities was having to use wood for fuel. It is time consuming to gather wood and tend to wood fires, the smoke is harmful to women's health, and wood consumption contributes to deforestation.

Rural electrification is progressing but many areas remain without access to the electricity grid and are likely to remain so for a long time yet. The challenge that many African countries face is to strengthen national capacity to develop, operate and maintain alternative and renewable energy systems, and to ensure that women—who contribute to 70 per cent of the food security in Africa—control and benefit from these systems.

Most women either work individually near their homes or are organized into small business cooperatives. With the deepening of the economic crisis, more and more women are moving from subsistence-related activities to rural food processing enterprises to earn a living. Despite the growing importance of small-scale food processing for the economy, there is very little formal research or training available to support these activities. Moreover, there is little attention to women's energy needs. In most countries in the region, government energy policies do not take gender issues into account, and energy concerns have not been high priorities of women's organizations.

In the past there have been some successful attempts to support the output, efficiency and environmental sustainability of women's activities by introducing devices such as fuel-saving stoves, fish smokers and other equipment, but these have mostly focused on women's needs as household consumers rather than as producers or entrepreneurs. In addition, the technologies introduced were often designed without either a proper needs assessment or the participation and input of women end-users, and this led to problems in acceptance of the new equipment. This project emphasises participation by women, as well as the importance of increasing income so that women can afford to pay for improved processing equipment.

Stakeholder consultations

During phase one of the project, UNIFEM commissioned a baseline study on the energy use and technology needs of women in major economic sectors, with special reference to food processing. National consultations were held in Ghana in 1998 and in Nigeria in 1997. Participants in both workshops included policymakers, financial and research institutes, non-governmental organizations, international development and cooperation agencies, UN representatives, the private sector, grassroots women's agricultural processing cooperatives and women entrepreneurs.

The national consultation in Ghana involved over 120 participants and stakeholders from the ten regions of Ghana. The consultation was unique in that it raised awareness about renewable energy technologies as well as the significance of gender responsive development.

Notwithstanding their traditional roles as mothers and wives, women in Ghana engage in a variety of productive activities to sustain their subsistence-level standard of living. These activities are generally carried out using labour-intensive techniques. Because rural women have so many responsibilities, they often cannot accomplish all their daily tasks. This results in a situation where a good proportion of farm produce is not processed for long-term storage and there are substantial post-harvest losses.

To provide a permanent solution to rural women's problems, it is necessary to look at the energy requirements of the day-to-day activities of women and begin to design an improved energy supply system.

Women's energy needs include the following:

- Sufficient power for grain threshing and milling, and tuber peeling for domestic consumption and marketing.
- Devices for pumping water from wells, bore holes and rivers.
- Energy systems for lighting, refrigeration and other electrical appliances.

A number of research and technological institutions in Ghana have developed proven energy-saving technologies aimed at reducing the drudgery of rural women. However, due to lack of proper interaction with the rural community, the transfer of these technologies has been very slow.

Through the national consultation in Ghana, UNIFEM and its partners gained valuable insights about project opportunities, and limitations. The country has already developed some expertise on bio-gas and solar photovoltaic technology, as well as solar thermal systems. Wind and micro hydro technologies and knowledge are limited. The discussions also showed that liquefied petroleum gas (LPG) has great potential for meeting women's energy needs, but it is often unavailable in rural areas.

During the national consultation, women engaged in productive enterprises identified the following needs:

- Training in businesses management and operations.
- Credit facilities to buy specialized equipment for improving operations.
- Training in the use of energy-saving devices.
- Support for exchange of information among groups through newsletters and networking.

Promoting income-generating activities for women

Following the national consultations, the GRATIS Foundation was selected to be the implementing agency for the GRESDA project in Ghana. The GRATIS Foundation evolved out of the Ghana Regional Appropriate Technology Industrial Service (GRATIS) Project, which was established by the Government of Ghana in 1987 to promote small-scale industrialization in Ghana. GRATIS has established Intermediate Technology Transfer Units in nine regions of Ghana to transfer appropriate technologies to small-scale industrialists through training and the manufacture and supply of machine tools, plant and equipment.

GRATIS also has a special Gender and Development Unit that provides technical and entrepreneurial skills through the implementation of development projects and extension programmes in rural communities. The activities of this unit include batik, tie and dye production, cotton spinning and broadloom weaving, bee keeping and honey extraction, soap and bead making, food processing (including shea butter and vegetable oil extraction) and citronella oil extraction. The unit has been successful in introducing technologies related to these activities through offices in the ten regions of Ghana.

In 1999, GRATIS organized a strategic planning meeting of GRESDA partners from both Ghana and Nigeria. The major challenge was to determine how to reduce reliance on fuel wood, for health as well as environmental reasons, and to reduce the time women spend in difficult and repetitive work. Discussions centred on ways of promoting the transfer of suitable energy technologies from research institutions to end users, especially by including women in the appraisal and adaptation of these appliances.

At the strategic planning meeting participants agreed to select a few demonstration sites, using information from existing sources and from the application of a rapid appraisal method, a tool for quickly obtaining demographic, economic and social data. The projects were meant to focus on rural areas where women were already engaged in some commercial activity related to food production or agricultural processing and needed a push in terms of technology to make their work more profitable and less difficult. After consulting with women's groups and gathering proposals, GRATIS discussed the suggested options in consultation with UNIFEM, other donor agencies and support organizations.

Although there was substantial interest in renewable energy technologies, the initial project designs involved more efficient processing equipment to reduce drudgery and demand for fuel wood, rather than new energy-producing technologies.

Examples of new energy efficient equipment include a cleaner fish smoker that uses LPG, and a shea butter extractor that dramatically decreases fuel wood consumption, water use and the amount of women's effort required for processing.

Shea Butter Extraction Project in northern Ghana

Traditional shea butter extraction is a major income-generating activity for women in the northern and upper regions of Ghana. Since 1998 over 32,000 metric tonnes of shea nuts have been exported from Ghana annually, generating about US$7,000,000 revenue per year. There is high demand for shea butter in the international market both for cosmetics and chocolate production.

Shea nut harvesting and shea butter extraction are predominantly done by women. Marketing, however, is controlled primarily by businessmen who earn more than ten times the income of the primary producers. The women producers work in small groups but generally have private, individual holdings. Earnings are low, mainly due to the traditional technologies employed in shea butter processing.

The traditional shea butter production process, which gives an average extraction efficiency of 62 per cent, consists of seven steps: grinding, roasting, milling, kneading, washing, cream boiling and clarification. This process has a number of production and environmental drawbacks, including the arduousness of the seven different operations, the long processing time, low production capacity, excessive use of water and firewood, and the women's long periods of exposure to heat and smoke. Many attempts have been made to introduce improved technologies but these efforts have not created the needed impact on small-scale shea butter production. Traditional processing still accounts for about 80 per cent of total shea butter production in Ghana.

Women without working capital cannot run their own operations, and generally work for one of the six local companies that export shea butter. Poor women in need of income are hired by exporters to produce butter for them at very low cost and under very deplorable conditions. In Tamale, the northern regional capital of Ghana, hundreds of women queue daily for a chance to earn a daily wage producing butter for a company. Sometimes 200 women out of 600 women in the queue are

The improved bridge press reduces fuel and water use, as well as exposure to smoke and heat.

THE LEGENDARY SHEA BUTTER

Shea butter is treasured in West Africa for its many healing properties, and legend has it that it is used as an oil and food by the gods. It has been used there for thousands of years as an all-around remedy for skin problems, to ward off wrinkles and stretch marks, rejuvenate skin cells, protect against ultraviolet rays and strengthen weak hair. It also has anti-inflammatory properties that make it useful in the treatment of rheumatism, muscular pain and sunburn. These days, it is found in a variety of pharmaceutical products and high-end cosmetics and chocolates. A 200-millilitre container of rich shea body butter sells for more than $25 in some New York Stores.

The butter is derived from the seed of the shea tree (*Butyrospermum parkii*) that grows wild in the savannas to a height of 55 to 60 feet. Once every year, the tree produces delicious fruits that are harvested during the rainy season. The seeds within are collected and usually sun dried.

At the end of the season when the nuts are well cured and dried, they are threshed. Because the shea nut seed is as hard as a pebble, the grinding process is arduous, especially without grinding machines. The powdered shea nuts are boiled in extra large clay pots for four to five days. The shea butter is skimmed off the top and stored in calabash containers.

selected and given the job of producing butter using the traditional processing method. Each woman is paid a daily wage of 3,000 Cedis, equivalent to $0.50.

The GRESDA shea butter processing project was formulated after women's groups in northern Ghana that had participated in the national consultation organized themselves and appealed to UNIFEM for assistance. They were shea butter producers who wanted to find appropriate technologies that would allow them to increase output, reduce fuel use, and eliminate the middlemen.

The focus of the project is on introducing and testing an improved bridge press that reduces fuel and water use, as well as exposure to smoke and heat. To eliminate middlemen, the project promotes more effective marketing of the women's products and is making efforts to link the women processors directly with international markets through collaboration with shea butter processors and exporters in Burkina Faso.

In an attempt to improve on the traditional processing method, Ghana's Technology Consultancy Centre developed a simple process known as the Intermediate Moisture Content (IMC) method for shea butter extraction. In collaboration with community-based women's groups, the centre successfully field-tested the new processing method at Vitim and Savelegu in northern Ghana.

The IMC method involves grinding dry kernels into paste using a motorised plate mill. This eliminates the roasting, creaming and boiling steps in the traditional process, which consume large quantities of firewood and water and expose the women to a great deal of heat and smoke. Immediately after milling the paste has a moisture content of 12 per cent and is at a temperature of 70° Celsius—warm enough to allow pressing to be done effectively. After loading into empty cotton sacks the paste is placed directly into the bridge press.

Some advantages of the new improved method over traditional processing include:

- A five per cent increase in extraction efficiency and 200 per cent increase in daily production capacity.
- Decreased firewood consumption (e.g. eight kilogrammes of firewood for the IMC method versus 72 kilogrammes in the traditional process for the processing of 85 kilogrammes of kernels).
- Decreased water use (e.g. eight litres of water for the IMC method as against 160 litres in the traditional method for 85 kilogrammes of kernels processed).
- Higher consumer preference for butter produced using the new improved method owing to its milder shea smell.

There are over 1,000 women's groups involved in shea butter processing, with an average of 30 members per group. The pilot project is targeting four women's groups with a total of more than 200 members.

Fish Smoker Project in Accra communities

The fish smoker project grew out of persistent requests by women entrepreneurs and women's groups in four rural fish smoking communities in the Greater Accra Region who asked for assistance from GRATIS in improving the traditional smoking processes. The communities include Kpone, Prampram, Tema and neighbouring fishing communities in Accra. The project was designed to involve 70 women and to be completed within 14 months.

The project is introducing a new hygienic smoker that meets the requirements of both the Ghana Environmental Protection Agency (EPA) and the Ghana Standards Board (GSB), as well as international standards. Fish processed using traditional methods do not meet international standards and can only be marketed locally at low prices.

Fish processed using the new hygienic smoker (left) can be marketed internationally at higher prices.

The target beneficiary group is women who currently use fuel wood for fish smoking and in so doing are subjected to long hours of smoke inhalation. The women are faced with dwindling wood supplies, low returns from the sale of low-quality smoked fish, and environmental as well as health hazards. They are therefore impatient to be assisted with an improved technology.

Fish provide an important source of animal protein for most people in Ghana. There is a fair-sized fishing industry comprised of both marine fishing and inland fishing. Marine fishing has been the most important sector, contributing about 80 per cent of the total domestic fish supply. Ghana's fishing industry has made tremendous strides during the past decades, developing from a predominantly traditional canoe fleet to a mixed traditional/modern fleet that includes factory trawlers. In the villages, however, canoe fishing is still of great importance and accounts for over half of the marine catch nationally.

In Ghana, canoe fishing is done only by men, and fish processing (smoking) is exclusively the domain of women. The main methods employed to reduce post-harvest losses in the fishing industry include solar drying, refrigeration, salting and smoking. Post-harvest losses are estimated at 45 per cent for fish products. In rural areas and less privileged communities, refrigeration facilities are either not available or too costly for most women to use. Solar drying, unfortunately, is only effective for a couple of fish species—the less bulky types. Preservation of fish through smoking represents the only option for most poor rural communities.

Fish smoking is traditionally done on an individual basis, or by a family group composed of three or four members, which may include a mother and daughters or a group of sisters. Sometimes individuals will break off from these groups once they have acquired the capital to set up business on their own. The fish are purchased from fishermen who demand immediate cash payment for the day's catch. The smoked fish are later used for domestic consumption and sold in the local market for income generation.

For many decades, women fish smokers have depended on traditional wood-fired techniques that are very laborious. Trees are cut daily for fish smoking, which contributes to the depletion of the wood stock. The women, often with their babies on their backs, inhale volumes of smoke into their lungs. The vicinity where they operate is engulfed with thick smoke, affecting other people in the area as well as the environment.

The traditional fish smoker is made out of an empty metal barrel cut in half. The chorkor smoker, an improvement over the traditional smoker, reduces fuel wood consumption to some extent, but does not solve problems of smoke inhalation or fire wood scarcity.

At the GRATIS Foundation, engineers, technicians and a food scientist, in consultation with the women's fish smoking groups, developed an improved fish smoker which depends solely on gas (LPG) for fuel. The improved fish smoker offers an acceptable, clean, energy-efficient and environmentally friendly fish smoking technology. The LPG-fired fish smoking oven is constructed from aluminum sheets and equipped with smoke generators neatly embedded at the rear. Smoke is generated by burning crushed sugar cane, coconut husks or any approved agricultural wastes.

The fish-smoking village of Prampram, in the Ga Dangbe district of Greater Accra, was chosen for the initial pilot project. The men in this village go to sea and do the fishing while the women buy the catch from them and do the smoking and marketing. The main income source for these women is the sale of smoked fish, mainly herrings, tuna fish and the local favourite, "Keta school boys" (anchovies). The smoked fish is only sold locally and the women's earnings are extremely low.

In the pilot project, three LPG-fired fish-smoking ovens will be constructed and installed. The women have no direct access to commercial banks because they cannot provide collateral or other security. The project will provide the smoker and the women will pay for the equipment in instalments out of their

Trees are cut daily for traditional fish smoking, depleting the wood stock.

profits. Operating costs for the LPG smoker are slightly less than for the traditional smoker. According to the women, they use about 30,000 Cedis worth of fire wood to smoke 50 crates (one ton) of fish. The new smoker uses 28,000 Cedis worth of LPG gas to smoke the same quantity of fish.

The project will also provide the women with credit for fish so they can get started and be able to operate the new facility close to full capacity. Two cartons of fish (about 260,000 Cedis or $40 per carton on the average) will be provided to each of the first 25 active women in the group out of a fund of about 10 million Cedis ($1,500). As the women repay their loans, the money will be used as a revolving fund.

During the pilot phase, the women will also benefit from a comprehensive training scheme provided by GRATIS and Divine Sea Foods Ltd., which will cover:

- Proper operation of the technology, i.e. the smoke generator, the heat generation apparatus and the temperature sensors.
- Minor repairs and maintenance of the equipment.
- LPG handling, purchase, valves and hoses.
- Simple bookkeeping and basic business management.
- Smoked fish packaging for national/international markets.
- Oven cleaning and wastewater disposal treatment.
- Credit utilisation and management.

At the end of a 12-month pilot phase, the project will be evaluated. If the women's collective group is found to have a strong management team, it will be given an opportunity to take over project operations entirely. Otherwise, an individual entrepreneur among the group, who is willing to operate and manage it to serve the others on a commercial basis, will be invited to make an offer for possible transfer.

LESSONS AND CHALLENGES

The GRESDA projects so far have tried to build on women's own knowledge and to engage them in the development and use of various technologies. It is not a simple matter, however, to get women involved in the design and use of equipment.

One of the difficulties in introducing new technologies is that they generally have to be accepted and approved by men in the community before the women can openly embrace them. Sometimes meetings with husbands, chiefs and elders at selected project sites are required to convince them that women are capable of using the technology.

In any event, getting illiterate rural women to operate and maintain equipment is a very great challenge in itself. Some of the women lack self confidence and are afraid to even touch the equipment, fearing that they might damage it. Therefore, comprehensive training and confidence building is required at the beginning of the project process.

In many cases, however, rural women do know what they need to make their work easier and more profitable, even though they lack equipment, capital and skills training. Stakeholder consultations are an important method for providing local women with an opportunity to present their needs, discuss them with technology experts, and consider viable options. Cooperation and coordination between women's groups and equipment designers can result in more widespread adoption of new technologies, and more effective results in meeting the real needs of rural women for income-enhancing improvements.

Approaching project design through focusing on activities women are already engaged in, like food processing, and working with them to improve food security and current livelihoods, can promote acceptance of new techniques and technologies and lead to tangible results in rural communities. It also seems that energy efficiency in equipment and processing techniques may be more important in some cases, because of enhanced income-generating opportunities, than provision of energy technologies (e.g., for lighting and electricity) not directly related to production needs.

…one of the main impediments faced by rural women entrepreneurs in optimising the efficiency of their food processing activities [is] having to use wood for fuel. It is time consuming to gather wood and tend to wood fires, the smoke is harmful to women's health, and wood consumption contributes to deforestation.

UPESI RURAL STOVES PROJECT

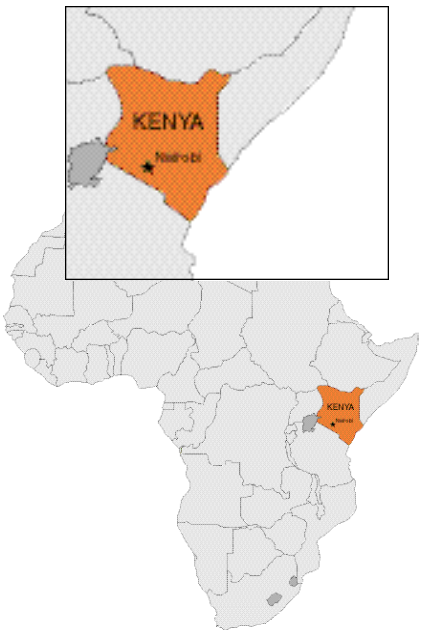
KENYA

BEATRICE KHAMATI NJENGA

The Upesi Project, supported by the Intermediate Technology Development Group (ITDG), was initiated in 1995 to promote the adoption of more efficient stoves in rural areas of western Kenya. Its goal was to improve the living and working conditions of women in rural households by enabling a significant and increasing number of women and their families to benefit from fuel-saving wood-burning stoves. The project set out to test and demonstrate the effectiveness of new approaches and technologies for commercialisation of Upesi stoves in five districts in western Kenya.

By working with interested women's groups and involving them in the design and field-testing of the stoves, the project was able to take advantage of women's knowledge and experience. Besides training the women in stove production, distribution and installation, the project focused on improving their marketing skills as well. This has been a critical element in enhancing the ability of women to earn income from stove-related activities.

Over 16,000 stoves have been installed, providing significant poverty alleviation for members of the women's groups, and their families. The benefits to men and women in the project areas include improved health and time savings for users of the energy efficient stoves, as well as relief from pressures caused by wood fuel shortages.



Reliance on wood for rural energy

Kenya has about 30 million people, 85 per cent of whom live in approximately four million households in rural areas. The average per capita annual income is about US$290, derived mainly from agriculture and tourism. The major sources of energy are biomass, hydro, imported petroleum, and geothermal resources, with growing utilisation of modern solar and wind technologies. Overall, traditional biomass is the largest single source of energy, providing about 75 per cent of final energy demand, and over 93 per cent of rural household energy needs.

Energy use patterns vary significantly between rural and urban areas and also among different economic levels. The preferred forms of energy continue to be electricity and liquefied petroleum gas (LPG), but these are inaccessible to the majority of Kenyans. A 1994 welfare survey showed that only 3 per cent of Kenyans use LPG for cooking. The national electricity grid is mainly hydro powered and supplies under 40 per cent of urban households, and less than 2 per cent of rural households. The electricity is primarily used for lighting. Poor urban households use biomass in the form of charcoal for cooking, while in the rural areas fuel wood and agricultural wastes are the predominant fuels for cooking and heating. Approximately 85 per cent of rural and 50 per cent of urban households use kerosene for lighting. While only a few households currently have access to solar energy, the numbers are increasing steadily, with about 10,000 new households added per year.

Women and children suffer the most from over-reliance on limited biomass energy resources in rural areas. They are the main procurers and consumers of wood fuel for domestic use and generally have very limited access to modern, clean and efficient energy technologies. Consequently they spend considerable amounts of time and energy involved in the drudgery of gathering fuel and performing basic daily tasks, and are exposed to high levels of air pollution and associated illnesses related to smoke from wood fuel fires.

Improved cookstove development

Following the 1980 United Nations Conference on New and Renewable Sources of Energy, many organizations began to work individually and collaboratively on improved stove development and dissemination. The organizations involved in the early 1980's included the newly created Kenya Ministry of Energy, the Appropriate Technology Centre, the Kenya Energy and Environment Organization (KENGO), United Nations Childrens Fund, Maendeleo ya Wanawake, CARE-Kenya, the Intermediate Technology Development Group and GTZ, the German technical cooperation organization. Among the more popular stoves introduced were the charcoal-burning Kenya Ceramic Jiko, and the wood-burning "Kuni Mbili" and "Maendeleo Jiko"—known also as the "Upesi stove".

The Kenya Ceramic Jiko stove, inspired by the "Thai bucket", was developed through a design process spearheaded by the Ministry of Energy. KENGO was responsible for making the Jiko stove available and popular in several countries in Eastern Africa, and in the 1980's the Appropriate Technology Centre was recognised as the regional focal point for training on stove design and testing. The Jiko stove easily found acceptance among urban stove producers who were initially offered free training and marketing support by KENGO, working with the Ministries of Energy, Agriculture, and Environment and Natural Resources. Although most producers and dealers of the Jiko stove have been men, many women in small urban areas have benefited immensely from the technology. A recent study reported that women selling and using the Jiko stove in arid and semi-arid areas significantly improved their standards of living through gains in time and income.

Rural stoves programmes

The success of the charcoal-burning Kenya Ceramic Jiko stove in urban areas affected subsequent programmes to introduce rural wood-burning stoves, primarily by creating false expectations among donors and implementing agencies. Over the years, improved stoves have been more difficult to introduce in rural areas because stoves cost money and the traditional three-stone cooking system is free. Rural people are generally very poor and women and children mostly collect their fuel wood for free, so there is less incentive than in urban areas to spend money on a stove for reasons of fuel conservation. Promotion and sales of the stoves have also been difficult because production and distribution of rural stoves have been conducted by women's groups with little or no experience in competitive marketing.

In 1986 ITDG joined with KENGO to initiate a new project focusing on the stove needs of households in rural areas. This study found that the most acceptable and efficient stove was the Maendeleo or Upesi stove designed and tested by GTZ at the Appropriate Technology Centre as part of the Women and Energy Project of Maendeleo ya Wanawake organization. Groups of women potters around Kisumu were trained to produce the already successful Kenya Ceramic Jiko as well as the Upesi stoves. The same women's groups were also involved in tree planting and agricultural activities for income generation.

In many rural areas, the Ministry of Agriculture's extension officers in home economics and agriculture were already engaged in "kitchen improvement" and nutrition projects. They became key promoters of improved stoves, because of the health and hygiene benefits of the stoves. Through funding from GTZ, the officers bought and distributed stoves at a nominal controlled price. The price was based on an estimation of what rural women would be willing to pay. Thus was established a secure marketing channel for the women's groups, and a steady but small income from stove production, irrespective

BUILDING A BETTER STOVE: THE UPESI

The Upesi stove, sometimes called the Maedeleo, was developed by the Ministry of Agriculture in Kenya, ITDG (the Intermediate Technology Development Group) and GTZ (the German Agency for Technical Cooperation). It uses a standard ceramic liner that can be produced by artisans and women in the informal sector. The liner is then installed into a hearth made from mud and stone.

The stove is designed to burn wood, although it can also burn crop waste, such as maize stalks and cobs, and animal dung. It uses about 40 per cent less fuel than three-stone open fires, with up to 60 per cent less smoke.

Many users say they are able to cook much faster on a Upesi than on an open fire. They also cite improved kitchen health, safety and hygiene as other advantages. In addition, the market for the stove has grown considerably, which is a good sign that the Upesi meets the needs of its users for a clean, efficient and fast-cooking stove.

of the quality of the stoves. After about eight years, however, support from GTZ ended and the government's home economics officers were unable to continue their marketing services on a large scale.

The Upesi Project

In 1995, ITDG's Rural Stoves West Kenya ended and a new phase focusing on commercialisation was initiated as the Upesi Project. The new project launched an intensive campaign to improve the sustainability of stove-related income-generating activities among women's groups.

The intended outputs of the project were as follows:

- Adaptation and production of quality Upesi stoves by the women's producer groups and local institutions.
- Strengthening of the capacity of women's producer groups and distributors in the marketing of stoves.
- Development of concrete commercialisation strategies to expand consumers' stove choices and increase incomes.
- Establishment of a network of key actors in energy saving technologies and marketing.
- Broad dissemination of stove production and commercialization techniques throughout East Africa and internationally.

The project worked primarily with eight women's groups, with differing levels of marketing skills and knowledge. Some were in villages where fuel wood could be collected free, while others were in wood buying areas. The women, who previously had been involved in various agricultural and pottery activities for income generation, took the initiative to approach development agencies working in energy and seek technical support in developing alternative income generating activities.

The Upesi stove was selected for production through field trials that showed it could provide fuel wood savings of up to 43 per cent compared to a three stone fire, and appeared to have a life span of four years. Some stoves have reportedly been used for up to seven years. During the field tests, the affordability of the stove was determined on the basis that "if an ordinary lady can sell bananas or a chicken to afford a stove, then the price is ok". Thus KShs. 70 was considered an acceptable price for an installed stove. Later, the Upesi project raised the price to KShs. 120, to reflect actual production costs.

Stakeholder participation

Important factors responsible in the Upesi Project have been stakeholder participation and the project's responsiveness to the knowledge and changing needs of the beneficiaries. Working partnerships among project sponsors in the region provided learning opportunities for ITDG to develop improved project strategies, and helped to establish a relatively stable background for the project.

Of particular significance was the fact that the women's groups involved had themselves approached the development agencies. Project beneficiaries were involved from the beginning in the design, development, selection and field testing of the stoves. Every revision of the marketing strategy was done in consultation with the women groups and the women came up with the content of promotional materials including posters and radio advertisements.

Women's participation was enhanced by the fact that they had been in contact with women leaders in the field, the home economics officers. These government extension officers may have distorted the earlier stove market through subsidised distribution, but they were certainly key agents in creation of awareness of the benefits of improved stoves in the rural areas.

One of the primary barriers to participation by women was that they did not have enough time and could not be away from home for long periods. Because of women's many domestic and community responsibilities, it was important to ensure that any new activity was compatible with their other ongoing duties. Many women became involved in stove production due to pottery skills acquired in connection with household activities, but needed training in marketing skills. Yet any new training and marketing activities needed to fit with their existing responsibilities.

Commercialisation strategies

The marketing approach for the Upesi project was developed over a period of five years. The producer groups represented isolated focal points in vast rural areas. Most of the potential users were far from the producers, the road network was poor, and motorised transport was generally unavailable. A strategy was needed to ease the transition from a controlled market to a relatively free market, where the prices reflected the full costs of production, marketing and provided a reasonable profit margin. The new strategy was piloted with the Keyo Women's group, after which it was adapted to the very different conditions of each producer group. The strategy was based on insights gained from a visit to an ITDG stove project in Sri Lanka, as well as a marketing study in the project area.

Identification of key stakeholders for support was an important part of the strategy. The relevant government departments, major NGOs and existing stove producers in the area were informed of the project's intentions and its interest in developing marketing plans.

Training was also seen to be critical as there were a number of different actors or intermediaries involved in the marketing chain, including stove producers, distributors, retailers, promoters and installers. These intermediaries typically became involved in the project after seeing a stove demonstration, or through others already producing or selling stoves. Producers were trained in group dynamics, stove production, costing and pricing, record keeping, forging marketing links, and responding to consumer demands. For retailers, there was in-depth training in customer relations and sales promotion, as well as costing and pricing.

Promoters and installers were trained in stove-promotion messages, carrying out successful demonstrations, and establishing linkages with communities. The idea was to have as many people as possible spreading information and carrying out demonstrations of the stoves. Thus a team of promoters was identified to visit homes, churches, market places, grain milling centres, schools and other public places. Other organizations such as the Anglican Church of Kenya in Eldoret diocese, the Marantha Mission of Kenya and the Ministry of Energy were involved in creating awareness and providing possible linkages.

ITDG sponsored radio promotions in local languages, which added value to the stove's image. Drama and songs were used for awareness creation. ITDG also provided advertising billboards. Posters, banners and flyers were produced in collaboration with intermediaries, to ensure that the selling messages were appropriate. The promotion was aimed at creating an attractive modern image for the stove and creating awareness of its benefits.

Stove producers and distributors were encouraged to use non-motorised transportation to link up to major roads. Over 40 bicycles were provided through a mutually agreed repayment scheme. All the transportation equipment carried Upesi promotional messages.

Marketing incentives included providing quality stamps for producers, and promotion signs for distributors with over 150 stoves. Promoters selling 100 stoves per month were given a bicycle loan and a certificate. Other incentives included tee-shirts and trophies.

Benefits to women users

The primary intended beneficiaries of the Upesi project were women and their families in rural households of western Kenya. At the final project evaluation, 16,000 stoves had been manufactured, purchased and installed.

According to the evaluation, users of the Upesi stove derived the following benefits:

- Savings of up to KShs. 7,200 per year (rural wages average KShs. 800 per month).
- Health cost savings of KShs. 260 per year.
- Time savings of about 10 hours per month.
- Smoke reduction of 60 per cent.
- Reduction of acute respiratory infections in children by 60 per cent and in mothers by 65 per cent.
- Reduction of conjunctivitis in children under five by 70 per cent and in mothers by 67 per cent.

Income generation

A total of eight producer groups, or at least 50 women, were trained directly by the project, and so were at least 23 promoters, eight retailers and five distributors. On average, stove producers devoted two to three days a week to stove production. Every active group member could sell 510 stove liners and earn KShs 15,300 in a year, or KShs. 1,275 per month. If producers sold directly to the users, then they could make

an extra KShs. 50 per stove for installation. Stove promoters made an average of KShs. 15,000 per year. As a result of stove-related activities, these women were able to enjoy a significantly higher standard of living.

Acquired production and marketing skills also enabled women to travel to distant places to provide training to others. Women from the Keyo Women's group have trained producers in Tanzania on a fee basis. Active women in the producer groups have also learned new skills useful for other business ventures. With increased confidence and social status, several women have since become active in community development committees. Thus stove production has also provided a launching pad for realising other ambitions.

Over all, wider commercialisation of stoves can have a significant impact on community poverty alleviation. With increased income, women are able to help support their families and pay for children's school fees, thus reducing school dropout rates. This is particularly significant for girls as they are always the first casualties when parents cannot afford school fees. Children of stove producers are also learning important skills for income generation, and acquiring knowledge about energy and environmental conservation as they observe and help their mothers. In addition, women producers provide employment opportunities to others who work as labourers in the procurement, processing or transporting of clay, liners and fuel wood for firing the liners.

Environmental conservation

The issue of fuel wood shortages in Kenya cannot be overemphasised. Any technologies that improve the efficiency of fuel wood use have real benefits to society. In west Kenya, the Upesi project has introduced an awareness of the need to conserve energy not only among those households that bought the stoves but also in many others exposed to stove demonstrations and promotional talks in public gatherings and at show grounds.

In much of the project area, fuel wood is harvested from live trees and sold in the market. The project evaluation revealed fuel savings of 90 kilogrammes per month for each household using Upesi stoves, representing 40 per cent savings in fuel use, which can have a positive environmental effect in terms of less felling of trees. The Upesi Project has also influenced an international research institute to support improved stoves as part of an effort to replenish and conserve the Kakamega forest in West Kenya.

Equally important is the tree planting encouraged as part of the project. In 1999, stove producers planted 2,500 seedlings, while other intermediaries planted another 3,773 seedlings as part of the move to replenish the wood used for manufacturing the stoves.

It should be noted, however, that clay procurement for increased levels of stove production could have adverse environmental impacts on soils and riparian ecosystems. To enhance environmental sustainability, therefore, it will be necessary to include training in land reclamation and soil conservation. It may be necessary to carry out an environmental impact assessment on this.

Project continuity

The project made significant progress in establishing a market for improved stoves through a network of promoters, retailers and artisans who buy from existing producer groups and then construct and install stoves for customers. The current market appears to be viable since the stoves are produced and sold through a market chain in which every actor earns a reasonable income.

Through the project, individuals and groups in the marketing chain have acquired a variety of potential income-generating skills, and it may be assumed that they can survive independently of ITDG. Internalisation and ownership of new knowledge and skills has been shown by the participant's adaptation of knowledge to changing circumstances. In the case of the Upesi stove, women producers and artisans have been able to come up with at least seven new innovative stove designs to meet consumer demand.

Other indicators of project viability include the following:

- Almost all (97 per cent) of the stoves installed are still in use.
- Seven out of eight women's groups trained are still producing stoves.
- Since 1999, groups have started producing their own promotional materials.
- New partnerships have been forged on training and information sharing, with strong networks emerging across the East African region.
- Local women are able to offer training to potential producers on request, even in Tanzania and Uganda.
- Women have begun to venture into male-dominated artisanal work, which diversifies their income-generating potential.
- Awareness of the improved stoves has spread over wider areas in the region, thus enhancing the potential market.

One variable, however, that may adversely affect expanded stove production is the availability of clay and other raw materials. This threatens basic continuity of the activities, and also the quality of the products.

LESSONS AND CHALLENGES

The project has demonstrated that rural stoves can be commercialised to provide multiple benefits to women, children and other poor people. Increased income-generating opportunities for women have benefited whole communities. By learning new skills related to stove production and marketing, women can considerably increase their incomes. As more actors enter the field of rural stove production and sales, promotional network densities will be increased, which can further enhance marketing and income opportunities.

The fact that improved stoves were originally introduced into the project region on a subsidised basis probably slowed down commercialisation, as the stakeholders had to completely change their way of thinking about the stove business.

Other constraints also affected the efficiency and cost-effectiveness of the project.

- The conventional flow of manufactured products is from urban to rural areas. The Upesi project was attempting a new feat—to produce and sell new stoves commercially within rural areas, and also sell them in some urban areas.
- Stove installation services have to be marketed and coordinated together with the sale of the clay stove liner. This makes the Upesi stove an awkward retail item.
- The project had to create from nothing rural stove purchasing agencies, and then offer subsidised training to the interested parties.
- The producers and promoters had a low capital base and no access to micro-credit schemes, and therefore could not buy stoves in bulk. Although there are many micro-credit financiers in the country, they have made limited inroads into the rural areas.
- Transport continues to be a major constraint and improved roads, rather than bicycles, are needed.
- Quality control has been a problem when new groups have entered the field without sufficient training. Although it is an indicator of success that stoves are considered a viable income-generating activity, poor quality discredits good technology and erodes the market for the improved stoves.

The experience in West Kenya has proved that introduction of rural stoves is not as straightforward as dissemination of urban stoves. It may be relatively easier for producers to change their habits because of immediate and easily quantifiable gains. Users, however, especially those with access to free wood and little incentive to save fuel wood, may take longer to appreciate the benefits of improved stoves.

Overall, commercialisation of a new technology for the rural poor has proved to be a tedious and expensive process. The lessons learned from the strategies explored in the Upesi project can help make replication of the experience elsewhere less expensive. This is an important area for donor funding; there is a pressing need for documentation of useful experiences.

By working with interested women's groups and involving them in the design and field-testing of the stoves, the project was able to take advantage of women's knowledge and experience.