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Community Action to Address Climate Change:

Case Studies Linking Sustainable Energy Use with Improved Livelihoods

SGP The GEF Small Grants Programme

November 2003

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GEF Small Grants Programme
United Nations Development Programme

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Printing
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Cover photo credits:

Far left:wind-solar hybrid power station,West Bank,Occupied Palestinian Territories.This innovative hybrid system provides power to the 100 residents of Innab Al-Kabeera. Photo by Steve Sabella.

Second from left: a family benefiting from the Biomass Fuel Efficiency Project in Tsirang, Bhutan.This project has trained women to build and disseminate efficient stoves, helping over 2,000 households to obtain efficient stoves. Photo by Durga Neopaney.

Second from right: community members from the Kizil-Charba village in northern Kyrgyzstan, standing next to a micro hydro installation, which is part of a biogas-micro hydro hybrid power system providing power locally for cooking and lighting. Photo by Muratbek Koshoev.

Far right:participant in the Community-scale Solar Water Pumping Project,which provides pumped water to 80 households in 3 villages in northeast Thailand. Photo by Adam Rogers.

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ISBN: 92-1-126161-9
Sales Number: E.04.III.B.3

Europe and the Commonwealth of Independent States (CIS)

Latin America and the Caribbean

Acknowledgements

Substantial financial support for writing these case studies and producing this publication was provided by the Global Programme on Energy for Sustainable Development, managed by Susan McDade and located in the Bureau of Development Policy of the United Nations Development Programme (UNDP). Minoru Takada, sustainable energy programme specialist at UNDP, has provided excellent guidance throughout the process, including strategic advice on the orientation and organization of this publication.

Stephen Gitonga, climate change specialist for the GEF Small Grants Programme, directly supervised this work and has provided critical guidance and technical expertise. These case studies have benefited greatly from his perspectives and wealth of knowledge. All members of the Central Programme Management Team of the GEF Small Grants Programme have contributed in various ways. Delfin Ganapin's encouragement, Marie Khan's help in locating documents, and Carmen Tavera's insightful comments have all made this a better publication. Gail Karlsson's careful editing has added greatly to the readability of the case studies. Finally, Edwin Adkins's contributions to the introductory material, attention to detail, and hard work made it possible to put this publication together.

At the heart of this publication are the projects themselves. These experiences are the result of the creativity, hard work, and perseverance of SGP national coordinators and program assistants, SGP grant recipients and other project partners. These individuals have generously shared their knowledge and expertise during the research and writing process. They spent considerable time responding to questions, sharing their perspectives, sending documents and photographs, and reviewing these case studies prior to publication. They are too numerous to list here, but every effort has been made to acknowledge these individuals in the list of sources consulted at the end of each case study. Without their help, this project would truly not have been possible.

Background

Climate change is a global environmental problem that will affect people all over the world. However, while the human consequences of climate change cannot be anticipated with certainty, researchers expect people in developing countries to suffer the most. The expected impacts of climate change, such as increased droughts and more frequent extreme weather events, will require some of the poorest people already living in difficult conditions to adapt to new and variable threats, especially people such as farmers and fishermen who are most directly dependent on the natural environment for their livelihoods. The United Nations Framework Convention on Climate Change (UNFCCC) calls upon all nations to address this growing threat, and upon industrialized nations to take the lead in greenhouse gas emissions reductions and to provide additional funding to support efforts to address climate change globally.[1]

People in developing countries who lack basic services and economic opportunities are primarily concerned with improving their living conditions. One critical factor affecting their livelihoods is whether they have access to affordable and reliable energy services for household and productive uses. The lack of clean and efficient sources of energy can limit access to clean water and healthy living conditions, prevent children from attending school regularly, and restrict women's choices and ability to pursue fulfilling activities. Energy is also required for most income-generating activities, whether at the household or commercial level. Thus, access to energy is strongly connected to the achievement of the Millennium Development Goals (MDGs), which set targets for poverty reduction, improved health, and gender equality as well as improved environmental sustainability.[2] Improving access to energy in underserved areas, using technologies that minimize the greenhouse gas emissions that contribute to climate change, can address the development and adaptation needs of affected communities while at the same time promoting a transition to cleaner methods of energy production and consumption.

The Global Environment Facility (GEF) is committed to achieving global environmental benefits in the context of sustainable development. This requires finding ways in which activities that lessen impacts on the global environment can also help meet development needs. If development priorities are neglected, project interventions may not be sustained over time. The GEF Small Grants Programme (SGP) addresses this challenge by working directly with communities, offering them funding and technical assistance to carry out projects they design themselves. Because of this unique approach that promotes country and community ownership, there is much to learn from SGP project experiences regarding the possibilities for achieving both global environmental benefits and local livelihood improvements. This collection of case studies of SGP projects that link climate change, sustainable energy use and improved livelihoods can be a basis for such learning.

The Global Environment Facility[3]

The Global Environment Facility (GEF) is an independent entity that unites 176 member governments – in partnership with international institutions, non-governmental organizations (NGOs), and the private sector – to address global environmental issues while supporting national sustainable development initiatives. In 12 years, the GEF has evolved from a pilot program to the largest single source of funding for activities addressing global environmental problems.

Since its inception in 1991, the GEF has committed $4.5 billion in grants and leveraged $14.5 billion in co-financing to support over 1,300 projects in more than 140 developing countries. The GEF Small Grants Programme (SGP), implemented by the United Nations Development Programme (UNDP), has also provided more than 4,000 small grants directly to community groups and NGOs.

The GEF serves as the designated financial mechanism for the international conventions on biological diversity, climate change, persistent organic pollutants, and desertification.

It also supports global agreements to protect the ozone layer and clean up international waters. GEF projects are implemented by UNDP, the United Nations Environment Programme (UNEP) and the World Bank. Seven other regional development banks and specialized UN agencies also help manage GEF projects.

As the financial mechanism of the UNFCCC and the leading multilateral entity promoting energy efficiency and renewable energy technologies in developing countries, GEF manages a $10.6 billion climate portfolio that supports more than 400 projects and enabling activities.

The GEF Small Grants Programme[4] (SGP)

Operational since 1992, the GEF Small Grants Programme is implemented by UNDP on behalf of all three implementing agencies, including UNEP and the World Bank. It complements the activities and scope of full and medium-sized GEF projects by disbursing grants directly to non-governmental and community-based organizations in developing countries for initiatives that conserve and restore the natural environment while enhancing local well-being and livelihoods.

Highly decentralized and demand-driven, SGP encourages maximum country and community-level ownership. Grants are screened, approved and disbursed at the national level by a voluntary national steering committee (NSC). The NSC typically comprises representatives from local NGOs, government, academia, UNDP and occasionally co-funding donors, indigenous

[1] For background about the problem of climate change, the latest research on expected impacts, please see http://www.ipcc.ch. For background about UNFCCC, visit http://unfccc.int/.

[2] For more information about the Millennium Development Goals, please see http://www.developmentgoals.org.

[3] For more information about the Global Environment Facility, please see http://www.thegef.org.

[4] For more information about SGP, please see http://www.undp.org/sgp

peoples' organizations,the private sector and the media.

In each country, a national coordinator is appointed to carry out day-to-day management of the programme. The coordinators are responsible for reaching out to local NGOs and community-based organizations (CBOs) to inform them of the availability of grants and to encourage communities to send in proposals based on their ideas. Each SGP country programme is guided by a specific Country Programme Strategy (CPS), which details the scope of activities that can be funded by the country programme. The CPS is developed through a participatory process involving a wide range of local stakeholders to encourage local initiative and raise awareness about the mechanism.

The maximum size of an SGP grant is $50,000. Projects are therefore usually small in size and are meant to demonstrate innovative approaches to addressing climate change at the community level. To achieve this, the process of project design includes all key stakeholders and partners, especially those providing co-financing, and focuses on the capacity development of stakeholders through demonstration and training, awareness creation and dialogue. Complementary partnerships increase the reach, impact and sustainability of SGP's demonstration projects. Occasionally, projects supported by SGP at the community level are scaled up to become GEF medium-sized projects and can be implemented by any of the three implementing agencies. In some instances, scaling up is facilitated by other communities, governments,donors and development organizations.

The SGP climate change portfolio

Working with communities to balance climate change concerns with local people's development needs is a central element of SGP's activities. It is the means by which the GEF supports implementation of the United Nations Framework Convention on Climate Change (UNFCCC) at the community level. Over the past decade, SGP-supported climate change activities have produced innovative approaches and experiences, demonstrating community by community how to achieve development goals in a climate-friendly way.

SGP projects address climate change through the following approaches, which are called GEF operational programmes.[5]

- Removal of barriers to energy efficiency and energy conservation
- Promotion of the adoption of renewable energy by removing barriers and reducing implementation costs
- Promotion of environmentally sustainable transport
- Integrated ecosystem management for projects with cross-cutting issues related to energy, climate change and biodiversity conservation

Since 1992, SGP has funded over 700 climate change projects, which represent about 20% of its portfolio of over 4,000 projects. It is important to note the emphasis in these operational programmes upon barrier removal.The GEF acknowledges that the actual emissions reductions achieved by individual projects cannot themselves reduce the risks of climate change. Instead, GEF efforts, including SGP projects,are intended to play a catalytic role in effecting changes that make it easier to access renewable and efficient energy technologies and sustainable transport options.Removal of barriers thus stimulates broader change, not only in local technology and infrastructure, but also in knowledge and management practices, which can contribute to global environmental benefits and development goals.

About this publication: objectives, selection criteria and methodology

This publication summarizes key information concerning selected energy and climate change projects supported by the GEF Small Grants Programme (SGP) between 1992 and 2003. These case studies emerged from a collaboration between SGP and UNDP's Energy and Environment Group. The goal was to collect detailed information about projects in a systematic manner in order to improve SGP's and UNDP's ability to learn from these project experiences and results, and to share those lessons with others.

While none of these case studies contains a thorough evaluation of project impacts and effectiveness, the diversity of experiences that they represent provides valuable information about community-led projects that address climate change while improving energy access and livelihoods. It is hoped that these project descriptions will be a useful reference for international institutions, energy and development practitioners, governments, and members of civil society and the private sector who are concerned with supporting, initiating and implementing future projects.

The summaries collected here represent only a small portion of the over 700 climate change projects undertaken during this period. This compilation is not an attempt to provide an exhaustive representation of the full range of SGP climate change-related projects. Instead, the focus is on community initiatives in which energy services and livelihood benefits are closely integrated.SGP activities related to environmentally sustainable transport are not included since this operational programme is quite new and few of these projects have been completed so far.

Prior to the development of these case studies,SGP undertook a review of its climate change portfolio, identifying the major types of project interventions, the sectors targeted, the technologies used, and the energy applications involved.The SGP project database was the main source of information for that review.The results of the review helped to guide the selection of projects with strong links between livelihoods and energy use for this compilation of case studies.An effort was made to cover a range of energy resources, technologies, end uses and types of project interventions, and also to achieve a regional balance among the communities in which the initiatives took place.

[5] For more information about GEF operational programmes, please see http://www.thegef.org.

Research for these case studies took place between December 2002 and October 2003. Since SGP is a decentralized programme, most project materials, such as final reports and evaluations, are maintained at the country level, and are often in local languages. Resources were not available for translation services or site visits, so the research process to document these case studies first identified resources available in English, French or Spanish in the SGP project database, SGP country programme publications, SGP country programme websites, and SGP files in New York. Next, extensive web research was conducted for each project to find websites, reports, newspaper articles and newsletters related to particular projects.After as much information as possible was collected in this manner, efforts were made to contact the grant recipients directly via email to request additional information and responses to specific questions raised in initial research. In some cases, SGP national coordinators were also contacted. When evaluation reports were available in English,French or Spanish,these were also consulted. After all the case studies were compiled, they were reviewed by SGP national coordinators and, when feasible, by grant recipients themselves.

While a major goal of the project was simply to gather and present information about projects in an organized manner, equally important was the identification of lessons learned from projects that could provide valuable guidance for others conducting similar efforts. Therefore, these case studies are not presented as "best practices," but rather as a collection of results of "learning by doing," a process that often involves making mistakes and learning from them.

The case studies template

Each of these case studies follows a single template to aid the reader in easily locating essential project information and lessons. The template was developed to achieve a balance between conveying key information quickly, while allowing for more detailed analysis of project experiences and lessons learned.

Easily and quickly identifiable project data appears in two lists that precede each case study:

Themes: The boxed list of themes for each study forms a basis for identifying commonalities with other projects.In the following section,these themes are described in more detail,and presented in a matrix to help readers find case studies of particular interest.The themes are grouped into four main categories, also described in the following section. Each is coded with a particular symbol:

★ Approach to addressing climate change

✲ Environmental management

❖ Methods for sustaining project interventions

✸ Livelihood components addressed (MDGs)

Project Data and Energy Overview: These lists provide essential project details, such as the project's location and implementing organization, and an overview of the project's energy interventions, including the end uses of energy, the technology cost and the number of households or people served,whenever possible.

The main text of the case studies follows. Each case study is organized into the following sections:

Background: This section describes the context in which the project was undertaken.

Project Description: This section provides a narrative of the project's goals,implementation,and results.It includes the following major sub-sections.

- *Overview:* summarizes the project's goals and approach in a few sentences
- *Implementation:* describes the activities the project carried out, including problems encountered in the process
- *Technology:* provides any available technical details about the project's energy interventions
- *Environmental benefits:* describes generally how the project contributes to global, and if applicable, local environmental benefits
- *Local benefits:* lists the project's expected links to local livelihood benefits, especially as they relate to the MDGs
- *Capacity development* notes the specific efforts a project has made to improve local capacity to carry out project functions as well as other community activities, whether or not they are related to environmental goals.
- *Partners:* identifies the major groups that were critical to the project, in addition to the implementing organization, and describes how these partnerships were important.

Lessons Learned covers three major areas:

Environmental management: This section notes distinctive environmentally-related features of the project's approach to addressing energy access. It highlights uses of innovative technology to address climate change and provide energy services in ways that are tied not only to local livelihoods, but also to other environmental priorities at the local, national and international level.

Barrier removal: This section details key lessons about how projects can contribute to removing financial,technical,institutional, policy, informational, cultural and other barriers to implementing clean and efficient energy. The barrier removal framework offers a useful lens for considering strategies for managing and organizing projects that enhance the ability of local people to implement and sustain these activities. Some examples of barrier removal might include:

- creation of revolving loan funds in order to reduce financial barriers;
- training for local artisans or small companies to produce energy equipment locally as a way of reducing technical barriers;
- involvement of local schools and universities, or the creation of media resources, to address knowledge barriers;
- creation of local community organizations that maintain a knowledge base and management skills, and build social cohesion, thus overcoming institutional barriers; and

- interaction with local and national policy frameworks that affect implementation of community initiatives.

Scaling Up: Although SGP grants are small, many projects have been able to achieve impacts beyond their initial objectives. This may be accomplished by expanding the size of individual projects, extending a project's model or methods to other communities, or increasing the reach and beneficial impacts of an initiative to others within a given community. Scaling up does not necessarily mean receiving additional grant support to do more of the same, although some projects follow this route. Other strategies for scaling up have included establishing market-based mechanisms to expand access to energy equipment, or building institutions to facilitate the spread of knowledge and awareness. Lessons about scaling up tend to be strongly related to the particular barriers a project has sought to remove.

A guide to project themes

Many interesting lessons are found in these case studies, and when taken together, key themes about lessons and impacts emerge. A set of themes has been developed to assist readers in identifying these, and in finding projects in this compilation that most closely match their interests. These themes are designed to provide a general indication of the project's technological and organizational approach to addressing climate change issues, the provisions made for sustained implementation,and the impacts with respect to environmental and development goals. It is important to note that projects are listed as identifying themes both when a project effectively addressed a given issue, and when a project experienced challenges related to that theme.

The themes fall into four categories, each of which contains 2-5 themes. These are described below.

★ *Approach to climate change*

The first category identifies the main technological approach taken by the project in relation to climate change. These approaches have been defined in reference to the first two GEF operational programmes identified earlier. As mentioned above, this report does not attempt to cover activities under the environmentally sustainable transport operational programme. The fourth operational programme on integrated ecosystem management is not included here, but projects that integrate climate change activities with other environmental goals are covered in the next category.

★ *Renewable energy:* This theme emphasizes the promotion of renewable energy technologies, such as solar energy, wind energy, micro-hydropower and biogas.

★ *Energy efficiency:* The theme focuses on the reduction of barriers to energy efficient technologies, such as improved cook stoves, insulation for homes,efficient lighting, and more.

✲ *Environmental management*

The second category of themes notes a project's contributions to understanding and improving environmental management. Since SGP projects take place in such diverse settings, often specific approaches to managing the interaction between humans and the environment emerge from project experiences. The two themes included here are not the only types of lessons that emerge related to environmental management, but they seem to be the most prevalent among these case studies.

✲ *Linkages with other environmental goals* this theme refers to ways in which a given project's approach to climate change also helps promote attention to another environmental problem, whether local or global. For example, several projects have improved watershed management after a micro hydro plant was installed. Other projects area located near national parks, and by switching to renewable or more efficient technology a project also reduces pressure on forests there.

✲ *Innovative technology applications:* This theme makes reference to innovative uses and modifications of existing technology to meet local energy needs under the particular environmental or socio-economic circumstances. This may mean adapting a particular technology for local use; for example, several projects have explored ways to use biogas in a cold climate. Others have altered equipment to make better use of locally available energy resources, such as the bakery ovens in Sri Lanka that use rice paddy husk for fuel. This compilation of case studies demonstrates that SGP has been playing an important role in testing and perfecting new technologies that are not yet ready for market distribution.

❖ *Sustaining project interventions*

Themes listed within the third category detail a project's contribution to developing local capacity and institutions that can help sustain implementation, broaden project impacts, or increase the potential for scaling up in the future. These themes are not an exhaustive list of how projects can achieve this, but instead highlight some of the major ways in which this set of SGP projects appear to be achieving this.

❖ *Financing mechanisms and private sector involvement:* This theme refers to the means by which long-term financial viability is enhanced. Financing mechanisms are systems set up by projects that help make it possible for local people to purchase technology. Revolving loan funds are used in a number of projects, and these contain interesting innovations to adapt this common microfinance mechanism to the energy context. Private sector involvement is another critical way in which the sustainability of project interventions may be improved. A number of projects have formed micro-enterprises, or integrated improved energy technology into existing business activity.

❖ *Technical capacity development:* This theme cover projects that place substantial emphasis on training local people to produce and/or use technology. Such training is critical for almost all energy project interventions. Projects included under this theme have made a particular effort in this area, or offer particular lessons in this area.

❖ *Policy and legislation:* This theme indicates projects that have contributed in some manner to the development of policy, regulations or legislation at the national level. In a number of cases, these policy dialogues are helping to create policy frameworks and regulations that allow for and support small-scale energy production and distribution.

❖ *Institutional capacity development*: This theme refers to the establishment of, or change within, institutions in order to enhance the sustainability of project interventions. Here, the word "institution" refers to social and organizational arrangements that persist over time. Thus, this theme includes the creation of local management committees or new community organizations, or the establishment of rules for use of a given technology or resource. Such institutions are critical factors for sustaining project interventions over time, but can also provide other, unrelated benefits to communities.

❖ *Awareness, culture, and practices*: This theme identifies projects that relate to local knowledge, beliefs, practices, and other aspects of culture that may strengthen or present challenges to a project or technology in a particular setting.

✷ *Livelihood Benefits*

This final category of themes refers to improvements in local livelihoods that result from projects. This specific list of themes is linked broadly to the Millennium Development Goals (MDGs). Contributions toward the MDGs are not quantified, but simply identified, and a project is included under the themes that it addresses most directly. These themes are not an exclusive list of how projects contribute to improved livelihoods. Many project descriptions discuss other interesting benefits, such as improved information access, better security, and an increase in social or recreational opportunities.

✷ *Poverty alleviation (MDG1)*: A majority of projects included here address this theme. Projects may either increase possibilities for income generation via greater energy access, or they may reduce the amount of money or time families must spend obtaining energy through the use of more efficient technology or equipment.

✷ *Education (MDG 2)*: Projects included here relate to energy use in schools, or they are projects that have otherwise improved educational opportunities for children.

✷ *Gender equity and empowerment (MDG 3)*: Since women tend to be very involved with obtaining and using energy in developing countries, a majority of projects included here involve women. The projects included in this theme, however, have a particular focus on building women's options and leadership capabilities.

✷ *Health (MDGS 4-6)*: Energy access can improve healthy living conditions in many ways, including better drinking water access, improved energy access in health clinics, and reduced smoke inhalation inside kitchens and homes. Projects included here are those that appear to have the most direct and significant health benefits.

There are many other ways in which these projects could be classified. In order to enable more specific searches for aspects of these projects, an online search function is planned for the SGP website, where the case studies are available for download (http://www.undp.org/sgp).

The organization of this document

Case studies in this document are organized according to the five regions in which SGP operates. Within each region, case studies are sequenced alphabetically by the name of the country. When more than one case study is included from a given country, each case study from that country is listed alphabetically by title, and is labeled with a number afterward, such as "Kenya-1" and "Kenya 2". The regions appear in the following order:

Africa

Arab States

Asia and the Pacific

Europe and the Commonwealth of Independent States (CIS)

Latin America and the Caribbean

The following table has been created to aid readers in locating individual case studies according to the particular themes of interest. Rows in the table identify each case study with by country name and number, in some cases. The second column provides the page number that marks the start of each case study. Thematic categories, and specific themes in each category, are identified in column headings across the top of the table. When a particular theme applies to a case study, a symbol appears in that box. In this way, the tables offer a guide that links projects with themes, and directs the reader to the page number in which the applicable case study appears.

Table 1: Linkages between project case studies and themes

Code	Start Page	Approach to Climate Change: Renewable energy	Approach to Climate Change: Energy Efficiency	Environmental Management: Linkages with other environmental goals	Environmental Management: Innovative technology applications	Sustaining Project Interventions: Financing mechanisms and private sector involvement	Sustaining Project Interventions: Technical capacity development	Sustaining Project Interventions: Institutional capacity development	Sustaining Project Interventions: Policy and legislation	Sustaining Project Interventions: Awareness, culture and practices	Livelihood Benefits: Poverty alleviation (MDG 1)	Livelihood Benefits: Education (MDG 2)	Livelihood Benefits: Gender equity and empowerment (MDG 3)	Livelihood Benefits: Health (MDGs 4-6)
Côte d'Ivoire-1	3	★			O		❖					✱		✱
Côte d'Ivoire-2	6	★			O		❖	❖			✱	✱		✱
Kenya-1	9	★					❖	❖	❖		✱			✱
Kenya-2	12		★	O		❖						✱		✱
Mali	14	★		O	O		❖		❖		✱			✱
Mauritius	17	★			O	❖	❖							✱
Tanzania-1	19		★			❖	❖				✱			✱
Tanzania-2	21	★		O			❖			❖	✱		✱	✱
Uganda	24	★		O			❖	❖		❖	✱	✱		✱
Zimbabwe	27		★			❖	❖				✱			✱
Egypt-1	30		★			❖	❖				✱			
Egypt-2	32	★			O	❖	❖				✱			✱
Egypt-3	35	★				❖	❖				✱			✱
Jordan	37		★				❖	❖	❖					
Morocco	39	★				❖	❖				✱			
Occupied Palestinian Territories-1	41	★			O		❖	❖		❖			✱	✱
Occupied Palestinian Territories-2	44	★					❖	❖			✱		✱	
Bhutan	46		★	O			❖			❖			✱	✱
India-1	49	★		O				❖			✱			✱
India-2	51	★				❖	❖			❖				✱
Indonesia	54	★				❖		❖	❖		✱			
Nepal	57	★				❖	❖	❖			✱			✱
Pakistan-1	62		★	O			❖	❖		❖	✱		✱	✱

Table 1 (continued): Linkages between project case studies and themes

Code	Start Page	Approach to Climate Change: Renewable energy	Approach to Climate Change: Energy Efficiency	Environmental Management: Linkages with other environmental goals	Environmental Management: Innovative technology applications	Sustaining Project Interventions: Financing mechanisms and private sector involvement	Sustaining Project Interventions: Technical capacity development	Sustaining Project Interventions: Institutional capacity development	Sustaining Project Interventions: Policy and legislation	Sustaining Project Interventions: Awareness, culture and practices	Livelihood Benefits: Poverty alleviation (MDG 1)	Livelihood Benefits: Education (MDG 2)	Livelihood Benefits: Gender equity and empowerment (MDG 3)	Livelihood Benefits: Health (MDGs 4-6)
Pakistan-2	65		★	✪	✪	❖	❖				✱			✱
Philippines-1	68	★		✪			❖	❖		❖	✱	✱	✱	✱
Philippines-2	72	★					❖				✱			✱
Sri Lanka-1	74	★			✪	❖	❖				✱			
Sri Lanka-2	77	★		✪	✪	❖	❖				✱			
Thailand-1	80		★	✪		❖	❖			❖	✱			
Thailand-2	82	★					❖	❖			✱			
Thailand-3	85	★		✪	✪		❖				✱			
Vietnam	87		★	✪	✪	❖	❖		❖					✱
Albania	89	★			✪		❖				✱			✱
Kazakhstan-1	91	★		✪	✪		❖				✱			
Kazakhstan-2	94	★				❖	❖			❖				✱
Kyrgyzstan-1	96	★	★		✪		❖				✱			✱
Kyrgyzstan-2	99		★		✪		❖			❖	✱			
Lithuania	101		★				❖	❖			✱			
Poland	104	★			✪			❖	❖	❖	✱			
Bolivia-1	107	★					❖	❖			✱			✱
Bolivia-2	109	★			✪		❖	❖						✱
Costa Rica-1	111	★		✪			❖						✱	✱
Costa Rica-2	114	★			✪			❖		❖			✱	✱
Dominican Republic-1	117		★	✪		❖	❖		❖		✱			
Dominican Republic-2	120	★		✪	✪				❖	❖		✱		✱
Dominican Republic-3	123	★				❖	❖	❖			✱	✱		✱
Ecuador	127	★		✪	✪		❖					✱		✱

Case Studies

Production and Dissemination of Solar Water Heaters, Côte d'Ivoire

Themes

★ Renewable Energy
⁜ Innovative technology applications
❖ Technical capacity development
✷ Education (MDG 2)

PROJECT DATA

Name: Training for young artisans in the production and dissemination of solar water heaters
Implementing Organization: Opportunities Industrialization Center (NGO)
Location: urban and rural areas of Côte d'Ivoire
SGP contribution: $22,128
Start Date: July 2001

ENERGY OVERVIEW

Energy Resource: passive solar
Technology: solar water heaters ("auto-storage" and solar collector models)
Application: water heating
Sector: public (schools,health centers), domestic
Cost of equipment/installation: $280 - $430 per unit produced locally (compared to $1,000 - $2,000 per imported unit)
Capacity: 2 m^2 reflector, heats 200 liters water/day (meets the needs of an 8-10 person household)
Number of People Served: 30 young people trained to produce them, 15 solar water heaters constructed out of a planned 30, solar water heaters installed in 10 public facilities

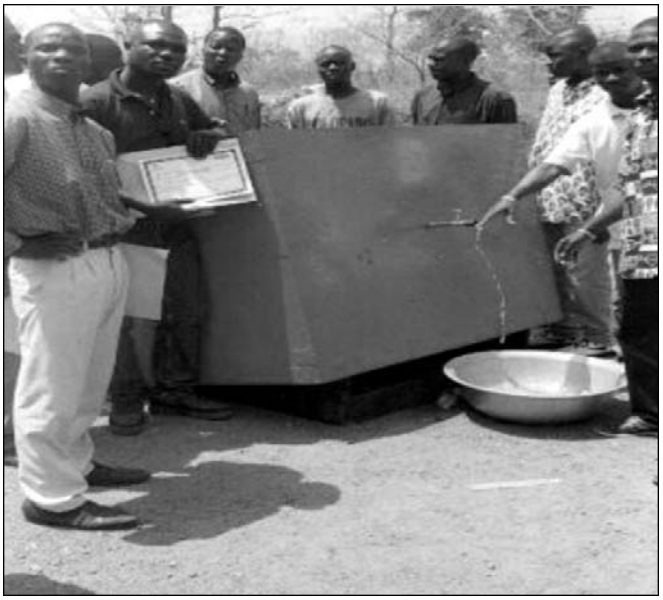
BACKGROUND

In Côte d'Ivoire, most schools and health centers in urban areas use electric solar water heaters. However, these are often out of order, and when they are working they consume large amounts of electricity:approximately 2kW to heat 150 liters of water. In rural zones where electricity is not available, firewood is used to heat water. Yet, Côte d'Ivoire is well-endowed with solar energy, and using passive solar heating can meet hot water needs while reducing the use of firewood and electricity. However, an imported solar water heater costs approximately $1,000, which is too expensive for most users. Developing the capacity to produce water heaters in-country at a lower cost can make it possible to distribute this technology more widely.

PROJECT DESCRIPTION

Overview

This project developed local capacity in Côte d'Ivoire to produce solar water heaters that cost less than imported models. The solar water heaters can be used in community centers, health clinics, schools and eventually in individual homes.



Locally-manufactured solar water heater, auto-storage model (Côte d'Ivoire).

Implementation

The grantee, the Opportunities Industrialization Center (OIC), has formed a cooperative of 30 previously unemployed young people, and trained them to produce solar water heaters adapted for local use. These young people had prior training in metal work, and through this project learned the specifics of building solar water heaters. They have produced 15 prototypes so far, out of a planned 30 units, and these have been placed in institutions such as schools and health centers.The project thus helps young people learn a trade and increases their opportunities to generate income. After they complete their training,the members of this cooperative are expected to form their own micro-enterprises and train other apprentices.

A second phase of this project,currently in the planning stages, will involve several micro-finance organizations as partners. These partners will help integrate solar water heaters into the design of new homes being built by Habitat for Humanity in rural and peri-urban zones.The cost of the water heater will be incorporated into the price of the house, and the micro-credit agencies will provide access to credit for buyers.

Technology

Two models of solar water heaters are being built:the so-called "auto-storage"model,and the solar collector model.The first is the simplest to construct, and is suited for rural needs. It was used primarily in the first phase of the project. The second model is more complicated, and is better suited to urban needs.

"Auto-storage" model: This model consists of a 200 liter water reservoir painted black and placed in the center of a semi-parabolic reflector. The water is warmed by solar rays directed towards the sides of the dark reservoir. The whole apparatus is placed inside a wooden case that is covered with a glass pane

to retain heat and tilted at an angle of 15-20 degrees to receive the maximum amount of sunlight.

Solar collector model: This model consists of a large glass pane covering a black water cistern that absorbs solar energy. A thermosiphon makes the warmed water flow from the area covered by the pane to a thermally insulated storage area. Particular adaptations made to reduce equipment costs and meet local needs in West Africa include: local fabrication of thermosiphon tubes by artisans trained in metal-working; use of a special vegetable fiber found in coconuts to insulate the storage tank; and construction of the insulated storage tank, which is normally imported, using locally available recycled materials. For example, a 100-liter oil drainage tank can be cut in two to create two 50-liter storage tanks. The use of recycled materials reduces the cost of this equipment by 30-50%.

Environmental Benefits

Global: For each 200 liters of water heated using solar energy, 50 kg of firewood is saved in comparison to heating water over a "3-stone" fire. If an improved stove is used, approximately 16 kg of firewood is saved. If solar water heaters replace electric ones, such as in urban areas, then fossil fuel-powered electricity use is avoided. In all cases, greenhouse gas emissions are being reduced.

Local: By reducing dependence upon firewood in rural areas, local forests and ecosystems may be under less pressure, which could result in local environmental improvements.

Livelihood Benefits

Health: Access to hot water is critical for maintaining sanitary conditions. The use of solar water heaters may improve hot water access in urban areas, where electric water heaters in health centers and schools are often in need of repair, and in rural areas where only a limited amount of firewood is available. When firewood use is avoided, smoke inhalation may also be reduced, which has additional health benefits, particular for women and children.

Employment: The 30 young people involved in this project are not only receiving training to construct the solar water heaters, but also are being assisted in forming their own businesses.

National Benefits

This project is helping improve access to affordable water heaters in Côte d'Ivoire by designing locally adapted models and by building local capacity to construct them. If these models indeed prove widely usable, this can help Côte d'Ivoire conserve foreign exchange by avoiding the import of solar water heaters, and generate greater economic activity inside the country.

Beneficiaries

The project beneficiaries are the young people employed by the project and the potential users of solar water heaters who could not previously afford the imported versions, including institutions such as health clinics and schools.

Capacity Development

A key element of the project involves building the capacity of young artisans in constructing solar water heaters. The grantee has also produced a manual, including diagrams, for how to construct the heaters. In addition, participation in the project's cooperative will improve the capacity of the trainees to manage their own enterprises later.

Partners

So far, the main partners are SGP, the Opportunities Industrialization Center, which has been designing the technology and training young artisans, and the Fund for the Development of Professional Training, which has supported the capacity building aspects of the project through substantial co-financing. In the next phase of the project, new partnerships are expected to be formed to expand the impact of the project. Micro-finance institutions, such as the Credit and Savings Cooperative of Côte d'Ivoire, and organizations building new homes, such as Habitat for Humanity, will be important partners to enable the project to integrate solar water heaters into the domestic sector.

LESSONS LEARNED

Environmental Management

Adaptation of existing technology to local conditions has allowed artisans to produce affordable solar water heaters. The project thereby promotes sustainable livelihoods, improves sanitation, reduces air pollution and carbon dioxide emissions, and decreases the pressures on the local environment cause by dependence on wood for fuel.

Barrier Removal

Financial: At least on a small scale, this project appears to be successfully reducing financial barriers to the use of solar water heaters in Côte d'Ivoire. The use of local materials, and in particular recycled metal, has been shown to reduce the cost of constructing solar water heaters. The project is already planning for the next step in reducing financial barriers, namely the introduction of credit schemes to enable domestic users to purchase them.

Technical: This project has also sought to reduce technical barriers by developing locally adapted models of solar water heaters, and by training young artisans to make them.

Scaling Up

The project's approach – building a cooperative of young trainees – may be particularly helpful for scaling up. The core group of artisans trained in the project's cooperative are expected to form their own micro-enterprises, and also train other apprentices. According to the SGP national coordinator, the creation of this "cooperative-school" is a key step toward improving the technology and its construction in order to prepare for larger scale manufacturing operations.

The current phase targets institutions as users, while the next

phase seeks to establish mechanisms to disseminate the solar water heaters in the domestic market.

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Shared Solar Panels for Indoor Lighting, Côte d'Ivoire

Themes

★ Renewable Energy
⛭ Innovative technology applications
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty Alleviation (MDG 1)
✷ Education (MDG 2)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: The "Minimum Comfort" Solar Electricity Program of the Côte d'Ivoire
Implementing Organizations: Opportunities Industrialization Center (OIC), St. Ignatius Loyola Organization for Economic and Social Study, Center for Training and Research in Rural Development, and the Program for Community Health and Development (NGOs)
Location: 15 villages in five regions of Côte d'Ivoire
SGP Contribution: $225,519.00 (5 separate grants)
Start Date: August 2001

ENERGY OVERVIEW

Energy Resource: solar
Technology: communal PV systems
Application: indoor lighting
Sector: residential,public buildings (schools, health clinics, and community centers)
Households Served: 2000 people, 31 public buildings
Cost per inhabitant: $52 per inhabitant for an installation lasting 25-30 years1
Total power provided: 7.1 kW (129 solar panels of 55Wp)

BACKGROUND

Approximately 7 million people living in Côte d'Ivoire's 8,500 villages still have no access to electricity. Through conventional methods of electrification,they cannot hope to have access for another 50 years. In the meantime, they rely on kerosene and wood for lighting, which provide poor quality light and create indoor air pollution.

PROJECT DESCRIPTION

Overview

This project sought to test communal solar photovoltaic systems as a low-cost method of electrification for households and public buildings such as health clinics,schools and community centers. The program involved four NGOs operating in about 15 villages in five districts of the country. These villages are not included in the country's electrification plans for the next ten years.The NGOs, local populations,and certain elected officials together agreed upon the locations for project activities. In one set of villages, household lighting was the focus. Villages chosen as sites had at most 60 households, with houses constructed of durable material, totaling approximately 500 inhabitants.These villages were situated along the major roads in the country in order to provide visibility for the project activities. In the second set of villages,public lighting was promoted, and villages chosen as sites had to have adequate public infrastructure. All villages in the project had to have existing social welfare committees in order to assure that equipment would be maintained in the future. Those sites involving household lighting also had to have sufficient income-generating potential to pay for extensions of the photovoltaic lighting system. Beginning in 2002,each community is expected to cover 1/3 of the cost of these installations.

Photovoltaic panel for a primary school (Côte d'Ivoire).

The communal photovoltaic system for households was organized as follows: each village was subdivided into groups of no more than 10 households; each subdivision received four 55Wp panels,totaling 220Wp per subdivision;and each household received two energy-efficient light bulbs and a plug for audio-visual equipment.

Environmental Benefits:

Global: The homes of about 2000 people, plus 31 public buildings, benefited from the lighting programs.The reduced use of wood and kerosene in these villages due to solar lighting reduces emissions contributing to climate change.

Local: Any reduction in the use of wood for lighting purposes reduces pressure on local forests and other ecosystems. However, reductions in wood use are not recorded.

Local livelihood benefits:

Health: The reduced use of kerosene and/or firewood for lighting improves air quality in the home, leading to reduced incidences of respiratory and eye problems. In addition, the lighting in health clinics improves the capacity for health care, both through improved lighting and the possibility of refrigerating medicines.

Poverty alleviation: An improved ability to work at night has made it possible for villagers to engage in more income-generating activities, such as spinning cotton and making other products from locally grown crops.

Education: Lighting has helped promote education in a variety of ways. First, better lighting in the schools provides a better environment for learning. Second, the existence of lighting in the schools attracted more teachers to the schools.For example, one school with six classrooms had been operating with only four teachers.The lighting attracted two additional teachers to the school. Finally, lighting in community centers has helped to enable greater adult education opportunities.

Improved local opportunities: All of the above benefits, plus greater access to news and information through television and radio, improve conditions in small rural villages,and may reduce somewhat the migration of young people to the cities.

National Benefits

This project has stimulated the interest of the national government in using solar panels for electricity access.

Capacity Development

Although detailed information is not available about capacity building activities undertaken by the NGOs, they helped to set up local committees for managing the systems in each village, and this involved some training on maintenance of the photovoltaic systems. However, it was reported that greater follow-up on the part of the NGOs to strengthen these management committees would have been desirable.

Beneficiaries: The main beneficiaries of the program are the inhabitants of the 15 villages that were chosen to participate in the project.

Partners: The major partners in this project were SGP, which provided a significant proportion of the funding for the project, the four NGOs that carried out the project, and the village community groups that were involved in the project. Government entities were also stakeholders,since some elected officials were involved in deciding which communities should take part.

LESSONS LEARNED

Environmental Management

This project was testing the feasibility of communal photovoltaic systems. While overall the results were positive, some problems were encountered. First, some of the panels were stolen. In addition, users of the electricity tended to increase their demand without taking into account the capacity of the panels. Finally, some villages had trouble locating spare parts due to the lack of private sector suppliers.These problems suggest a few key lessons regarding photovoltaic systems, particularly communal ones:

Property rights to the solar panels must be very clearly defined and enforced.It is not clear from the information available how the ownership of the panels was organized.The panels shared by the subdivisions of households may have been construed to be jointly owned by the 10 households, or by the community group that was in charge of managing and maintaining them.

Limits on the use of electricity must be clear and enforced.The use of excess electricity from communal panels is related to the issue of property rights. In this scheme, each household is not charged according to how much electricity it uses. Without strong communal sanctions for overuse, or without a technical means of limiting electricity use, each person has little incentive to remain within the agreed-upon electricity use limits. As a result,some households will use more than their share and others will get less.

Attention must be paid to the development of a market for solar panels. Without such private sector involvement, spare parts are likely to be hard to find,and expansion of existing systems will require the intervention of an NGO. This is true for both individual and communal solar panel systems.The experience of other SGP projects that focused on developing markets for certain products suggests that private companies do not emerge on their own, especially domestically where technical capacity to produce the products may not exist.

Barrier Removal

Financial barriers: The communal photovoltaic scheme was being tested as a lower cost method of electrification than individual systems.The cost is low, at approximately $52 per inhabitant for a system that should last 25-30 years.However, this figure includes only installation costs.While in general the maintenance costs of solar panels are small, the possibility of the theft of panels and the lack of replacement parts,as described above, add to the per-inhabitant cost over time. In addition, if the committees responsible for maintaining the systems are not fully engaged or do not collect sufficient funds from villagers for this purpose, the systems may not last as long as anticipated. The report on the project indicates that problems did occur with the village committees responsible for maintenance.

Two lessons mentioned in the report regarding the removal of financial barriers are:

*When possible,communities should contribute financially to obtain the solar systems*The report suggests that communities whose agricultural activities bring in sufficient income should pay, while other less prosperous villages should receive full support for system installation.

Solar panel installation should be linked with income-generating activities The report indicates that efforts should be made to encourage income-generating activities at the village level that depend upon electricity.

Institutional barriers: This project highlighted the importance of addressing institutional barriers, particularly if communal energy systems are being proposed.The project report indicates that greater efforts should have been made by the NGOs to strengthen local village committees. If more capacity building had been undertaken, perhaps some of the problems with the theft of panels or managing the use of electricity might not have been so severe.

Scaling Up

Additional testing is required before this project can be scaled up. One proposed setting for a larger scale program is villages around which "satellite settlements"are located.In these places,

village electricity cooperatives could be organized using this model, with the cooperative charging tariffs for electricity use to recover costs. More recently, the government has expressed interest in scaling up the project to 300 villages.

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Affecting Electricity Policy through a Community Micro Hydro Project, Kenya

Themes

★ Renewable energy
❖ Technical capacity development
❖ Institutional capacity development
❖ Policy and legislation
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Tungu-Kabiri Community Micro Hydro Power Project
Implementing Organization: Intermediate Technology Development Group – Eastern Africa (NGO)
Location: Mbuiru village, Meru South District, Kenya
SGP Contribution: $63,700 through Phase 1 and Phase 2 grants
Start Date: April 1998 (Phase 1), January 2001 (Phase 2)

ENERGY OVERVIEW

Energy Resource: water
Technology: run-of-the-river type micro hydropower plant
Application: micro-enterprises (especially agro-processing), health, indoor lighting.
Sector: commercial (agro-processing), residential
Capacity: 18kW
Cost: US$3,495 per kW installed
Households Served: 400 (3000 people)

BACKGROUND

Approximately 96% of rural Kenyans lack access to grid-based electricity. Instead, rural families light their homes with kerosene, and carry out essential food processing tasks,such as milling grain, using diesel-powered systems.The cost of energy amounts to about a third of a rural family's income. In addition, women and children spend many hours per week searching for wood or dung for fuel.

Hydropower is central to electricity provision in Kenya; over 70% of Kenya's electricity is provided through large hydropower schemes. In 1997, Kenya's Electric Power Act allowed independent power producers to supply electricity to the grid, but small decentralized schemes, such as micro hydropower, were not fully addressed. Micro hydropower is not new to Kenya; prior to the 1960s micro hydro was used to power grain mills. However, these out-dated systems were quickly outpaced by the diesel engine for milling grain. Today, improved technology makes micro hydropower economically viable in many situations, but the country lacks the infrastructure for production and installation of micro hydro systems,or for repair of systems once they are installed. In addition, there are no standards or other policies to encourage and enable local communities to take advantage of this renewable and environmentally benign source of power.

Tungu-Kabiri community working together to build a micro hydro power plant (Meru South District, Kenya).

PROJECT DESCRIPTION

Overview

This project sought to remove the policy, technical and institutional barriers that limited the development and use of renewable energy sources to meet the energy needs of poor, off-grid communities.By demonstrating how communities can organize themselves to build and operate a micro hydropower plant, and by showing how the new supply of energy can improve their lives, the Tungu-Kabiri community project has stimulated changes in national policy and encouraged efforts to build domestic capacity to produce micro hydro system components.

Implementation

The grantee, the Intermediate Technology Development Group – Eastern Africa (ITDG-EA), worked closely with the Tungu-Kabiri community in developing and carrying out the micro hydropower scheme. About 200 members of this 300-household community came together to form a commercial enterprise to own and operate the micro hydropower plant. Each individual purchased a share in the company, with the maximum share having a value of approximately $50.The 200 members contributed free labor and participated in building a run-of-the-river, "penstock" type micro hydropower system, dedicating one day per week for over a year. In addition, government involvement was sought from the start, and the Ministry of Energy provided technical support throughout the project. The community acquired one acre of land from the government, where they built a micro-enterprise center that now receives power through the project.A 10-member community power committee manages the day-to-day operations of the plant, and conducts community consultations to decide upon

additional uses for the power generated by the system. In this way, the power committee is also playing the role of a village development agency.

There are two interesting aspects of this project's implementation.First,ITDG and the Ministry of Energy began by doing feasibility studies in this region to assess the potential for micro hydro power. However, they did not inform nearby communities at the time they were doing this, because they felt it would be highly disappointing and a setback if community hopes were raised before the potential for meeting their perceived needs was thoroughly explored through a feasibility statement. It was only after ITDG had determined the feasibility of the project at Tungu Kabiri that the community was made aware of the possibilities of a power scheme. Second,the community was mobilized to decide how best to use the power provided by the micro hydro system. In the ensuing community discussions, the majority of women wanted to use the power first to pump water nearer to the village and to purify it, while the majority of men wanted to begin with electricity and micro-enterprises. In the end,the men's first choice was the route taken,with the plan that water pumping would be installed next. However, while the micro-enterprises have been installed and are operating, the community has not yet been able to find the money to implement the water supply scheme.

Environmental Benefits

Global: Grain-milling is now carried out using micro hydropower instead of a diesel engine or fossil fuel based electricity. In addition, the community will soon be able to cure tobacco using hydropower rather than biomass, thereby reducing the use of wood resources.The use of kerosene for lighting will also be reduced because of the availability of electrical power.

Local: Over time, the reduced use of wood for fuel will reduce local deforestation, thereby reducing environmental damages such as soil erosion, which is a problem in this hilly region on the southern slopes of Mt. Kenya.

Local livelihood benefits

Health: A health clinic is one of the intended uses of part of the micro-enterprise center.With the new power scheme, it will be possible to refrigerate medicines.In addition,some villagers will receive light in their homes, which will reduce their use of kerosene and therefore their risk of respiratory and eye problems.Finally, when water pumping becomes available, improved access to clean water will help improve sanitation and health.

Poverty alleviation: Running micro-enterprises will provide some increased income to certain households, and provide services locally that previously people would have had to travel far to get.Thus,everyone will save time and money traveling, and some villagers' income will increase.

Education: Children in houses that receive lighting have an easier time studying at night than before. In addition,those households with increased incomes may now be able to afford school fees.

Reduced drudgery: Collection of firewood and fetching water remain among the most heavy tasks for rural women.The project,once fully completed,will free up women and children from traditional chores that have tended to keep women disadvantaged, and will allow children to attend school more often and participate in other social activities.

Improved local opportunities: In addition to the micro-enterprises,a social hall and community development office are expected to receive power, both of which can contribute to creating greater opportunities and an improved quality of life in the village. Micro-enterprises already in operation include a barbershop, a hair and beauty salon, a welding unit, and a battery charging station.These benefits of power can be enjoyed not only by community members but by residents of neighboring villages as well.

Regional and National Benefits

Demonstration effects: Supporters in two other communities have built at least two pico hydro (less than 5 kW) power projects as a result of the demonstration project in the Tungu-Kabiri community.

Capacity building: The Tungu-Kabiri project stimulated regional and national interest in learning to construct cross-flow turbines for micro hydropower systems.This project imported a cross-flow turbine from Ethiopia, but ITDG and the Kenyan Ministry of Energy realized these could be made in Kenya. A training program was led by a Nepalese engineering company for 12 enterprises from Kenya,Uganda and Tanzania.A separate workshop on the manufacture of Pelton turbines and electronic charge controllers was sponsored by other donors in the region. As a result, Kenya has established its capacity to build system components, including turbines, penstocks, electronic load controllers and others.The project has also built the country's capacity to conduct feasibility studies for potential micro hydro projects.

Policy development: The Ministry of Energy, having been involved in this project from the start, learned a great deal from the experience. The Ministry has realized the potential of micro hydro as a small-scale power source, and has initiated a process with the Kenya Bureau of Standards to establish standards and a code of best practice for the small hydro sector, including standards related to transmission poles, wires and accessories, and general installation.

Capacity Development

The project built the capacity of the local community to construct, maintain and repair a micro hydropower system. It also established their capacity to manage and operate a power scheme. ITDG is still providing advice and support as the community decides upon tariffs for the use of power and rent for the use of stalls in the micro-enterprise center. In addition, Kenya's improved capacity to manufacture the components of micro hydro systems,as described above, was another result of the project.

Beneficiaries

The primary beneficiaries are the 200 households holding shares of the commercial power entity in the community. Secondary beneficiaries are the entire Tungu-Kabiri community, as well as others from surrounding communities, who benefit from the services provided in the micro-enterprise center.

Partners

The Tungu-Kabiri community was the most important partner in developing and carrying out the project. They donated land, materials and all of the labor requirements, and also paid cash for licenses and ground handling of materials that were shipped to the community.

The Intermediate Technology Development Group (ITDG), which received grant funds from SGP, brought technical expertise and also contributed additional funding outside of the SGP grant.

Several Kenyan government departments were also involved, bringing technical expertise and other assistance to the project, including the Renewable Energy Department of the Ministry of Energy, the local government authority, the Ministries of both Water and Land, and the Social Services Department.

LESSONS LEARNED

Environmental Management

This project illustrates the potential for communities to develop and manage their own power systems in Kenya. ITDG's work in assessing the feasibility of various sites suggests that there are a number of sites where such micro hydro projects are feasible.

Barrier removal

Technical: The community built the entire micro hydro system, and in doing so learned all of the technical aspects of the system, including how to perform maintenance. Thus, involving the community in all aspects of project development from the start is critical to reducing local technical barriers. The project also effectively used opportunities to build manufacturing capacity for micro hydro system components. Government involvement seems to have helped with this, especially in facilitating efforts to build manufacturing capacity for cross-flow turbines.

Policy: This project was quite successful at addressing policy barriers at the national level through a single demonstration project. This was greatly facilitated by the fact that the project involved the Ministry of Energy as a partner from the very beginning. Thus, the Ministry saw itself as having a stake in the outcome, and saw first-hand the benefits that micro hydropower can offer. This made taking steps toward improving the policy environment for micro hydropower much easier.

Institutional: Ensuring complete community ownership of the power and its benefits is essential. This project achieved this directly by having community members purchase shares directly, providing capital for establishing other productive uses for the power. In addition, the community was involved in construction of the scheme as much as possible. This effort represents a large investment of time and money, which means that the community is not likely to abandon interest in maintaining the project, and instead will seek to meet the community's needs through its use.

Financial: This community still faces large financial barriers to taking full advantage of their new power source. For example, currently they would like to use some power to pump water up from the river so that women could reduce their work in fetching water for drinking and irrigation. Drinking water could also be purified using some of the power, which would reduce exposure to disease. However, as of a site visit in May 2003, the community had so far been unable to find the money to purchase the pipes and the purification equipment. Similar financial barriers exist for the many other communities for whom micro hydro power may be a technical possibility.

Scaling Up

This project has led to important changes that are critical to expanding the use of micro hydropower in Kenya. The two most important impacts are building capacity to manufacture system components domestically, and initiating a process to establish standards for component manufacture and installation. Both of these are essential to establishing a market for investing in micro hydropower projects. The project itself demonstrates that even poor rural communities, when they understand the benefits that such power can offer, are willing and able to contribute financially and physically to such a project. However, the financial resources from poor communities alone are not generally sufficient to construct micro hydro schemes. This financial barrier will need to be addressed if scaling up is to occur.

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Energy-Saving Institutional Stoves in the Mt. Kenya Region, Kenya

Themes

★ Energy Efficiency
✲ Linkages with other environmental goals
❖ Financing mechanisms and private sector involvement
✷ Education (MDG 2)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Energy-Saving Institutional Stoves
Implementing Organization: Renewable Energy Technology Assistance Programme (NGO)
Location: rural areas around the Mt. Kenya World Heritage Site, Kenya
SGP Contribution: $45,000
Start Date: August 2001

ENERGY OVERVIEW

Energy Resource: biomass
Technology: stainless steel, brick-insulated,energy-efficient stoves
Application: cooking and water heating
Sector: public (education)
Efficiency improvement: 60 - 70% biomass fuel saved
Institutions Served: 100 schools in Mt. Kenya Region (20 resulting from SGP funding),and a total of 150 schools nationally, including non-SGP funded areas

BACKGROUND

About 80% of the Kenyan population relies on biomass-based energy for cooking and heating. One set of biomass users includes educational institutions (primary and secondary schools,as well as colleges).Of Kenya's 20,000 educational institutions, about 90% use wood fuel to prepare meals. Firewood collection leads to the destruction of trees that could absorb carbon dioxide emissions and degrades local ecosystems, particularly in the watershed region of Mt.Kenya, a World Heritage Site. Recently, the Kenyan government has banned the collection of firewood from the World Heritage Site itself.This has caused a significant rise in the cost of firewood for schools in the area, which now pay approximately $25 per ton. Finally, in some schools children use significant amounts of time searching for fuel wood – time which could otherwise be spent on learning.

PROJECT DESCRIPTION

Overview

This project involves replacing open fire cooking systems in schools with heavy-duty, brick-insulated stainless steel stoves that require 60 - 70% less firewood. In doing so, schools save money on fuel costs and reduce smoke and emissions. In schools where children must collect firewood, the use of more efficient stoves allows children to spend more time studying.

Heavy-duty brick-insulated stainless steel stoves, school kitchen (Kenya).

Implementation

The implementing NGO, the Renewable Energy Technical Assistance Programme (RETAP), has addressed financial barriers via a credit system that enables a school to pay off the cost of a stove over two years. Some schools have also starting planting their own woodlots, using certain varieties of eucalyptus trees, to grow their own fuel. Since the new stoves use much less fuel than before, the schools may even be able to sell excess wood to other schools and tea and tobacco factories in the region, thereby generating income for the school. A number of schools estimate that the financial savings resulting from the stoves and woodlots may translate into 5-10% reductions in the cost of education per year.

Environmental Benefits

Global: So far, a total of 100 schools in the Mt. Kenya region have installed improved stoves.Prior to installation,each school used an average of about 160 tons of wood per year.The new stoves have saved each school 96 tons per year, making the total reduction in firewood use about 9600 tons annually.1 In addition,some schools have begun to plant their own trees (20 schools participating in the SGP-funded project planted a total of 100 acres of forest).Together, the reduced firewood use and increased tree planting reduces carbon dioxide emissions and increases carbon sinks.

Local: The local environment benefits substantially, since the forests suffer less degradation and tree loss.Water resources in the region are also better protected due to less forest destruction. Further, the planting of fast growing eucalyptustrees as alternative sources of fuelwood has contributed to conservation of the indigenous species within the World Heritage Site.

Local Livelihood Benefits

Education: Schools with the improved stoves spend 60% less on fuel costs. A school with an average of 300 students saves $1,025 per year, not counting the initial purchase of the stove. This means that educational institutions can channel these savings, totaling $100,000 so far, to meet other needs, such as reducing tuition costs, providing extra instructors, and improving facilities. Some schools have also required students to help search for firewood. Where this is the case, these students will no longer have to collect so much firewood, thereby allowing them more time to study. The project has also provided practical environmental education for students, focusing on energy efficiency, tree planting and biodiversity conservation. Environmental education for students is essential in securing sustainable management of energy and forest resources in the future.

Savings/income generation: The direct financial savings from reduced fuel wood use represent a significant economic benefit to schools. The cost of stoves is repaid using financial savings accrued from reduced fuel wood use, thus schools do not have to incur additional debts and/or raise money from other sources. This self-financing of the stoves is the most unique innovation of the project and underpins the success and sustainability of the revolving fund credit scheme. Taking into account the fact that the stoves have a lifespan of ten years, and the credit is fully repaid in two years, the financial savings in the subsequent years can be treated as direct economic benefits to the schools.

Partners

The Mt. Kenya region World Heritage Site is part of the Community Management of Protected Areas Conservation (COMPACT) effort. This initiative is the result of a collaboration at the global level between the GEF Small Grants Programme and the United Nations Foundation to promote community involvement in protecting World Heritage sites. The RETAP project was funded by SGP in this context, since it reduces threats to the area's forests while also improving livelihoods. The project has also been co-financed by the Ashden Trust of United Kingdom. Another partner has been the Forest Department and Tree Bio-technology Project in Kenya. RETAP has received seedlings and technical advice from them in order to start the woodlots.

Locally, RETAP works with schools, helping them to understand the benefits the stoves can offer and then working with them to make this financially possible. RETAP also works with the private companies producing the stoves to ensure that they produce high-quality stoves and provide much valued after-sale repair and maintenance. The fact that schools are guaranteed quality products and after-sale support gives them the confidence to acquire the stoves and pay for them in installments over a two-year period.

LESSONS LEARNED

Environmental Management

The project experience suggests that kitchen staff and school management needed more training on how to maintain the stoves so that the stoves last as long as possible (10-15 years with good maintenance). In addition, since schools do not keep good records of their energy use, many do not realize how much they could save with the stoves. Additional training on bookkeeping is also necessary to address this problem.

Barrier Removal

Financial: Additional financial resources are necessary to remove financial barriers. Since the producers of the stoves are generally small-scale businesses, they require full payment for the stoves at the time of purchase. Therefore, another source of credit is necessary to enable schools to make the purchases. Also, a larger project would have better economies of scale, leading to significant reduction in the final cost of stoves to schools.

Institutional: Currently, there is no setting in which educational and other institutions can come together to discuss common energy concerns. This would be of great help in addressing other barriers, including the policy barriers listed below, as well as leveraging additional funding and support from the government and the private sector in Kenya.

Policy: The project has not addressed policy barriers, but has identified some of them. They include the requirement that stove producers pay VAT taxes for stoves delivered to schools, yet other essential learning inputs are tax exempt. Lack of quality standards for stove production is another barrier. These two elements must be addressed if the project is to be successfully scaled up.

Scaling Up

There is good potential for scaling up this project. In the Mt. Kenya area alone, there are 400 remaining educational institutions that could use the improved stoves. However, in order to scale up, the barriers listed above must be addressed. In addition, the manufacture of stoves must be spread over a wider number of producers. This can help keep the prices of the stoves from rising as demand increases.

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Biogas in Peri-Urban Areas, Mali

Themes

★ Renewable energy
✲ Linkages with other environmental goals
✲ Innovative technology applications
❖ Technical capacity development
❖ Policy and legislation
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6

PROJECT DATA

Name: Pilot Project for the Installation of Domestic Biogas in Peri-Urban Zones of the city of Bamako
Implementing Organization: Mali Folkecenter (NGO)
Location: peri-urban areas of Bamako, Mali
SGP contribution: $31,133
Start Date: February 2000

ENERGY OVERVIEW

Energy Resource: biogas
Technology: biodigesters (floating metal drum type)
Application: cooking, heating water
Sector: residential
Cost of each system: approx. $750
Capacity of each system: 2.5 m3 biogas per day
Households Served (as of January 2002): 5 household demonstration sites, with an average of 30 individuals per site, meeting on average 40% of the family's energy needs.One additional demonstration system in a local technical training institute serving 200 students.

BACKGROUND

In Mali, approximately 92% of household and small industry energy needs are met with wood and charcoal. In peri-urban regions, where small farmers work to supply cities with food products, wood resources are especially over-exploited. Bamako, Mali's capital, has doubled in size in the past 20 years, and has placed a huge strain on the wood resources of the surrounding area.Loss of vegetation cover leads to desertification in a country that is already one-third desert. Biogas offers one possible solution to land degradation due to over-reliance on wood for fuel, since it converts livestock waste into a combustible gas, and also produces high-quality fertilizer. However, prior to this project, most efforts to promote biogas systems failed.This was primarily because the biodigester models were made of metal and required skilled metal-workers and access to electricity to operate the tools needed to produce them. In addition, the metal would rust in wet weather. Since 1970, the government has made numerous efforts to address the situation, but these projects were not well coordinated.In 1990,the government formulated a new National Domestic Energy Strategy and gained international financial backing. It was within this context that the Mali Folkecenter, an off-shoot of the Danish renewable energy organization called the Folkecenter, began its biogas project.

PROJECT DESCRIPTION

Overview

This project initiated the spread of biogas units in peri-urban areas around the city of Bamako through the development of a locally-adapted prototype, the establishment of demonstration sites, training for local people on constructing the biodigesters, and public awareness-raising about the benefits of the model. Wider use of biogas units would help reduce the demand for firewood in peri-urban areas and would supply high-quality fertilizer for local farming efforts.

Implementation

The project was supported by a local expert in biogas technology who worked at selected demonstration sites to develop a locally-adapted model of a biodigester, using local materials.The project began by conducting a feasibility study to better understand current local conditions as they related to project implementation. Using this information, the project then selected five demonstration sites.These were individual farms selected according to the following criteria:1) they owned sufficient agricultural land;2) they raised livestock in a permanent way; 3) there were at least 20 cows, to produce sufficient manure; 4) they were willing to provide labor, local materials, and a financial contribution to the project; and 5) there was a large household that consumed significant amounts of wood or charcoal.The project then trained these farmers to construct and maintain biogas units,using their own labor and local materials, with the advice and participation of the local expert and other project team members. In September 2001, the project organized a national seminar to inform communities, local authorities, and development partners in the region about the new biogas systems, and produced information materials to spread the word.A final evaluation, including the environmental and social impact of the project,was also planned.The project is now looking for funding to scale up to 100 more sites, thereby reducing the per unit cost of the technology.

Technology

This biodigester is of the floating metal drum type. It is built underground and lined with cement and brick. It has fibrocement feeding and outlet tubes, a floating metal drum to collect the gas,and plastic and metal tubes to transport the gas to the burners for cooking. Using 100 kg of cow manure per day over a period of 23 months,these biogas systems produced an average of 2.5 m3 of biogas per day, and an average of 900 m3 per year. Significant amounts of fertilizer were also produced.At the Technical Institute for Research and Applied Training, the Animal Production department is testing the use of chicken waste to produce methane gas.This gas could be used to warm the chicks in the wintertime.

While the digesters at the five sites cost around $750 each,the project aims to refine its local model such that it could be produced on a large scale at a cost of approximately $200 per unit.

Environmental Benefits

Global: The reduced use of firewood for cooking and other activities as a result of the biogas installations reduces greenhouse gas emissions.

Local: Local forests and vegetation will be under less pressure as a result of the decreased use of firewood.

Livelihood Benefits

Health: The reduced use of firewood for cooking improves health conditions for women and children who are the ones most exposed to indoor smoke.

Income: Less firewood and/or charcoal will need to be obtained, since the farms are producing their own energy.

Food production: Use of the high-quality fertilizer produced as a byproduct of the biodigester may lead to increased agricultural productivity.

Reduced drudgery: Women and children spend less time and effort collecting wood for cooking.

Beneficiaries

Direct beneficiaries so far are the families at the five farms,each with an average of 30 people, which are serving as demonstration sites for the technology. Other beneficiaries are the 200 students at the Polytechnique Institute for Research and Applied Training, which houses a demonstration site for teaching purposes.

Capacity Development

This project has conducted intensive training to develop the capacity of at least one local person at each site to build and operate the biogas unit.These individuals will later be responsible for spreading the technology around their area.

In addition, the project itself employs two technicians, who through the process of working with this project have learned more about biogas units and are familiar with this particular model.These individuals are also now more capable of facilitating the spread of biogas technology. Finally, the project's national expert is a professor at a local university, and students at that university will have an opportunity to intern with the project as a part of their studies. At the Polytechnique Institute for Research and Applied Training,200 students are learning about biogas using the school's demonstration model developed by the Mali-Folkecenter.

Partners

Local universities: By involving a professor from the Rural Polytechnique Institute as a local expert, the project helped spread understanding of biogas technology to students at the university. In addition, at the Polytechnique Institute for Research and Applied Training, a demonstration biogas system has been constructed,helping this institute's 200 students learn about the technology. Already, at the Technical Instititute other applications of biogas are being uncovered. For example, the Animal Production department hopes to use digesters to make methane from chicken waste, which could then be used to keep baby chicks warm during the winter months.This is an example of how partnerships can yield unexpected benefits.

Local farmers: The farmers at the five demonstration sites are the most critical partners, since they are contributing local materials and labor, and serve as the future promoters of the technology.

Local government officials: According to SGP Mali, government officials at the municipal level are interested in promoting this project. Many of them were invited to the national seminar to disseminate information about the project and the biogas technology. They have also visited some of the biogas demonstration sites.

LESSONS LEARNED

Environmental Management

The project illustrates the importance of adapting technology to local conditions to ensure that it works in the local setting, and that its use can be sustained. Prior to this project, biogas could not be sustained because models required materials that were not locally available and that were not adapted to local weather conditions. This project made a specific effort to address both of these problems, and as a result has met with much greater success.

Barrier Removal

Technical: This project has helped remove technical barriers by developing, with the involvement of community members, a new version of a biogas unit that is adapted to local conditions. The project is also helping to train a new generation of students at local technical schools who will be aware of the biogas technology and its benefits.

Financial: The current models used in the project cost $750 dollars each, far too much for the market in Mali, but if the organization is successful at scaling this up to more sites and therefore reducing construction costs, then the project will have helped reduce financial barriers. The development and testing done at these five sites was the first step toward addressing this barrier.

Information/awareness: The project incorporated several aspects to help improve access to information about biogas technology:

- A national seminar, held in September 2001, to which public officials, development agencies, and many others were invited.
- Development of written materials, such as brochures, radio and television clips, to educate the public.

- Integration of capacity development for local farmers. The involvement of these individuals from the beginning in construction and design,with the goal of preparing them to promote the technology in their area, helped greatly in raising awareness about biogas and its benefits.

The presence of the model digester at the Technical Institute for Research and Applied Training.This has resulted in improved understanding of the biogas technology on the part of 200 students,and this knowledge is being transferred to other departments, which are developing other applications of biogas technology.

Policy: Municipal government officials have become aware of the project and support it.Thus,when policy measures become necessary to promote the spread of the technology, these individuals may be more supportive. For example, the seminar held in September 2001 was attended by the General Secretary of the Ministry of Mines, Energy and Water, who appeared supportive of the project. However, there is no evidence yet of specific commitments on the part of the government.

Scaling Up

The project shows good prospects for scaling up its results. Certainly, the use of local demonstration sites to develop and refine the technology helps ensure the biogas units are effective in this environment and are reproducible with local materials.However, further support is needed in order to test these biogas systems on a larger scale before they can be commercialized. Recently, the Mali-Folkecenter was about to receive support from DANIDA, a Danish government source, to conduct a socio-economic feasibility study for an additional 100 biogas sites, but due to political changes in Denmark that source of funding was suspended. That project would have brought an Indian biogas specialist, Raymond Myles, to Mali to study implementation there in conjunction with the Rural Polytechnique Institute. However, instead the Folkecenter is consulting with private companies and other NGOs who are working on commercializing improved stoves that can be used with biogas systems. Government officials have visited the current biogas sites, and are very enthusiastic but no specific support has yet been made available.

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Solar Powered Water Desalination, Mauritius

Themes

★ Renewable energy
⁂ Innovative technology applications
❖ Financial mechanisms and private sector involvement
❖ Technical capacity development
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Solar Water Desalination in Coastal Villages
Grantee: Rodrigues Council of Social Services
Location: Rodrigues, Mauritius
SGP contribution: $30,279
Start Date: September 1997

ENERGY OVERVIEW

Energy Resource: solar
Technology: desalination stills
Application: water desalination
Sector: domestic
Cost of equipment: $200-$250 per still
Capacity: produces 3-7 liters of drinkable water per 10 liters of seawater in one day
Number Served: 21 households

BACKGROUND

The island of Rodrigues is located 320 nautical miles from Mauritius. Located along the southern coast of the island are 21 families residing in the village of Cite Patate who have been refugees since the Celine II cyclone. The coastal community is surrounded by seawater, and people make their livings mainly from fishing. Drinking water is difficult to obtain, however. It does not rain often there, but when it does the community catches all the rainwater it can in large tanks. When these tanks are empty, women must generally walk 3-5 hours per day to a natural spring to find and carry home water for their families. However, even the water from the spring is not always potable, and may carry disease.

PROJECT DESCRIPTION

Overview

This project developed locally-constructed solar water desalination units and installed them in the remote community of Cite Patate, providing these households with improved access to drinking water. The project also demonstrated the use of solar energy to desalinate water, an approach that may be usable in other areas of the island nation of Mauritius.

Implementation

The idea for this project emerged from a stakeholder's workshop held by SGP in Mauritius in which a presentation was made by specialist in renewable energy at the University of Mauritius. The president of the Rodrigues Council of Social Services, the grantee NGO, participated in the workshop and proposed this project for using solar energy to desalinate seawater. The technical design and prototype for the desalination stills were prepared by this specialist at the University of Mauritius, who then worked with a local company that manufactures boats using fiberglass to produce 20 replicates of the prototype still that had been shipped to Rodrigues. The stills were then installed in the backyards of the 21 families of Cite Patate. These families contributed to the project by building well for easy access to seawater, which is then placed in the still for desalination. For every 10 liters of seawater, 3-7 liters of drinking water are produced in a day. This water must still be treated with minerals before drinking. In fact it is helpful to add a pinch of salt to the desalinated water!

Solar powered desalination improves local freshwater supplies and reduces the vulnerability of Cite Patate villagers to drought (Island of Rodrigues,Mauritius).

Based on an evaluation of the project after the stills were installed, it appeared that most families used the still as a "survival kit" to get through periods of reduced rainfall. In addition, some families did not perform the required maintenance, which decreased the performance of the stills. It was also reported that some children took the desalinated water to school during drought periods.

A few months after the project started, an international religious NGO made a donation and connection of water pipes to the village of Cite Patate. This proved to be unsuccessful as the water supply is very unpredictable. Thus the most reliable way to get everyday drinking water is by using the stills.

Technology

The solar desalination plant consists of a 1m x 2m reservoir covered with fiberglass. Seawater is placed inside, and the sun causes evaporation. The steam condenses on the inside of the glass cover which is tilted at a certain angle to allow the con-

densed water to drain out of the reservoir into another receptacle. This water, which is approximately half the volume of the original seawater, still must be treated with minerals before drinking. Each of the 21 households has a still in their backyard. In addition, the still must be maintained regularly to ensure this level of performance. The community has built a well out of which seawater can be easily drawn in order to be desalinated. Several keys to success were recorded, including making sure to find paint that sticks properly to fiberglass, ensuring that the glass panes fit tightly with rubber seals, and determining the optimum seawater level in the reservoir (3/4 of an inch in this case).

Environmental Benefits

Global: This project does not directly reduce greenhouse gas emissions, since the water desalinators do not displace fossil fuel use to produce drinking water. However, in the long term, demonstration of this technology may provide global environmental benefits. Future methods to obtain water in Mauritius might involve the use of fossil fuels to obtain additional amounts of drinking water, either through desalination or purification of other water sources. If scaled up, this technology could offer an option for non-fossil fuel dependent water access.

Livelihood Benefits

Health: This project improves access to clean drinking water for this isolated community. The previous drinking water obtained from the natural spring often carried diseases.

Reduced drudgery: The women in these 21 families no longer have to walk 3-5 hours per day to find drinking water.

Adaptation to possible impacts of climate change: By enabling these families to convert seawater into drinking water, the project increases the community's capacity to cope with long periods without rain.

Capacity Development

This project has built local capacity to construct solar water desalinators. A local boat-making company has made them, with technical assistance from engineers at the University of Mauritius. It appears that the project had some shortcomings in its training of users, since maintenance problems did emerge and affected the technology's performance.

Partners

Several key partnerships helped make this project happen. SGP support has not been limited to providing funds for the project; the idea for the project came out of a SGP workshop on renewable energy sources. The president of the Rodrigues Council of Social Service attended the workshop, where Mr. Revin Panray Beeharry, an engineer at the University of Mauritius, gave a presentation. The project then evolved as a partnership between the Rodrigues Council of Social Services and the University of Mauritius, with Mr. Beeharry serving as a technical consultant. Another key partner was the local boat-making business which, with the university's technical guidance, learned to make the solar desalination units. Community participation was also key, since community members provided the labor for digging a well from which to draw seawater to be desalinated.

LESSONS LEARNED

Environmental Management

This project demonstrates an option for small island states to consider in developing better access to drinking water. If solar desalination is effective and not too costly in a small-scale setting like this one, it may be an option for other small island states to improve the diversity of water sources and thereby reduce communities' vulnerability to water shortages.

Barrier Removal

Technical: The project reduces technical barriers to solar water desalination by developing a prototype made by a local boat-making company, and implementing it in a small community. The project offers the opportunity to learn more about the technical issues involved in solar water desalination and to improve the possibility of implementing it more widely.

Scaling Up

The project has potential for scaling up, since there is a need for increased options for drinking water access in Mauritius and in other small island states. According to the SGP National Coordinator in Mauritius, this project has led to the proposal of a larger solar desalination on the island of Rodrigues. The proposal is apparently still under consideration. Similar technology is used in other parts of the world, such as El Paso, Mexico, the Canary Islands, Spain and Porto Santo, Atlantic Ocean.

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Assessing the Spread of Improved Charcoal Stoves in Urban Areas, Tanzania

Themes

★ Energy Efficiency
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: A Study of Factors Hindering Wide Adoption of Improved Charcoal Stoves
Implementing Organization: Tanzania Traditional Energy Development and Environment Organization, or TaTEDO (NGO)
Location: Dar es Salaam, Tanzania
SGP Contribution: $25,724.00 (for assessment)
Date of assessment: March 1998

ENERGY OVERVIEW

Energy Resource: charcoal
Technology: improved charcoal stove (ICS, or jiko bora)
Application: cooking
Sector: residential, commercial (micro-enterprises)
Households Served: 4,000 ICS produced per month

BACKGROUND

The Improved Charcoal Stove (ICS) was first introduced in Dar es Salaam by the Ministry of Energy and Minerals in 1988 with assistance from the World Bank. Adapted from the Kenyan ceramic jiko, this stove consists of a metal outer casing,a ceramic firebox and an insulation collar. The stove has been promoted because it is low-cost, reduces cooking time, improves thermal efficiency by 30-36%, and reduces the consumption of charcoal and therefore household expenditure. In 1992, the Tanzania Traditional Energy Development and Environment Organization (TaTEDO) assumed responsibility for disseminating this technology in the country. It has trained artisans to produce the stoves and helped establish workshops and repair centers by offering small loans, training and technical support.

Dar es Salaam's population in 1998 was about 3 million and growing.More than 85% of the population depends upon charcoal as cooking fuel, and each person consumes an average of 120 kg of charcoal per year. As a result,360,000 tonnes of charcoal are consumed in Dar es Salaam annually, accounting for 50% of charcoal use in the country. Prices of charcoal are increasing, as it must be transported from further away due to the scarcity of trees in nearby villages.

However, the sales and production of the ICS had not expanded as much as TaTEDO had hoped. In 1997, demand for the ICS was estimated at 12,000 per month. However, only about 4,000 stoves were actually being produced each month. Therefore, TaTEDO conducted a study in 1998 with funding from SGP to understand the reasons for this lack of production and market expansion.

PROJECT DESCRIPTION

Overview

The study conducted by TaTEDO was intended to determine why the production of ICS had not expanded to meet existing demand and why existing demand was not greater given the benefits offered by the stove, and to identify ways of addressing these problems.

Implementation

The study was conducted as a Participatory Rapid Appraisal because information from users and producers of the stove was essential to identify problems and evaluate possible solutions.A four-member team of energy and environmental engineers, sociologists and socio-economists conducted the study, which involved visiting four workshops, conducting semi-structured interviews of producers,users and distributors, and holding focus group discussions involving these same groups. Based on the findings,the team prepared a report that included a plan for resolving the problems identified through the study.

Environmental Benefits

Global: The use of an ICS reduces the amount of charcoal used in cooking by 30-36%, if stoves are made according to established standards. This reduces carbon dioxide emissions that contribute to climate change.

Local: Reduced use of charcoal improves local air quality. In addition, since coal is produced from wood obtained from the country's forests, reducing the use of charcoal also alleviates one source of pressure on forests.

Livelihood Benefits

Health: The reduced use of charcoal improves indoor air quality and therefore reduces the risk of respiratory and eye problems.

Poverty alleviation: The use of an ICS reduces the amount of charcoal a household must purchase, which saves money. This assumes that the ICS was constructed according to standards.

National Benefits

Reduced use of wood products: By reducing charcoal use in Dar es Salaam, other regions of the country in which coal is produced from wood will suffer less depletion of forests. This was a goal set out in the country's 1992 National Energy Policy.

Capacity Development

Technical training: Prior to February 1998, TaTEDO had trained more than 200 artisans who had produced over 150,000 improved stoves between 1993 and 1998. Not every artisan was trained to produce an entire ICS – some learned to produce only certain parts.

Business training: TaTEDO has provided some business assistance, especially through the provision of loans for the purchase

of equipment. TaTEDO is apparently the only source of such credit for most ICS producers.

Partners

Government: TaTEDO has worked with various local and national government entities in promoting the ICS.

The Ministry of Energy and Minerals was responsible for developing policy and regulations related to energy products and use.

The Dar es Salaam City Council was responsible for creating a good business environment via regulations related to designating business areas, producing and distributing products and enforcing measures to safeguard the environment. However, the Council's small business guidelines have not been adequate, and as a result many ICS businesses remain informal in nature.

NGOs: TaTEDO was primarily responsible for promoting production via technical assistance and training,and via provision of credit for equipment purchase.

Small Industry Development Organization (SIDO) provided small business management assistance.

Funders: SGP provided funding for the study to analyze problems in expanding production and market size.

LESSONS LEARNED

Environmental Management

Widespread adoption of the ICS would result in a significant decrease in charcoal use in Dar es Salaam. However, this depends upon the stoves being constructed according to standards, and upon the sufficient expansion of the market for the stoves.

Barrier Removal

Technical: TaTEDO has invested considerable effort in technical training since 1993, and is responsible for training over 1000 artisans to date. However, the report found that some among this group were trained to produce only one part of the stove, or otherwise did not feel that their training was complete. In addition, others learned via apprenticeships or by simply copying designs, which leads to products of variable quality. The problem of having poor quality stoves on the market is a persistent one, and has "tarnished the image" of the ICS. In addition to insufficient training, the report identifies several reasons for this. First, quality materials cannot be reliably obtained; for example, rice husks ash is a necessary input for a stove, but there is not a formal market for it, so producers must depend upon personal relations with ginnery operators.Second, many producers lack sufficient capital to purchase the appropriate materials,and therefore they substitute materials of lower quality. Third,there is not agreement even among the most experienced producers on the established standards for a stove.

Financial: Adequate credit is essential for establishing sufficient production, since producers need to purchase equipment.The report recommends establishing a revolving fund for ICS producers and developing producer cooperatives.

On the other hand,those seeking to purchase stoves may need access to credit as well.One way to address this is to find new, more flexible purchase methods, such as a rental system. Cheaper production methods could also be pursued.

Institutional: One problem identified through the study was the lack of a coordinated source of information about stove designs, materials and training, and marketing of the products. The report recommended that TaTEDO establish an information center to meet this need.

Policy: One of the most significant barriers that face ICS producers is their inability to obtain approved production sites for small-scale production. There is no procedure for allocating small plots for businesses,and thus many ICS producers remain informal despite having business licenses.This creates instability and hinders the sector's development. The report proposes that TaTEDO work with government agencies to address this problem.

Scaling Up

All of the above barriers are also obstacles to scaling up production of the ICS.A further hurdle, however, is the low level of awareness on the part of potential purchasers concerning the benefits of the ICS. In some cases a reputation of poor quality perpetuated by the factors described above. A serious effort is necessary to raise awareness about the stove, especially among women who are the primary users. In addition, promotion in other cities besides Dar es Salaam where charcoal is used would help expand the market. The report noted that women have not been actively involved in the promotion of the stoves, but since women are the primary users, their involvement is critical. Community-based women's organizations are another potential place to promote the stoves.

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Nehemiah Murusuri, national coordinator, GEF Small Grants Programme Tanzania.Email communication,October 2003.

Biogas Technology in Agricultural Regions, Tanzania

Themes

★ Renewable energy
⁂ Linkages with other environmental goals
❖ Technical capacity development
❖ Awareness,culture and practices
✷ Poverty alleviation (MDG 1)
✷ Gender equity and empowerment (MDG 3)

PROJECT DATA

Name: Promotion of Low Cost Biogas Technology to Resource Poor Farmers in Tanzania
Implementing Organization: Foundation for Sustainable Rural Development, or SURUDE (NGO)
Location: Tanzania,with replication in other African countries
SGP Contribution: $88,016 (two grants)
Start Date: January 2001

ENERGY OVERVIEW

Energy Resource: biogas
Technology: tubular plastic biogas technology
Application: cooking,limited lighting
Sector: agriculture/livestock
Households Served: more than 1000 households in Tanzania
Cost per system: $100
Total energy provided: a 4 m^3 volume digester produces 1 m^3 gas per day, equivalent to 0.5 liters of kerosene

BACKGROUND

Farming is the major rural activity in Tanzania, but this does not generate sufficient income. As in most of Africa,fuel wood and charcoal are the primary sources of energy for Tanzania's rural population.On average each rural household spends ten hours per week searching for fuel wood.In urban or peri-urban areas, households spend considerable amounts of money on fuel wood and charcoal. Consumption of charcoal and fuel wood is a serious factor in deforestation,air pollution and carbon dioxide emissions.When all forest uses are included, the deforestation rate in Tanzania is around 100,000 hectares per year. In addition, Tanzania's 13 million cattle also produce greenhouse gas emissions; dung that is left to degrade produces significant amounts of methane and carbon dioxide.

PROJECT DESCRIPTION

Overview

This project seeks to address technical, financial, and informational barriers to the implementation of biogas technology in order to increase incomes, improve home air quality, and reduce carbon dioxide emissions.The project's strategy is to integrate livestock into the farming system and promote the production of biogas for energy.

Implementation

The project began when scientists from Tanzania learned about a low-cost, tubular plastic biodigestor being used in Vietnam. They adapted it to Tanzanian conditions, and then began seeking ways to integrate its use into the farming system, ensuring its sustainability.

Technology

The biodigester produces gas that can be used as fuel for cooking and heating, as well as for lighting, with proper equipment. It costs about $100 and takes about 4 hours to assemble. For proper functioning, the digester requires the excreta from 1-2 cows, 5-8 pigs or 4 able-bodied people on a daily basis.The digester also requires an adequate water supply, ideally operating on 2 parts water for one part manure. Cows can provide a steady supply of manure, and farmers are helped to obtain them through a "Heifer-in-Trust"scheme under which a farmer is loaned an in-calf heifer, and agrees to give the first two female calves to neighbors.

Environmental Benefits

Global: Using biogas for cooking reduces the need for fuel wood and charcoal. Each biogas unit is estimated to reduce deforestation by 37 hectares per year. Since it also uses cow dung that would otherwise have degraded,further greenhouse gas emissions are avoided.

Local: Reduced deforestation helps preserve forests and all of the services they provide, such as biodiversity and maintenance of water quality. In addition, the promotion of agro forestry practices in conjunction with livestock helps protect soil fertility, prevent erosion,and reduce the risk of overgrazing problems often associated with cattle.

Local Livelihood Benefits

Health: Reduced use of kerosene and wood for cooking improves air quality in the home, decreasing the incidence of respiratory and eye problems. The benefits are particularly great for women, who spend the most time in the household and do the cooking.

Poverty Alleviation: Biogas production integrated with cattle raising and farming provides a reliable source of cleaner fuel as well as increased income and employment opportunities. The sale of milk in Tanzania generates significant income relative to the sale of crops, thereby increasing the family's income. Women generally control this income, and studies have shown that income from the sale of milk goes toward school fees for children,improved housing,clothing and transportation equipment (such as bicycles).In addition, a large percentage of dairy farmers use hired labor. Therefore, increased incorporation of cattle into farming methods increases employment opportunities. The production of biogas also produces a slurry that is very effective as a fertilizer. Farmers have effectively used it in banana cultivation and vegetable gardening. Studies by Sokoine Agricultural University in Tanzania have shown that the use of this fertilizer helps maintain soil quality over time, thereby improving crop yields.

Reduced drudgery: Women and children do not have to spend as much time looking for firewood. Cooking with biogas is also faster than with firewood.As a result, the drudgery of women is lessened. Some households have reported that some men now help their wives cook since using biogas is so easy.

National Benefits: Increased use of biogas reduces Tanzania's overall reliance of charcoal, wood and fossil fuels.

Capacity Building Activities

SURUDE conducts two major types of training:

Training for farmers to incorporate livestock and biogas into their farming system.More than 1000 farmers now use this system.

Training for biogas technicians to install and repair biogas systems. In Tanzania,SURUDE has trained 50 technicians.

Beneficiaries

Rural,farming families benefit most from biogas.Women benefit especially, since biogas reduces their workload, improves their access to income through the sale of milk, and reduces health problems.

Partners

Founded in 1994, SURUDE is a membership organization currently involving about 250 farmers. SURUDE's main office is located in Turiani, about 200 km west of Dar Es Salaam. Five sub-centers are being established in the various regions of Tanzania in an effort to further spread the use of biogas technology incorporated with farming and livestock practices.Many important partners that have been critical in advancing SURUDE's work:

Farmers are SURUDE's most important partners, as they are integrally involved in developing and distributing new techniques and technologies. Farmers are involved in local community-based organizations whose activities help support the integration of biogas and new farming systems.

Universities: SURUDE has worked closely with the Sokoine University of Agriculture and several other universities in Denmark and other European countries.They assist the organization in data collection, research, monitoring results, and developing new products.

Companies: A Danish company called Superflex has helped produce and distribute the tubular plastic biogas digester.

Funders: SGP and UNDP, as well as the Ashden Trust in Great Britain,have been critical funding and technical assistance partners.

Government: The Tanzanian government supports SURUDE by providing agricultural extension services,into which biogas and livestock practices are being incorporated. The Ministry of Energy and Minerals, responsible for promoting renewable energy, also supports SURUDE's work. SURUDE's efforts help to achieve goals contained in the Action Programme for the Development of Tanzanian 2001-2010.

International networks: SURUDE has worked with the UNDP/Africa 2000 Network,through which it has helped promote biogas in other African countries, including Cameroon, Uganda and Nigeria.

LESSONS LEARNED

Environmental Management

SURUDE's ability to successfully and sustainably address environmental management issues is due in large part to its close work with farmers themselves, who provide feedback and input, and its collaboration with university research programs that have helped monitor and report on results. Since biogas production requires a steady supply of biodegradable material, it can be combined successfully with livestock farming. In addition, the slurry produced as a by-product can be used as an effective fertilizer to improve crop yields.

Biogas use is sometimes hindered by a lack of sufficient water. Designs that use less water, or that are incorporated with rainwater catchment systems, need to be developed to ensure greater adoption of this technology.

Barrier Removal

Financial: The Heifer-In-Trust program seems to have been effective in making cattle available to income-constrained farmers.However, financial barriers still exist in obtaining the biogas systems. Each system costs $100-120, and although the system more than pays for itself over time through income generation and savings on fuel purchase, this up-front costs represents a large percentage of many farmers' yearly income. Micro-finance systems must be developed to ensure the spread of this technology. In Turiani, a women's organization called Kamuutu has established a revolving credit fund with support from SURUDE. Each family contributes a set amount of savings per month,and farmers then can then acquire credit on a revolving basis.

Technical: SURUDE's primary contribution to reducing technical barriers is its development of the tubular plastic biogas digester adapted to Tanzanian conditions. SURUDE worked with a Danish private company, Superflex, which helped to develop and distribute the model. Through experience, SURUDE has identified several ways in which the digester can be further improved, such as integrating rain water harvesting with biogas systems, improving its durability, and developing a biogas-powered lighting system. SURUDE is currently applying for expanded funding to undertake these research efforts and further spread biogas technology in Tanzania and other African countries.

One other technical barrier that SURUDE has begun to overcome is the availability of technicians who can install and repair biogas systems.SURUDE has trained them in Uganda as well as in Tanzania. However, SURUDE seeks a great need for more technicians, as there are only 50 in Tanzania at this time. Overcoming this barrier will require additional funding to start a larger technician training program.

Informational: Affecting the farming, livestock and energy use

practices of farmers is SURUDE's main goal. Several lessons may be drawn from SURUDE's experience with this.

First, SURUDE's partners have been critical to helping overcome informational barriers. First, universities have been involved in conducting research, and establishing record-keeping methods for farmers to collect information to be analyzed. The government's agricultural extension service has also helped to promote the introduction of biogas and livestock into farming systems. Both of these partnerships appear to be extremely effective ways to obtain information for analysis, and disseminate information about best practices.

Second,researchers who have sought to establish record-keeping practices among farmers in conjunction with SURUDE have found that farmers will keep records of information necessary for analysis – such as the calves'birth dates,and the amount of milk produced and sold – but they are more likely to do so when they see how this information is used to benefit them. Thus,the project is involving farmers in the process so that they can see the results of their efforts.Also, recording systems need to be simple and track as few parameters as possible.

Scaling Up

SURUDE has been extremely successful in scaling up its activities to reach five different regions of Tanzania,and also to begin spreading the biogas technology to other African countries. It seems that there are several key elements to achieving this:

The technology is relatively low cost.Therefore, a reasonable number of farmers can begin using it without very significant financial assistance. Only very small loans would be necessary to make the biogas available to almost all farmers who could benefit.

Links with agriculture, the source of livelihood for a large portion of Tanzania's population, have helped the project build partnerships with government programs related to agriculture as well as those related to energy. Word has spread about biogas through the government's agriculture extension services, not just through energy-related programs which are smaller. Since agriculture is important in all African countries,biogas has appeal in many parts of Africa.

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Nehemiah Murusuri, national coordinator, GEF Small Grants Programme Tanzania.Email communication,October 2003.

Demonstrating Wind and Solar Energy on Lake Victoria, Uganda

Themes

★ Renewable energy
✲ Linkages with other environmental goals
❖ Technical capacity development
❖ Institutional capacity development
❖ Awareness, culture and practices
✷ Poverty alleviation (MDG 1)
✷ Education (MDG 2)

PROJECT DATA

Name: Bufumira Islands Alternative Energy Demonstration Project
Implementing Organization: Bufumira Islands Development Association (CBO)
Location: Lake Victoria,Uganda
SGP contribution: $2,000 planning grant, $41,290 full grant
Start Date: November 2000 (planning grant); July 2001 (full grant)

ENERGY OVERVIEW

Energy Resource: solar, wind
Technology: battery charging station
Application: battery charging for household use, solar panels
Sector: domestic, commercial (battery charging), public (primary and secondary schools, BIDA headquarters)
Capacity: 3 wind generators of 400W each, combined with 6 photovoltaic panels (Musoni site); 2 photovoltaic panels (Bufumira site); photovoltaic panels in school and 11 homes (Bukasa site)
Number Served: demonstration projects in 3 communities

BACKGROUND

The Bufumira Islands are located in the Kalangala district of Uganda, along the western shore of Lake Victoria.This is the second-largest freshwater lake in the world and feeds into the Nile River and the Mediterranean Sea.The Kalangala district includes 84 islands, 70 of which are inhabited, and the main activity in this area is fishing. Before the project started, most energy needs were met through single-use dry cell batteries, kerosene, paraffin and firewood. Many batteries were not disposed of properly, which resulted in soil and water contamination. Women and children used to have to go to far-away areas in search of clean water, away from the contaminated sources of water. In addition to such problems, it used to be very expensive for schools,as well as for children and parents,to pay for paraffin hurricane lamps in order to work at night, for example when students needed to study for exams. Limited energy options hindered communities' possibilities for improving their livelihoods.These challenges led communities to seek assistance in finding solutions.

Solar photovoltaic panels outside a secondary school at the Bukasa demonstration site (Lake Victoria,Uganda).

PROJECT DESCRIPTION

Overview

This project demonstrates the use of wind and solar energy sources to recharge batteries and meet lighting and other power needs within homes.A hybrid wind/solar power station has been built, and public awareness campaigns about proper battery maintenance and disposal have been conducted.

Implementation

The project is led by a community organization, called the Bufumira Islands Development Association (BIDA).This community group has partnered with the East African Energy Technology Development Network (EAETDN), based in Kampala, Uganda. EAETDN-Uganda has provided technical expertise, while BIDA offers local knowledge, through artisans and local technicians, and strong ties within the community. In Musoni, BIDA has formed a community committee to manage the wind/solar hybrid power station.This station is mainly used to recharge batteries,which are used to meet household energy needs and also the needs of fishermen working at night.The community members managing the power station have established a system by which people can pay to have their batteries recharged there. The cost for charging a battery is approximately $1. A receipt is given for each payment, and the funds are distributed as follows: 30% to the technician, 50% to the bank, and 20% for maintenance and office costs. Those customers who do not own batteries can purchase them from the charging station on credit. While the stations serve approximately 100 people, there is a much greater need than this for battery charging services.

In addition to establishing the power station, the project has allowed some homes to make use of solar panels to meet their energy needs. To overcome the significant financial barriers involved in accessing solar panels,BIDA is creating a small credit fund to help people purchase the panels. Eleven homes have already received solar panels,which were paid for by BIDA, but users are paying back the cost of the equipment over time,

thereby improving ownership and responsibility among the users.

Technology

Musoni Site: A hybrid wind/solar power station has been built at Musoni.This system consists of 3 wind generators of 400kW each,combined with six solar panels.This power station is used to charge batteries. So far, the wind generators have not performed as well as expected due to insufficient wind,and during the rainy season the solar panels provide diminished charging capacity.

Bufumira: The BIDA office and the local primary school now receive power through installations at this site, and battery charging services are available to the community. Seven solar panels, one inverter, 3 power regulators, and 2 100AH solar batteries are now installed and used here. The office has been fitted with 7 energy-efficient light bulbs.The primary school also has a solar battery and energy-efficient light bulbs.

Bukasa: The secondary school receives light,and battery charging services are available to the community. This site involves 8 solar panels, 3 regulators, and 1 inverter.The secondary school has two 100AH solar batteries and 10 energy-efficient light bulbs.

Environmental Benefits

Global: Reduced use of firewood, kerosene and paraffin reduces greenhouse gas emissions.Additionally, Lake Victoria feeds into the Nile and borders on several countries, so any improvements in local water quality, described below, may also be considered to bring global benefits.

Local: The project has initiated the use of rechargeable batteries,and has begun to educate users about proper battery maintenance and disposal.This means that water pollution problems related to improper dry cell battery disposal may be reduced.

Livelihood Benefits

Income generation: At least 12 community members in Musoni now supplement their incomes by recharging batteries for other households at the wind/solar hybrid power station. Better access to battery power can also help support fishing activities.In Bufumira,increased use of BIDA's newly-lit lodge is also increasing income to BIDA.

Health: Reduced use of firewood and kerosene may bring health improvements. In addition, households are using less paraffin for lighting,which has led to a reduced number of accidents involving paraffin.

Education: The Bukasa secondary school and the Bufumira primary school have received power as a result of the project, resulting in better conditions for education. Improved lighting access in homes can also enable children to study in the evenings.

Increased stability: Users of batteries have responded to surveys conducted by BIDA and said that access to the battery charging systems has helped encourage them to settle permanently in the area.

Capacity Development

BIDA has significantly improved its operational capacity both through training of its staff members and through the improvement of its office conditions and equipment. For example, the project will soon receive a donated computer since the office now has access to power.

Community members are receiving training in technical issues provided by EAETDN-Uganda, as mentioned above. Those involved in managing the power generator are improving their skills in project management. Finally, community members are receiving training in proper battery maintenance, which will increase the lifetime of batteries and improve their access to energy services.

Partners

The partnership between BIDA and the East Africa Energy Technology Development Network (EAETDN-Uganda) has been critical for the success of this project.EAETDN-Uganda is an established NGO with technical expertise and contacts across East Africa, while BIDA is a local community organization. EAETDN-Uganda is able to provide technical assistance and conduct assessments for alternative energy use in the Kalangala District around Lake Victoria,which will in turn benefit their work in similar projects in the region. BIDA, on the other hand, benefits from the expertise of this partner organization in terms of skills in renewable energy.

LESSONS LEARNED

Environmental Management

This project sought to demonstrate how renewable energy can improve local livelihoods while relieving environmental pressures. More information is needed on how many people are now using rechargeable batteries, and on the effect of this on water contamination, in order to assess the long-tem impacts of the project.

Barrier Removal

Technical: By implementing the first demonstration of a wind/solar hybrid power station in this area,the project should reduce technical barriers and provide information for assessing the feasibility of more large scale implementation of this type of energy source. EAETDN-Uganda's involvement should be very helpful in this regard.

Information/Knowledge: The project has promoted awareness among battery users about the impacts of improper battery disposal,along with the benefits of using rechargeable batteries. However, the project's final evaluation indicates that there is a much greater need for battery charging in the area than can be met by the current power stations. In addition, the surveys of users indicated that there is still some lack of understanding

about these power systems. For example, some do not appear to understand why during the rainy season there is less battery charging capacity, and some think that the technology is poor.

The final evaluation indicates that communities would like wind generators for every power station. This is because they had heard good things about wind power from another community, where wind speeds were quite high. However, the low wind speeds in this area decrease the performance of the wind generator. There is therefore still need to sensitize and train communities to better understand technical issues that guide the choice of energy technology appropriate to their needs. Projects involving the transfer of technical skills to communities require continuous interventions over a period of time.

Scaling Up

There is a great need to scale up these efforts, since there are many islands in this region to which it will be very difficult to extend the grid in the near future. Thus, a successful demonstration of renewable energy sources could be of great help to this region if scaled up to meet more peoples' energy needs. However, additional work seems necessary to decide upon the best way to scale up the project.

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Energy Efficiency Improvements in Small, Medium-Sized and Informal Enterprises, Zimbabwe

Themes

★ Energy efficiency
❖ Financial mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Implementing Energy Efficiency Measures in 12 Small, Medium and Informal Enterprises
Implementing organization: Heritage Energy and Environment (NGO)
Location: Zimbabwe
SGP contribution: $47,483
Start Date: April 2001

ENERGY OVERVIEW

Energy resource: grid electricity (fossil fuels)
Technology: various (ovens, light fixtures, grinders, welding machines, etc)
Application: various industrial production processes
Sector: commercial
Efficiency improvement: various, depending upon the business and technology
Number of businesses served: 12 small, medium-sized or informal enterprises

BACKGROUND

According to the Ministry of Industry and Trade, in Zimbabwe in 1997 approximately 1.6 million people in the country worked for small and medium-sized enterprises or for informal enterprises.The informal sector alone accounted for about 1.1 million jobs. In the mid-1990s the government established a ministry responsible for policies related to small and informal enterprises, and other entities are also engaged in supporting them, including several micro-finance institutions such as the Zambuko Trust, and the Small Enterprises Development Corporation (SEDCO), which operates in many countries across Africa. However, these entities have not focused much,if at all, on how energy efficiency improvements can help these small businesses, as well as the environment. Yet, these enterprises have little access to information about energy auditing and efficiency improvements, and are often too focused on day-to-day survival to think about environmental impacts or how efficiency improvements can help them.

PROJECT DESCRIPTION

Overview

This project examined the possibilities and benefits of improving energy efficiency in small and medium sized or informal enterprises. To do this, 12 such enterprises were selected and undertook specific energy efficiency improvements, and at the same time built their capacity to understand energy use issues and to manage their own energy use.

Implementation

Two micro-finance institutions that work with small or informal enterprises, EMPRETEC Zimbabwe and Zambuko Trust, were involved in identifying potential enterprises to participate in the project. Selection criteria were developed, and included a gender balance in enterprise leadership and willingness on the part of the enterprise to attend training sessions and make investments in appropriate energy efficiency improvements.The 12 enterprises selected cover a range of commercial activities, including baking, pottery-making, metal-working, food service, soap-manufacturing,and fabric-making.Representatives of each enterprise attended an in-class training workshop about energy efficiency, and then further training was provided onsite. Through energy audits and feasibility analysis, specific efficiency improvements were identified in each enterprise, and 7 out of the 12 enterprises have so far undertaken the improvements. These improvements required some financial contribution from each enterprise.

Technology

This project led to a variety of technical changes to improve energy efficiency, depending upon the needs of the enterprise. Of the 12 enterprises involved in the effort, four have not undertaken the identified efficiency improvements and one has been delayed for financial reasons,mostly due to large currency devaluations in Zimbabwe during the project period.The other seven enterprises have taken a variety of steps to improve energy efficiency. Four have achieved significant improvements, while the other three have not.

Purdueast Investments (a workshop): compressor valves were re-conditioned, and filter elements were replaced. Two Hitachi grinders were repaired, along with other equipment. These interventions have been completed, but energy savings have not proved significant.

- *African Trends (pottery factory):* new heating elements were installed, and an oven was insulated. Upon completion, the energy intensity of pottery production reduced from an average of 70 kWh/kg to an average of 25.7 kWh/kg.
- *Longway Engineering (metal fabrication):* old welding machines were replaced with a new one. Upon completion,this intervention has achieved only minor energy savings.
- *Beverly Cakes (confectionery):* three domestic stoves were replaced with a new, more efficient industrial-sized oven. Upon completion,energy consumption was reduced from an average of 1,300 kWh/month to approximately 400 kWh/month.
- *Trivial Engineering (metal fabrication):* as with Longway Engineering,the replacement of old welding machines with a new one did not significantly reduce energy use.
- *Brumford Bakery:* a new dryer envelope and temperature

control instruments were installed.The final energy analysis is not yet complete, but preliminary results are positive; the enterprise's energy bill has been cut in half.

- *MoCliff Engineering (foundry, workshop):* a new castings machine was installed. Although the evaluation is not yet complete, this is expected to reduce molten metal loss by up to 30%.
- *Maggie's Kitchen (take-out food):* a wood-fired open-grate cooking system is to be replaced with an improved stove. Implementation of this intervention has been delayed due to financial difficulties.
- *Glen Lorne:(soap manufacturing):* a modified improved stove is to be installed, as well as a wire mesh for cutting pieces of soap. Implementation has been suspended due to funding roblems.
- *JEY-EM: (take-out food):* a refurbishment of fryers and cookers was planned, but suspended due to funding problems.
- *Batik (fabric production):* currently, this enterprise is using a domestic stove for commercial cloth drying. A new, more appropriate system was to be installed, but implementation was suspended.
- *Taste of Africa (take-out food):* domestic cookers were to be replaced with industrial-sized, energy efficient cookers. However, implementation was suspended.

Environmental Benefits

Global: Improvements in energy efficiency reduce greenhouse gas emissions,since approximately 60% of power generation in Zimbabwe is from coal-fired power plants.

Local: Local environmental improvements, such as in local air quality, may very well result from these interventions in some cases, since efficient stoves create less smoke. In addition, one improvement is expected to result in 30% less molten metal wasted in the production process.This may reduce waste disposal problems and reduce pressure on the local environment.

Livelihood Benefits

Health: Efficiency improvements, especially those related to stoves,may result in improved health conditions for workers in these enterprises.

Income generation: Since these are small enterprises, savings in energy costs can sometimes translate rather directly into increased income for owners and employees.

Beneficiaries

Beneficiaries of this project include the participants in the training sessions on energy management, the workers who may now have improved working conditions,and enterprise owners who now have greater awareness of their energy costs and ability to control them.

Capacity Development

A major activity of this project was holding training sessions on energy management with at least one representative of each of the enterprises.All 12 enterprises received in-class training,and the 7 enterprises that undertook energy efficiency improvements also received on site training,which led to energy audits and the identification of possible changes to result in improved efficiency.

Partners

The major partners in this project are:

Small scale enterprises: The participating enterprises received training and assistance, but they also were required to contribute financially to the improvements made in their own plants. For example, African Trends paid all the labor costs for insulating furnaces and changing heating elements and the thermocouple. Beverly Cakes upgraded from a single-phase to a 3-phase electricity supply at its own cost. Brumford Foods met 15% of the material costs,and MoCliff met all labor costs.Thus, their partnership in this effort has been essential to the project and the achievement of results.

Micro-finance organizations: Two micro-finance organizations, EMPRETEC Zimbabwe and Zambuko Trust, helped identify enterprises to participate in the project.These organizations are also an audience for the project;one goal is to demonstrate to micro-finance institutions the importance of energy efficiency and possible ways to achieve it.Efforts are underway to scale this project up to a medium-sized GEF grant, and these institutions will have an important role in the medium-sized project.

LESSONS LEARNED

Environmental Management

The project demonstrates the potential for introducing energy saving techniques into the informal economy, which in most developing countries is a major part of the economy.The scope for improvements can be great; one enterprise achieved 50% reductions in energy use through this project. However, one lesson from this project is that not all enterprises will have scope for implementing energy-saving techniques, and certain changes may not make economic sense for the enterprise. In this project, 4 out of the 7 enterprises that actually undertook changes appear to have reduced their energy use as a result of those changes. A certain amount of time must be spent with each enterprise assessing their energy use to find out whether or not energy efficiency improvements are possible. This suggests that in designing a larger scale project like this, time be spent developing good criteria for selecting participants, and that initial assessments be carefully designed so as to minimize time spent on enterprises that do not really have much scope for improving their efficiency.

Another lesson the managers of this project learned was that when an enterprise replaces equipment, it does not simply throw out the old one but resells it on the market. From the perspective of the energy efficiency project managers,this does not help because the old equipment is now in use somewhere else.

Finally, access to the appropriate equipment is only part of the

challenge for improving energy efficiency. The other factor is how the equipment is used; improper use could also lead to continued inefficiencies. This requires good training programs for participating enterprises.

Barrier Removal

Technical: This project reduces technical barriers first by educating enterprises about how to monitor their energy use and read their electricity meters, and second by assisting them in replacing equipment and/or implementing new procedures to save energy. In addition, the project suggests that not only should enterprises be more technically skilled in this area, but also energy suppliers should be aware and able to implement energy saving techniques. One technical barrier that was identified but not addressed through this project is the fact that energy efficient equipment is not being manufactured on a large scale in Zimbabwe.

Financial: 4 of the scheduled participants in this project had to drop out due to the poor economic conditions in Zimbabwe. Part of the problem was that due to currency fluctuations in Zimbabwe, it became impossible to purchase the necessary equipment to implement improvements. This could be addressed by purchasing equipment from outside of Zimbabwe. Another necessary step to reducing financial barriers is to involve micro-finance institutions in energy efficiency improvements. These institutions could offer loans for the purchase of equipment, which could be repaid over time through savings in energy costs. This project laid the groundwork for a larger collaboration with micro-finance institutions.

Scaling Up

This project is being considered for a medium-sized GEF grant. The potential for impacting the informal sector in Zimbabwe is great, provided that ways are found to cope with currency fluctuations and other economic problems.

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Energy Efficiency in Lighting, Egypt

Themes

★ Energy Efficiency
❖ Financing Mechanisms and Private Sector Involvement
❖ Technical Capacity Development
✷ Poverty Alleviation (MDG 1)

PROJECT DATA

Name: Efficient Use of Energy
Implementing Organization: The Friends of the Environment and Community Association in El Gharbia (CBO)
Location: El Gharbia Governorate, Egypt
SGP contribution: $22,353 ($159,533 total for seven similar grants on energy efficiency)
Start Date: December 2001

ENERGY OVERVIEW

Energy Resource: grid electricity generated by fossil fuels
Technology: efficient light fixtures
Application: lighting
Sector: domestic, public
Efficiency improvement: 75-80% increases in efficiency compared to regular locally available lighting equipment

BACKGROUND

During the 1980s and early 1990s, Egypt rapidly expanded its access to fossil fuel energy sources,and became an oil exporter. The heavily subsidized prices for energy in Egypt made it one of the most inefficient users of fossil fuels in the world. In the 1990s, policies began to be implemented to raise prices of energy to reflect real costs.Nevertheless,there is still significant scope for efficiency improvements both in the generation of electricity and its use. A large GEF project implemented by UNDP in Egypt focuses on improving demand-side efficiency, especially in lighting equipment.One of the goals is to improve energy efficiency in all Egyptian governorates, and in doing so reduce lighting costs as well as fossil fuel use. Small grants to seven communities through SGP are designed to help facilitate community involvement in the effort.There is currently very inefficient lighting in homes with electricity as well as community areas. Efficient bulbs and ballasts can save 75-80% in electricity, and therefore in electric bills, but the initial cost of the equipment poses a barrier for low-income households.

PROJECT DESCRIPTION

Overview

This project promotes the use of efficient lighting equipment by training young people to maintain and install the equipment, demonstrating the benefits of efficient lighting in public areas, and lowering financial barriers to the domestic use of efficient lighting equipment through a revolving loan fund.

Energy efficient lighting installed and maintained by local youth (El Gharbia Governorate, Egypt).

Implementation

Staff members of the large GEF energy efficiency project have supported a workshop to build the capacity of 25 NGOs nationwide to support energy efficiency activities. In conjunction with this GEF effort, SGP has approved projects to promote energy efficiency in seven different communities, with a total value of $159,533. In the El Gharbia project, the grantee, The Friends of the Environment and Community Association, has entered into agreements with the Delta Electricity Company and the local company making light bulbs to train young people in installing and maintaining energy efficient lighting equipment. So far, 40 young people have been trained.The project has organized six exhibitions of the equipment in awareness seminars for the community. Working closely with local municipalities, the project has selected seven public buildings as demonstration sites and equipped them with the efficient lighting equipment.

Environmental Benefits

Global: Through improved lighting efficiency, the use of fossil-fuel generated electricity is reduced. So far, the project has mostly focused on training technicians and installing equipment in a few demonstration sites,so actual reductions are not significant yet.The new equipment is estimated to offer a 75-80% efficiency improvement.

Livelihood Benefits

Savings: The major livelihood benefit is the savings in electricity costs generated by improved lighting efficiency.This benefit has not yet been realized by the project, since the high initial cost of the equipment must first be addressed. However, savings over time in electricity bills could be significant.

Employment:The project helps provide employment opportunities for local young people by training them in equipment maintenance and installation.

National Benefits

Municipalities and governorates in Egypt could save significant amounts in electricity costs for public buildings if these lighting fixtures were widely installed, while also reducing greenhouse gas emissions related to electricity generation using fossil fuels.

Beneficiaries

Primary beneficiaries of this project are the young people trained as technicians,who gain skills that can help them to find employment in an area where unemployment is widespread. Municipalities are benefiting from the small number of demonstration sites in electricity savings, and domestic users will save on electricity bills once financial barriers to the purchase of the equipment are reduced.

Capacity Development

Training for young people in maintaining and installing energy efficient lighting equipment has been the major capacity development activity in this project.

Partners

This project integrates several important partnerships.

Large GEF project: Links with this effort have helped the grantee gain experience in energy efficiency issues. GEF project staff have provided training and links with other similar efforts in other communities.

SGP: SGP's role in partnership with the large GEF project has been critical. SGP brought connections with local NGOs and CBOs to the table, and these benefit the large GEF project by enabling it to involve communities in a meaningful way.

Private companies: Companies have supported trainings programs for young people, who are now able to provide critical maintenance and installation services. Without this support, expansion to the domestic market,or even widely in the institutional market, would be difficult due to the lack of available maintenance and installation assistance.

Local governments: Close collaboration with municipalities has enabled the grantee to start demonstrating the technology locally in public buildings.This will be critical for expanding the use of the equipment in other public settings, and for convincing local governments that real savings can be gained from using this equipment.

LESSONS LEARNED

Environmental Management

This project provides an example of the opportunities for energy efficiency improvements that may exist in many countries. It also demonstrates the role that communities and NGOs can play in helping to disseminate new technology and demonstrate the immediate benefits it has to offer – in this case, savings on electricity bills – which is essential to ensure widespread adoption.

Barrier Removal

Information/Knowledge: One of the project's major impacts so far has been expanding the knowledge about the equipment among local governments and other interested parties, via demonstration sites as well as through exhibitions.The possible role of NGOs in helping achieve widespread awareness is one of the important lessons this project has to offer.

Technical: The project has helped reduce technical barriers by training young people to maintain and install the equipment.

Financial: The project plans to address financial barriers by establishing a revolving fund. However, there is no information about whether or not this has yet been implemented,and if so, what impact it is having on the ability of households to afford this equipment.

Scaling Up

This project is one of seven SGP-funded projects connected with this large GEF project.Thus,there is scope for applying the learning from this SGP project to the other ones. However, learning and transfer of lessons might have been greater if all seven projects were not launched at once. Perhaps funding several initially, learning from those, and then funding additional ones if necessary is another approach to consider when seeking to link with large GEF projects.

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Small-Scale Wind Turbines for Water Pumping and Electricity Generation, Egypt

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Design and Manufacture of Small-Scale Wind Turbines for Water Pumping and Electrification; Design and Manufacturing of Wind Turbines for Electricity Generation
Implementing Organization: Egyptian Solar Energy Society (NGO)
Location: rural Egypt
SGP contribution: $28,000 (irrigation); $22,000 (electricity)
Start Date: September 1995 (irrigation); December 2000 (electricity generation)

ENERGY OVERVIEW

Energy Resource: wind, wind/solar hybrid
Technology: wind turbine that pumps water; wind/solar hybrid that generates electricity
Application: water pumping for irrigation and/or drinking; electricity for lighting, refrigeration and TV
Sector: agricultural,domestic
Cost per system: $2,500 per wind turbine to pump water; $4,000 per wind turbine to generate electricity
Power provided: turbines pump from between 700 and 9800 liters of water per hour at local average wind speed; 300-560 kWh/month, depending upon average wind speed
Number Served: 6 wind pumps installed in 6 villages, serving an unknown number of households;2 turbines generating electricity for 10 households (70 people)

BACKGROUND

Water access is a critical need in rural Egypt today.The Egyptian economy depends highly upon agricultural production, which accounts for over 15% of its GDP. Water is essential for agriculture, but these villages involved in this project do not receive sufficient water from the Nile. Diesel fuel was being used to pump water out of the ground.Because these communities are remote and transporting diesel fuel is costly, wind power can be an economical option.

Overall, Egypt has fairly good electricity access rates – an estimated 94% of the population has access to electricity – but this still leaves an estimated 4 million Egyptians, mostly living in remote areas, without access.Wind energy could be an effective way to provide electricity in areas that may not receive grid connection any time soon.

Wind energy for water pumping and electricity generation (Egypt).

PROJECT DESCRIPTION

Overview

These two projects,implemented by the Egyptian Solar Energy Society (ESES), involve the use of wind energy to meet water access and electricity needs.The goal is to build several turbines for small-scale use to demonstrate and refine the technology, and eventually to lower the cost of technology for larger-scale use. According to one report, the first project, which focused on designing, manufacturing and installing wind turbines to pump water, was successful in achieving lower costs of construction, and for this reason the second grant was made for designing and installing turbines for electricity generation.

Implementation

Wind energy for water pumping:The first project, carried out from September 1995 to September 1997,was resulted in the design and manufacture of four small-scale wind turbines for water pumping.The Egyptian Solar Energy Society, worked with the Arab Manufacturing Authority, the largest manufacturing company in Egypt, to design and build the turbines.The four small-scale versions were built and installed in four village areas between September 1996 and June 1998, pumping from 700-2400 liters of water per hour for agricultural use. After the SGP-funded project ended, several more turbines were manu-

factured at a lower per unit cost. These operate at greater capacities; one pumps 3000 liters of water per hour which is used for drinking, and another pumps 9800 liters per hour for agricultural use.

Wind energy for electricity generation:Given the success of the first project, SGP funded a second ESES project, this time to design and build wind turbines to generate electricity. ESES again worked with the Arab Manufacturing Company to produce the engines. Although the project originally planned to build only one turbine, the technology still is quite expensive, and therefore the decision was made to produce two turbines instead so that per-unit costs would be less.The first turbine, which will be connected to solar panels to create the first hybrid wind/solar system in Egypt, will be installed in August 2003.The second turbine is 60% complete, and ESES expects to install it in December 2003. ESES will provide a guarantee for the good operation of the turbines for the first two years, and then will sign a maintenance contract with the community. ESES plans to train local community members to operate and maintain the systems.

Technology

Wind pump: ESES has designed a 3kW wind pump that pumps water at a rate of 1-12 cubic meters per hour, depending upon well depth and average wind speed at the site.The pump, called the ESES2002, uses the mechanical energy produced by the wind to operate a pump. Each system is estimated to last a minimum of 10 years, and an average of 15 years. Very little maintenance is required;only an occasional check that the bolts are tight is necessary.Very detailed technical information,including sketches of the designs,are available on the NGO's website, http://www.soficom.com.eg/eses.

Wind-powered electricity generator: The first wind turbine to be installed will be connected to two 240-watt photovoltaic panels to create the first wind/solar hybrid system in Egypt. Once completed, this system will provide 300kWh/month at 4 m/s wind speed, 420kWh/month at 5 m/s, and 560 kWh/month at 6 m/s.

Environmental Benefits

In the six villages involved in the project,water pumping is now achieved through the use of wind power rather than diesel-powered pumps.In addition,electricity is being supplied to two Bedouin tribes, powering 10 lamps in 10 households, a collective refrigerator and a TV. These projects can reduce greenhouse gas emissions and pave the way for future emissions reductions by designing and testing wind energy technology.

Livelihood Benefits

Health: In at least one village using the new wind-powered pumps, water is used for drinking, which is likely to have produced some health benefits to the local population. With regard to electricity generation, the avoidance of kerosene or traditional lighting sources results in better indoor air quality, which leads to improved respiratory health. In addition, improved access to refrigeration will allow food to be kept fresh and possibly medication to be kept cold.

Income generation: Because of the low water supply, local farmers can normally only generate approximately $82 per month per feddan (a measure of land area).With a consistent water supply, income can be as much as four times greater.Therefore, a farmer who has approximately 5 feddans will earn approximately $1,640 per year instead of just $410.

Beneficiaries

Water pumps: The people in six villages benefit from improved access to water for agriculture and/or drinking.

Electricity generation: Two Bedouin tribes in Neweibaa,Aquaba Gulf benefit from the wind turbines used to generate electricity. The total number of beneficiaries in this community is 10 households or approximately 70 people.

Partners

Both projects have been carried out via a close partnership between the Egyptian Solar Energy Society, the Arab Manufacturing Company, SGP, and the beneficiaries. In general, ESES has been responsible for overall project implementation, the design of the turbines, supervising the manufacturing, installing the turbines and ensuring that the system is maintained.The Arab Manufacturing Company was responsible for manufacturing the turbines, and the pumps or engines. This partnership seems to have been beneficial, although after the first project a few problems were identified. Apparently, the Arab Manufacturing Company was not properly acknowledging ESES or SGP as being associated with the project. SGP therefore organized a meeting involving ESES, the manufacturing company, and representatives of the Bedouin tribes who were to benefit from the new electricity generation project, to discuss roles and responsibilities.

Capacity Building

It is very likely that this project has resulted in improved capacity at the Arab Manufacturing Company to manufacture wind turbines. Indeed,there is evidence of improved capacity in that SGP's support has been requested for a medium-sized GEF project to be implemented by the Arab Manufacturing Company and ESES.

LESSONS LEARNED

Environmental Management

This project has demonstrated the potential for the use of wind energy to meet development needs in Egypt, both to improve agricultural production via water pumping, and to improve access to electricity in remote areas not connected to the grid. However, given that the rate of water extraction increases with the installation of the wind turbines, it may be important to monitor the water extraction rate so that it is sustainable over the long term.

Barrier Removal

Technical: The Egyptian Solar Energy Project has developed and

implemented designs for two different uses of wind energy, and has made its design concepts and technical information available on its website. It has also worked closely with a major Egyptian manufacturing company in the production process, which means this company is now better prepared to produce similar wind energy equipment in the future.

Financial: SGP progress reports indicate that the first water pump project had resulted in lower per-unit costs for wind turbines connected to water pumps.This was part of the reason that the next project on wind energy for electricity generation was funded.However, it also seems that the per-unit cost of this equipment still may be too high to enable widespread marketing.

Institutional: This project provides a good example of how an NGO can help introduce new technology that is designed to meet development needs.ESES came up with a design concept then partnered with a major manufacturing company in order to construct it. ESES also made sure that the technology was properly installed and used. Such partnerships can help ensure that renewable energy technology is designed and implemented in order to meet development needs.In a sense, the NGO has been a bridge between communities and the manufacturing company:without ESES brokering the deal,this type of wind energy application might not have emerged.

Scaling Up

Currently, the ESES is the only designer of wind-powered pumps in Egypt.In late 2000, ESES and the Arab Manufacturing Company began to develop a proposal for a medium-size GEF grant. However, the concept paper they submitted was not accepted.ESES plans to continue its efforts to spread this technology in remote areas in Egypt.

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Solar Energy for Heating Water in Urban/Peri-Urban Areas, Egypt

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)

BASIC INFORMATION

Name: Renewable Energy for Daily Life: Solar Water Heating in El Menia
Implementing Organizations: Society for Community Welfare in Kom El Aghdar-Maghagha, CBO (2 projects), and Coptic Evangelical Organization for Social Services, NGO (1 project)
Location: urban and peri-urban areas, Egypt
SGP contribution: 3 grants, totaling $65,835: $11,184 (June 1998-June 1999); $26,527 (June 1998 – June 2000), and $28,124 (November 2000 – November 2001); $211,166 for all eight SGP solar water heater grants in Egypt
Start Date: June 1998 (2 projects), and November 2000 (1 project)

ENERGY OVERVIEW

Energy Resource: solar energy
Technology: solar water heaters
Application: water heating
Sector: domestic
Water Heater Capacity: 150 liters
Number Served: 164 solar water heaters (total for all three projects); 429 solar water heaters installed by 8 SGP-funded projects in Egypt, reaching 3,790 people

BACKGROUND

Hot water is critical to maintaining adequate sanitation and health. Often, water must be boiled in order to make it safe to drink. In poor communities in Egypt, water is normally heated using agricultural residues in a kanoun, which produces smoke and is generally unsafe. In more well- off communities, electric or gas water heaters are used, but there may be shortages of gas cylinders, or electricity costs may be high. Egypt is well endowed with solar energy, so solar water heating is a viable option; on average, the sun is shining for 9-11 hours per day, with an average insolation of 1900-2600 kWh/m^2. These solar water heater projects took place in poor villages and neighborhoods surrounding El Menia, a city in Upper Egypt.

PROJECT DESCRIPTION

Overview

These three projects introduced the use of solar energy to heat water, and raised awareness about climate change and the effects of pollution produced by traditional methods of heating water. SGP has funded at least eight projects in Egypt related to solar water heaters.

One of approximately 160 solar water heaters installed in urban and peri-urban areas (El Menia,Egypt).

Implementation

The projects installed solar water heaters in poor neighborhoods of El Menia, and also carried out training and education programs for community members regarding the installation and maintenance of solar heaters and how the use of solar water heaters is related to solving global and local environmental problems. Community members contributed part of the costs of the water heaters,which increased project ownership and allowed more water heaters to be installed. In addition, the projects partnered with private sector entities and local governments to improve the quality of the technology used and to sustain the effort.

Environmental Benefits

Global: The use of solar energy to heat water for household use reduces or eliminates the need to use agricultural waste or other traditional fuels to heat the water, thereby reducing greenhouse gas emissions. These three projects installed a total of 164 water heaters.

Local: The reduced use of agricultural waste and/or wood for heating water reduces the amount of smoke released into the air, thereby improving the local air quality.

Livelihood Benefits

Health: Improved access to hot water can help improve sanitation, and therefore lead to health benefits. Reduced smoke inhalation due to the reduced burning of agricultural waste to heat water is another health benefit.

Cost savings: Although no specific cost savings information was available for these projects, it is estimated that solar water heaters of 150-liter capacity save a household 10-15 Egyptian pounds every month.

Employment: The project implemented most recently involved training three local young people to install, maintain and repair solar water heaters.The training should help these young people earn an income doing this work.

Capacity Development

Each project has incorporated training to improve the community's understanding of solar and other renewable energy sources, and their capacity to maintain and use solar water heaters.The first project, which installed a total of 33 water heaters, held 10 seminars through which 250 people learned about the water heaters and how they relate to local and global environmental problems.The most recent of the three projects held 8 such seminars.

Partners

One of the lessons learned through the first project was the importance of working with the private sector and local governments to ensure high quality technology and the sustainability of the project.Through these projects,relationships have been developed with the government's Renewable Energy Authority as well as companies manufacturing solar water heaters.

Beneficiaries

Beneficiaries are residents of poor areas in and around the city of El Menia who are now using solar water heaters.In addition, those who are now working as solar water heater technicians have directly benefited from these projects.Approximately 160 water heaters have been installed, which can be assumed to benefit at least that many households, and more if some of these are publicly used.

LESSONS LEARNED

Barrier Removal

Technical: Since the projects have trained local community members to better understand,operate, install and repair solar water heaters,technical barriers to their use in this region have been reduced. However, it is unclear where these solar water heaters are being constructed, and whether or not these projects have helped reduce any barriers to their construction and adaptation to local needs.

Financial: One important lesson learned from the first project implemented was the importance of requiring individual contributions from households to help cover the cost of water heaters.This also means that households are not paying the full cost for the heaters, and implies that access to the water heaters would still depend upon subsidies from non-governmental organizations like those implementing these projects. However, there is evidence within SGP documents that because of the relatively large number of solar water heater projects funded by SGP, SGP has played a brokering role between the projects and the solar water heater suppliers.SGP seems to have sought bids from eight different suppliers, and asked these suppliers to offer a discount off regular costs for these projects.This would reduce financial barriers for those directly benefiting from these projects, but it is unclear how this contributes to lowering overall financial barriers to accessing this technology.

Information/awareness: These projects have placed great emphasis on raising awareness, educating hundreds of people about the connection between renewable energy use and global and local environmental problems. The importance of public awareness in promoting renewable energy use is another of the lessons learned from these projects.

Policy: According to SGP reports, these projects have encouraged policy-makers to support environmental activities and to welcome community involvement. However, no information is available about specific policy steps taken.

Scaling Up

In Egypt, SGP has been very active in sponsoring solar water heater projects in many regions of the country. Recent direct contact and negotiations with solar water heater suppliers may be seen as a step toward consolidating the impact of these dispersed small projects. Certainly, lessons learned in one SGP-sponsored project are being transferred to other SGP-funded projects. Information is not currently available about how access to solar water heaters is improving in areas where NGOs are not involved. However, according to one source more than 25,000 household solar water heaters have been manufactured and installed in Egypt, particularly in new cities.

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Energy Efficiency Manager Program, Jordan

Themes

★ Energy efficiency
❖ Technical capacity development
❖ Institutional capacity development
❖ Policy and legislation

PROJECT DATA

Name: Energy Efficiency Manager Program
Implementing Organization: National Energy Research Center (NGO)
Location: Jordan
SGP contribution: $37,150 (July 2000) and $12,850 (February 2003)
Start Date: July 2000

ENERGY OVERVIEW

Energy Resource: fossil fuels
Technology: equipment and techniques for energy efficiency
Application: industrial production
Sector: small and medium-sized businesses
Number of People Served: 50 young engineers trained

BACKGROUND

Since Jordan is almost fully dependent upon imported oil,there are political as well as environmental benefits to improving the efficiency of energy use. However, these skills and technologies have not been sufficiently supported or emphasized in order to make this a reality on any large scale.

PROJECT DESCRIPTION

Overview

This project builds skills, technology access and institutional commitments for improving energy efficiency in small to medium-sized industries in Jordan. It achieves this by training young engineers in energy efficient technologies and techniques, and then helping them find employment within the industrial sector where they can use these skills.

Implementation

The first grant to the National Energy Research Center (NERC) supported a training course for an initial set of 50 engineers.These young engineers were trained in energy efficient technologies and techniques that could be used in specific types of industrial facilities.NERC then assisted the engineers in finding jobs.It also organized an exhibition of energy efficient equipment from international suppliers in order to introduce this sort of equipment in Jordan.NERC has raised awareness in the industrial sector about the benefits of energy efficiency, and has built partnerships with specific industries that later employed the trained engineers in positions specifically designated for energy efficiency experts. Following the completion of this project, a second SGP grant to NERC helped support the training of a second group of young engineers, as well as promotion of an energy conservation law that would require industries to appoint an energy conservation specialist for any establishment whose budget exceeds a certain amount. A panel of experts would help decide what facilities would fall under this law. NERC also continues to raise awareness in the industrial sector about the benefits of energy conservation.

Technologies

The engineers have been trained in a variety of energy efficient technologies and techniques. Twelve "case studies" have been prepared of energy efficiency improvements and designs for technologies such as electrical systems,motors,lighting systems, heat recovery systems, and air conditioning.

Environmental Benefits

Global: Since most industries are dependent upon oil and other fossil fuels, any efficiency improvements lead to reductions in greenhouse gas emissions. NERC has estimated that this project could save 28,000 tons of carbon dioxide emissions.This figure was calculated based on numbers obtained from some 40 industries that had preliminary studies conducted at their plants by NERC analyzing energy saved and converting that into estimated carbon dioxide emissions.

Local: Improving the efficiency of energy use by industries may very well result in local air quality and environmental improvements.

Local Benefits

Employment: This project provides employment to young engineers in small to medium-scale industries. If the legislation that is being proposed under the second grant is successful, then this employment aspect may be further expanded since all industries of a certain size would be required to employ an energy efficiency specialist.

National Benefits

The national benefit of this project could be significant, assuming the project's efforts to introduce new energy efficient technologies in Jordan are successful.Access to these technologies, combined with a new set of young engineers who are skilled at implementing them, will be a national benefit since this could reduce the nation's dependence upon imported oil.

Beneficiaries

This project benefits young engineers, who receive employment, and small to medium-sized industries, who can save money on their energy bills by implementing energy saving techniques and technologies.

Capacity Development

This project is centered around capacity building activities.The initial set of 50 engineers has received intensive training to prepare them for jobs in energy efficiency. In addition, NERC has designed ongoing week-long training programs in energy efficiency that occur on a regular basis.

Partners

NERC, the grantee, has partnered with a range of businesses and business organizations.

Small to medium-scale businesses: These businesses provide employment to graduates of the training program, allowing them to implement their new skills in energy efficiency.

Chamber of Industry: This organization representing industry has co-sponsored the training sessions.

Jordan Engineering Association: NERC has worked with this organization to find candidates for participation in the training and employment program.

Policy-makers: Through dialogue with policy-makers NERC has been developing legislation that would help promote energy efficiency in industry.

LESSONS LEARNED

Environmental Management

This project demonstrates a particular approach to achieving energy efficiency improvements in industry, one that is based on training and capacity building for young engineers in energy efficient technologies,together with support for policy changes that would guarantee them a role in the industrial sector.

Barrier Removal

Knowledge/information access: This project has primarily focused on building up awareness about the benefits of energy efficiency, and on building up the knowledge of individual young engineers in implementing energy efficient technologies and techniques.The project has used an exhibition of international technologies to help educate local firms about technological possibilities, and trained technicians to ensure that the capacity is there to implement energy efficient approaches. NERC publishes an annual Directory which contains a listing of all suppliers of Renewable Energy and Energy & Water Conservation Equipments and Retrofits,as well as a quarterly newsletter that covers a vast spectrum of subjects relating to energy efficiency. The newsletter and directory are distributed free to approximately 1200 industries,hotels, hospitals,and all relevant private and governmental institutions. However, this project's evaluation revealed a need for stronger outreach, and the most recent grant is designed to address this.

Policy: This project has promoted a piece of energy conservation legislation that would help institutionalize the use energy conservation techniques and technologies. The legislation would require industries of a certain size to employ an energy conservation specialist. It is not known how likely it is that this legislation is passed. Of course, if energy-saving techniques already save industries money on their energy bill, it would be in their interest to take these steps anyway. If they are not, it is not clear that a lack of legislation is the problem; there may be a lack of awareness, or insufficient capital to invest in the technology.The project appears to be undertaking efforts to reduce information and knowledge barriers, but perhaps if this is not sufficient then perhaps financial barriers should be explored along with the policy barriers. In general, a careful diagnosis of the barriers is essential in order to promote policy that will actually make a difference. The solutions may be different for different industries.

Institutional: By encouraging industries to establish paid positions focused on energy efficiency, the project has encouraged a change in the institutional structure that can pave the way for energy improvements.This is different from encouraging industries to adopt a particular energy-saving technology or technique, and may yield greater long-term results,if these positions for energy conservation engineers are taken seriously by industries.

Scaling Up

NERC has leveraged contributions from some major national institutions to support its trainings, such as from the Chamber of Industry and the Jordan Engineering Association. If these institutions see positive results from those who have already been trained and placed in jobs, they may continue to invest in training young engineers in energy efficiency. NERC is also supporting the new energy conservation policy requiring each establishment of a certain size to employ an energy efficiency expert.However, as mentioned above, outreach about the savings may be the most important way to scale up, since it should be in the interest of industries to make at least some investment in energy conservation. In addition, studies may be necessary to understand the barriers to energy efficiency within particular industries.

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Building Capacity for Energy Micro-Enterprises and NGOs, Morocco

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development

PROJECT DATA

Name: Building Capacity for leaders of energy micro-enterprises and NGOs
Implementing Organization: Group for Study and Research on Renewable Energies (NGO)
Location: rural areas of Morocco
SGP Contribution: $41,241.00
Start Date: December 2000

ENERGY OVERVIEW

Energy Resource: solar, biomass
Technology: photovoltaic panels, solar water heaters, solar dryers for agricultural products
Application: lighting, water heating, battery charging, agricultural product drying, cooking of bread and food, domestic heating
Sector: commercial (micro-enterprises), NGOs
Institutions Served: 30 young entrepreneurs, 50 NGOs

BACKGROUND

Since 1996, Morocco has pursued an aggressive rural electrification program via the Office of National Electrification (ONE). Morocco's approach involves two components. In some cases, the government helps support the extension of the grid. In other cases, however, the government contracts with private retailers to install solar home systems, providing a one-time payment of $300 per home. This second approach,particularly pursued in the northern part of Morocco, depends upon the existence of local micro-enterprises in non-electrified regions with the capacity to install solar home systems and guarantee them for a 7-10 year period in return for monthly payments from customers.

PROJECT DESCRIPTION

Overview

The project is building the capacity of entrepreneurs to run rural energy micro-enterprises, particularly helping them build a good understanding of a variety of renewable energy sources and how these relate to various sectors, including agriculture, water use, and food preparation. It also seeks to build the capacity of 50 Moroccan NGOs concerning renewable energy and climate change.

Implementation

In the context of the larger electrification process, the Group for Study and Research in Renewable Energy (GSRRE) provides training and produces communication and training materials for young entrepreneurs and NGOs on a variety of renewable energy sources,including solar, biogas and the gasification of biomass. A consulting service has also been put in place to provide advice on handling energy issues.

Benefits and Impacts

While the SGP-funded project has not directly implemented energy services, it provides substantial support to the micro-enterprises in doing so. The trained NGOs will also support micro-enterprises by informing and sensitizing local communities on energy issues.The potential impact of the education and training that the micro-enterprises and the NGOs receive is great given the national scale of the electrification process; in 1999, 1,650 villages were electrified, many by micro-enterprises.

Environmental Benefits

Global: The 30 micro-enterprises and the 50 NGOs receiving training on renewable energy are located in 11 provinces throughout Morocco. All promote renewable energy, providing modern energy services in villages that previously depended upon wood, kerosene and dry cell batteries.Thus, the micro-enterprises and the NGOs are achieving reductions in carbon dioxide emissions.

Local: In many cases, villages previously depended upon local biomass resources for cooking. By reducing these needs, via improved stoves, biogas or other renewable means, local ecosystems are also protected.

Local Livelihood Benefits

Health: The micro-enterprises learn through the SGP-funded training how energy is used in various sectors, including water. This education helps the enterprises to look for ways to improve access to water using renewable energy, thereby improving sanitation and health.The reduced use of kerosene and wood as fuel also improves local air quality.

Poverty Alleviation: The micro-enterprises provide gainful employment to the young entrepreneurs as well as to other local residents. In the first phase of the program (prior to the implementation of this grant), 17 micro-enterprises provided employment to a total of 41 people.

National Benefits

Improved electrification rates: Morocco has placed a high priority on extending modern energy services to rural regions. The project helps the country achieve this goal by strengthening the ability of micro-enterprises and NGOS to meet a variety of energy needs.

Capacity Development

The major focus of this project is building the capacity of young micro-enterprise leaders and NGOS. This is being achieved through training sessions,training and communication materials and 'as-needed' consultations.

Partners

Morocco's overall approach to electrification is based on partnerships between government, private sector entities, NGOs and individual communities. The particular SGP-funded aspect of this project involves helping young entrepreneurs and NGOs understand the benefits of building partnerships with entities in other sectors, such as water and agriculture, to diversify support for the extension of energy services.

LESSONS LEARNED

Environmental Management

This project focuses on the importance of creating links between energy services and a variety of economic and livelihood sectors. In addition, the project promotes the use of a diversity of energy sources; different sources may be appropriate depending upon differing energy needs and local conditions. The project's effort to educate entrepreneurs and NGOs broadly about a range of energy sources and technologies is unique, since most micro-enterprises specialize in a single technology.

Barrier Removal

Information/Knowledge: While Morocco's overall approach to electrification addresses financial and institutional barriers, the SGP-funded portion addresses knowledge barriers to the implementation of various energy sources in a variety of sectors. The approach to reducing knowledge barriers has largely been a participatory one, bringing together local community actors in various sectors to discuss energy needs and possible solutions. The project therefore takes advantage of existing local knowledge and complements it with expert knowledge offered by the grantee on forms of renewable energy. While the project emphases building the capacity of the participating entrepreneurs and NGOs, others in the communities learn through the process as well due to the participatory approach.

Scaling Up

Unlike many SGP grants that involve very small scale demonstration projects, this program is part of a larger, national scale effort to bring modern energy services to remote areas of Morocco. The increased capacity of NGOs and of these entrepreneurs to provide energy services will impact a much broader range of people receiving the energy services. In addition, other NGOs partners and entrepreneurs that are part of the larger program could also receive similar assistance if the benefits of this project are adequately demonstrated.

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Hybrid Wind-Solar Power System for Village Lighting, Occupied Palestinian Territories

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Technical capacity development
❖ Institutional capacity development
❖ Awareness,culture, and practices
✷ Gender equity and empowerment (MDG 3)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Providing Innab Alkabeera village with lighting by promoting solar energy technology
Grantee: Union of the Palestinian Agricultural Relief Committee (PARC), West Bank (NGO)
Location: West Bank,Occupied Palestinian Territories
SGP contribution: $45,600
Start Date: November 1999

ENERGY OVERVIEW

Energy Resources: sun and wind
Technology: solar-wind hybrid
Application: lighting (public and domestic),TV, radio, refrigeration, washing machine, and public phone
Sector: residential,public
Cost to consumers: at least $3,300 paid by the community for installations, daily use of electricity also paid for by consumers
Total power provided: 17-18 kW (9 kW wind, 7 kW photovoltaics, and 1-2 kW diesel generator)
Households Served: 10 homes (100 inhabitants), a mosque and a school

BACKGROUND

The area of the Occupied Palestinian Territories is one of the most densely populated regions in the Middle East. Approximately 15% of the communities in the West Bank and Gaza are not connected to the electricity grid, and electricity is expensive for those who are connected.This project targets a small, 100-person Bedouin community in Innab Alkabeera, which is located in Hebron,the southern area of the Palestinian Authority, along the border with Israel.Although this community was established in 1948,prior to implementation of this project residents still relied on kerosene lamps and a diesel generator for their energy needs.The diesel generator only provided enough power for 3 hours of electricity per day.The village also lacks most other types of infrastructure, including water supply, a sewage system, and paved roads.

PROJECT DESCRIPTION

Overview

The project assisted this community in building and operating a solar-wind hybrid power system to meet most of the village's energy needs.The work was completed with strong community cooperation and contribution, facilitated by a five-member committee. In addition, the project incorporated energy efficiency awareness into its project plans,to ensure that the community would get the most possible use out of the energy generated.Finally, the project plans include efforts to share this idea with other nearby communities.

A hybrid wind-solar power system provides lighting to Bedouin community in Innab Alkabeera (Hebron,Occupied Palestinian Territories).
Steve Sabella

Implementation

The community formed a five-member committee, which included one woman, to facilitate cooperation between the community and PARC with the technical expertise. This committee helped choose the necessary land for building the power station and negotiate the agreement of land owners to extend the mini-grid through their lands,and contribute manual labor to complete the project. The community also contributed over $3,300 to help cover construction costs, paid in several installments. However, for those who worked to build the system, for example by helping to dig holes in which to stand the wooden poles to string distribution wires,the project paid wages or counted that work as part of their contribution. PARC trained two members of the committee to maintain the station,and to respond to any emergencies.If maintained properly, the system is expected to last 25 years. Finally, PARC conducted a workshop in the village about energy use, with the goal of encouraging the most efficient use of the limited energy made available by this system.

Community members also pay for the electricity they use, as

calculated by the meter in their house, which provides an additional incentive to conserve the power. These payments are used to cover maintenance and replacement of the battery in the system every three years. The community has also agreed to gather the equivalent of at least $100 via electricity payments, and these funds will be used for other development needs in the community. Innab Alkabeera has many infrastructure needs, including a water supply system, a sewage system, and paved roads.

Technology

The system is a solar/wind hybrid, and the power station is located within the community. There are 42 photovoltaic panels,set on concrete bases, which generate 7 kW. The wind generator, at a height of 15m, generates 9 kW. The old diesel generator is also connected to the system. The entire power station,therefore, produces 17-18 kW. The community built a control room, which contains the photovoltaic generator and a storing unit for 24 batteries with a capacity of 840 amps. The community also built a single-phase distribution network, using eleven wooden columns and cables, instead of uncovered wires, to improve security. There are 3 distribution lines, and each is connected to a separate generator so that when one or two fail,the third one is still supplying electricity. Households have had to rehabilitate old and incomplete indoor wiring. Each household has an automatic switch to prevent electricity use that exceeds 500 W, and a meter to monitor use. The meters are intended both to track electricity use for monthly payments and in order to warn those who have, on average, over-consumed electricity over the past year. Each household uses energy-efficient 15W light bulbs.

Environmental Benefits

Global: This project reduces greenhouse gas emissions by reducing the community's reliance on diesel and kerosene for energy services. Currently, 80% of the community's energy needs are met by the solar-wind hybrid system.

Local: Reduced use of diesel leads to less local air pollution.

Livelihood Benefits

Health: The introduction of the renewable power system has allowed the community to begin to refrigerate food and medicine items on a more regular basis. Today, the community has five shared refrigerators that operate for 24 hours. In addition, the reduced use of kerosene for lighting means better indoor air quality.

Education: The local school now has light, as well as a photocopier, which improves children's ability to study and learn.

Information access: The new power system enables the community to access television and radio, thereby improving their connection with the outside world.

Community building: The mosque now has power, making it possible to use a microphone for the call to prayer, and for prayer sessions to be held in the evenings.

Security: With lighting, community members feel safer moving around at night.

Beneficiaries

The 100 residents of the community are the primary beneficiaries of this project. Lighting is provided in households, the school and the mosque. Refrigeration is available to all via 5 shared refrigerators. Television, radio and a public phone are also powered by the system.

Capacity Development

The Palestinian Agricultural Relief Committee (PARC) held a 3-day workshop in May 2000 for women only. They were trained in understanding which appliances use the most energy, and how to choose energy saving ones. They also learned how to use devices that measure the electricity used by individual devices in their houses so they can know how best to conserve energy.

The five-member community committee that works with PARC has improved its capacity to understand and maintain the new power system. It is not clear, however, to what extent this project has improved their overall capacity for project management;the new infrastructure may make it possible to attract new investment in the community that was not possible before.

Partners

PARC's partnership with the community was formalized through the establishment of the community committee. This mechanism appears to have been effective at mobilizing community support and contribution to the project. PARC signed agreements with the village committee to ensure that responsibilities, including financial payments, were clear to everyone. PARC has sought to empower this community to manage the power system on its own.

LESSONS LEARNED

Environmental Management

This project is one of the first examples of solar-wind hybrid energy systems in the Middle East. Because of the dual power sources and the use of batteries,the power station can provide electricity 24 hours a day, compared to the diesel system,which allowed use only three hours per day.

Another key aspect of the project was its incorporation of energy efficiency techniques and incentives. Efficiency in energy use was not only promoted through special training;community members are charged by how much energy they use, and there is no minimum fee, as in the case of grid-connected customers. Therefore, families who conserve electricity can realize savings on their electricity bill.

Barrier Removal

Technical: This project has implemented a new technology in only one village. An important lesson that emerged in the implementation of this project was that the implementing NGO should have a basic amount of expertise in the technology being implemented in order to guide the project. Whether or not technical barriers are reduced through this project depends upon whether or not the experience in this village

makes it easier for other villages to adopt similar technology. PARC, the grantee, has taken steps to familiarize local technicians with this power system, to ensure that they will be able to handle maintenance, and will also help them in dealing with future systems that are established.

Institutional: The project has successfully established a community committee to help administer the new power system.SGP documents indicate that one important lesson learned through this project,which was implemented in future projects,was that it is important for community members to contribute financially to the project in order to increase their ownership of the effort.Thus, both establishing the community committee and setting the financial contribution were important aspects of this project.

It is likely that over time, the new committee will help facilitate better management of the community's energy resources,given all the emphasis on efficient energy use. In addition, the new committee is laying the groundwork for other development projects by collecting and saving payments from electricity use.

Information/awareness: The project conducted a workshop in the community about efficient energy use. One lesson learned through this project was the importance of involving youth in such outreach efforts.A survey would need to be conducted to verify the effectiveness of this workshop in terms of changing energy use practices.

Gender: Women's participation was particularly important in this project,since they are the primary users of electrical appliances in the community. One member of the five-person community committee was a woman, which was a significant achievement in this community. PARC also held a workshop specifically for women, advising them on how to conserve energy and what refrigerators to buy.

Scaling Up

Following this project, SGP has funded another project in the Palestinian Territories that is designed to improve access to electricity by installing photovoltaic panels in the Al-Aqaba village located in the northern border area of the West Bank. It seeks to provide solar energy to 10 houses,a school,a women's charity and the village's main street.This project will also serve to demonstrate the potential of renewable energy in this area. On a larger scale, the GEF Focal Point at UNDP/PAPP has expressed interest in preparing a proposal to use solar energy to meet the needs of the 15% of Palestinians who are not connected to the electric grid.

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Solar Energy for Drying Crops, Occupied Palestinian Territories

★ Renewable energy
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Utilizing solar energy for drying agricultural crops and medicinal herbs
Implementing Organization: Union of the Agricultural Work Committee (UAWC), Gaza
Location: Gaza, Occupied Palestinian Territories
SGP contribution: $32,500
Start Date: August 2001

ENERGY OVERVIEW

Energy Resource: passive solar
Technology: crop dryers
Application: drying agricultural produce
Sector: small-scale commercial
Cost of each system: $1000
Total capacity: dries fruit/herbs in several days
Number Served: 65 women in 17 cooperatives

BACKGROUND

Within the Occupied Palestinian Territories many homes are not connected to the electricity grid, and grid-based electricity is costly for those who are connected to it. Solar and other forms of renewable energy can offer independent energy sources for certain applications that otherwise might not be possible if they depended upon scarce electricity. Reflecting the difficult economic situation throughout Gaza, employment and income-generating activities are very scarce in Deir al Balah and Abassan Al Jadidah, the communities covered by this project. Thus, there is great benefit in linking renewable energy with income-generating activities. Women in this community have traditionally dried herbs in the sun, but this can be time-consuming and takes away their color and freshness. Solar dryers can offer improved product quality in a shorter time period.

PROJECT DESCRIPTION

Overview

This project has started 17 small women's cooperatives that use solar dryers to prepare fruits, herbs and other produce for sale in local markets. The project has also conducted workshops and informational sessions to disseminate the solar dryers to other neighboring communities.

Implementation

The Union of Agricultural Work Committees (UAWC) initiated this project by seeking women in Deir Al-Balah and Abassan Al Jadidah who were interested in crop drying and could maintain a solar dryer in their homes. UAWC's women's production unit manager has played a key role in developing the project, since she has intimate knowledge of the people in these communities and their needs, particularly the women. Solar dryers were installed in the backyards of selected women's houses, and for each one a cooperative consisting of 3-5 women was formed. These women pool their crops and herbs, growing some themselves and buying others at the market. They dry them in the solar dryer, then package and sell them, sharing the income they earn. UAWC has also created brochures about the solar dryers and their benefits, and distributed them at workshops for neighboring communities in order to disseminate this technology.

Fruits, herbs and other produce prepared for sale by small women's cooperatives using solar dryers (Gaza, Occupied Palestinian Territories).
Steve Sabella

Technology

The solar dryer is equipped with solar panels on the outside and trays for fruit and herbs on the inside. The trays are filled with fresh produce, and then left to dry, which takes only a few days. The dryers were designed by a local consultant in conjunction with UAWC, and they are being manufactured locally.

Environmental Benefits

Global: Previously, women would dry some produce in the sun. Since takes a long time, women would often use gas-powered ovens to accelerate the process. Adoption of the solar dryer has replaced this use of fossil fuels. In addition, the solar dryer has opened up new income-generating opportunities, since it produces higher quality dried produce in a shorter amount of time. Therefore, as the project is scaled up, it may enable women to generate income from this renewable energy-powered activity instead of from another activity that depletes energy or other natural resources.

Livelihood Benefits

Income generation: This project helps women generate additional income. The husbands of many women participating in the cooperatives are unemployed, so the income generated from this project is critical for these families. Currently, 65 women are working in 17 cooperatives.

Capacity Development

This project involves significant capacity building for the 65 women involved in the cooperatives. UAWC has conducted workshops,totally 70 training hours, for these women covering topics such as how the solar dryer works and how to package and market their products. Institutional capacity building also took place when an SGP planning grant was used to hire a specialized local consultant to design the solar dryers, together with a team from within UAWC. This helped to build local capacity to produce the equipment.

Partners

This project has worked very closely with the women of these communities, and has established 17 new women's cooperatives.These cooperatives are the most important partners.

LESSONS LEARNED

Environmental Management

This project illustrates a productive use of solar energy. Although the project is not displacing existing economic activities that create emissions, the use of solar dryers could avoid future emissions by replacing income-generating activities that might have been powered by grid-connected electricity. In other words,these women now have a way to earn income for their families, and are therefore less likely to search for other means of income generation that might also generate emissions.

Barrier Removal

Financial: Each solar dryer costs $1000, and SGP grants fully covered the cost of the first dryers to demonstrate the use of the technology. Subsequently, a grant from a separate foundation covered the costs of an additional 15 dryers.So far, it does not appear that users are paying for this technology. However, because the solar dryers are linked to an income-generating activity, it should be possible to design a system of loans that could be repaid over time from revenues. Potentially local capacity for building the solar dryers could be developed,which would reduce costs.

Information/awareness: The project introduced a new technology to this region and also built the capacity of the women's cooperatives to understand and use it.The grantee's production of booklets describing the design and use of the solar dryers will be of great benefit for future efforts to disseminate this technology and start similar businesses.

Gender: This project works almost exclusively with women. Its main outcome is the provision of income-generating opportunities for women.Women have gained important technical and business skills through the project, and are now running these cooperatives on their own.This improves their ability to undertake other similar activities in an independent manner.

Institutional: The projects' establishment of women's cooperatives is the key to reduction of institutional barriers.These are now independent income-generating organizations which could undertake other activities should the need arise (although there is currently no information about whether or not they are doing this).

Scaling Up

The grantee has clearly planned activities geared toward scaling up the project,such as the creation of brochures describing the solar dryers and their use, and the organization of seminars to spread awareness about them.There appears to be interest on the part of other funding organizations in expanding solar dryer efforts in the area. The German Fund for Palestinian NGOs is currently funding the same grantee, UAWC, to build 15 solar dryers and to train women to use them and market their produce. The Canadian International Development Agency (CIDA) is also in discussions with UAWC regarding the SGP project, and has asked UAWC to submit a proposal to them to expand the solar dryers effort.

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Disseminating Efficient Cookstoves, Bhutan

Themes

★ Energy efficiency
⁂ Linkages with other environmental goals
❖ Technical capacity development
❖ Awareness,culture and practices
✷ Gender equity and empowerment (MDG 3)

PROJECT DATA

Project Name: Improved Community Cooking Stove – an alternative to mitigate fuel wood pressure in North Trashigang; and Biomass Fuel Efficiency Project in Tsirang
Implementing Organizations: Bhutan Youth Development Association (NGO);Tsirang Women's Group (CBO)
Project Location: northern Bhutan (Trashigang); southern Bhutan (Tsirang)
SGP contribution: $25,670 (Trashigang);$44,400 (Tsirang)
Start Date: September 1999 (Trashigang); October 1999 (Tsirang)

ENERGY OVERVIEW

Energy Resource: fuel wood
Technology: improved community stoves (Trashigang); improved household cook stoves (Tsirang)
Application: cooking
Sector: public (Trashigang), domestic (Tsirang)
Cost of equipment: $750 (community stoves)
Efficiency improvement: 50% reduction in fuel wood consumption
Number Served: 20 community stoves (2 stoves in each of 10 religious institutions); 2,000 household cook stoves

BACKGROUND

Bhutan is a small country of only about 800,000 people, but the population is growing at an estimated 2.6% per year. Almost 80% of the population still lives in rural areas,where most people rely heavily on fuel wood for cooking and heating.Bhutan is estimated to have one of the highest rates of fuel wood consumption in the world, at 1.27 tons per person per year, according to a 1991 Food and Agricultural Organization (FAO) study cited in the project evaluation.

North Trashigang is a relatively isolated region of eastern Bhutan, which has suffered great land degradation and deforestation due to heavy use of firewood for cooking and heating needs.The wood consumption rate there is higher than average: 1.47 tons per person per year, according the FAO study. The area has a number of Buddhist monasteries and communal religious centers at which where holy rituals are performed over 50-60 days per year.The potential savings in firewood and in money to these institutions from the use of improved stoves is significant.It is estimated that each year, each of these institutions consumes 8-10 truckloads (45-57 tons) of fuel wood.

Community-sized metal stoves (Trashigang,Bhutan).

Tsirang is in the southern part of the country and is very densely populated.Most local people use open fire mud stoves, which they use for cooking food both for their families and for their cattle.

PROJECT DESCRIPTION

Overview

The project in Trashigang installed community cook stoves in 10 religious institutions, including two nunneries. Although community training in maintenance could be improved, the project has reduced the use of firewood at these sites by 50%,and has stimulated the interest of the Trashigang District Administration in distributing the stoves in other community kitchens such as schools, monasteries and army camps. The project in Tsirang has resulted in the installation of individual, improved stoves in 2,000 households. The project, which involved the Tsirang District Administration from the start,achieved these results by training women from villages to construct, maintain and repair the stoves; these women have in turned trained others.

Implementation

Led by the Bhutan Youth Development Association (BYDA), the Trashigang project involved local community members in launching this effort to reduce the use of fuel wood in institutional cooking. The demonstration of this technology by religious institutions seems to be particularly effective, as most residents of the Trashigang region are devout Buddhists.

The project's evaluation, however, noted several shortcomings in implementation. First, BYDA was not located on site, and therefore staff had to travel to the region.Implementation,particularly related to training community members in stove maintenance, might have been improved if the implementing agency had been closer to the area. Second, following the implementation of this project, the key staff at BYDA left the organization.Therefore, much institutional memory was lost,which may hinder follow-up on this project's work. However, the stoves have generated great interest in improved cook stove technology within the community, including among local district admin-

istrators.The project evaluation further suggested that in the future, smaller, individual stove designs be introduced along with communal cook stoves. In fact, another project was recently approved for SGP funding that promotes improved stoves for individual households in a particularly remote and high-altitude area of Trashigang.

The Tsirang project was led by the Tsirang Women's Group, which is made up of women from various villages. Women from 12 villages were trained systematically in building, maintaining and repairing stoves.This helped contribute to the widespread use of these stoves.The Tsirang District Administration was integrally involved in the project from the beginning, providing logistical support for training, procuring materials, and even covering the salary and expenses of the technical supervisor during the project period.This technical supervisor was deputized to the project by the Ministry of Trade and Industry.

Technology

The Trashigang project used community-sized, shielded, cylindrical, metal stoves with hot water jackets.They were manufactured in Khaling, a town in the district of Trashigang where the project was implemented,at a cost equivalent to $750.Through the project, this model of the stove was demonstrated to use 50% less fuel wood than other stoves in this region.

The Tsirang project used an improved stove that is essentially a mud kiln with a metal sheet chimney pipe and an iron gate.The stove is simple to construct using locally available materials, except for the metal chimney pipes. The pipes must be obtained from the neighboring Indian town of Bongaigaon, but apparently this has not posed a problem for the project.

Environmental Benefits

Global: According to reports from the kitchens of the religious institutions involved in the Trashigang project, fuel wood consumption has dropped by 50%.According to calculations performed by project evaluators, for the 10 institutions, this adds up to 220 to 280 tons of firewood saved per year.The Tsirang project, on the other hand, is estimated to save approximately 7,500 tons of fuel wood per year, assuming that each household has 6 people and that stoves are being used in 2,000 households. Thus, the overall impact of the household-sized stove project is far larger.

Local: Reduced use of firewood is reducing pressure on local forests, which are a major source of firewood in these areas.

Livelihood Benefits

Health: Those individuals who actually use these stoves to cook, in particular women,are now breathing in less smoke, and also spend less time cooking because the new stoves are easier to handle and cook food more quickly.

Capacity Development

Both projects built the capacity of the respective NGOs to undertake such projects. In both cases, this was the first energy-related project for these organizations. BYDA, primarily a youth organization, conducted outreach to schools in local villages about environmental responsibility. Training was provided for stove users in the religious institutions, but appears to have been somewhat inadequate. The Tsirang Women's Group involved its membership by training them to build stoves and teach others.The capacity development efforts in Tsirang seem to have been more focused toward project goals.Also, the primary constituency of the Tsirang Women's Group was directly affected by the problem of fuel wood collection, which the household stoves helped to solve. In contrast,BYDA needed to train kitchen workers,who were not its traditional constituency; youth were involved more as volunteers in carrying out installations.

Partners

Religious groups: In Trashigang, local religious institutions were important partners in this project.Because of the great respect they are accorded in the community, their adoption of this new technology reportedly had a great influence.

Government authorities: The Tsirang project involved two government agencies – the Tsirang District Administration and the Ministry of Trade and Industry – from the start of the project and their support was integral to project success.The contrast with Trashigang is quite interesting.There the project design was presented to the administration after the project was fully planned and the budget finalized. Originally, the project was to cover only 7 religious institutions, offering them 3 stoves each, which together could handle all of their cooking needs. However, the Trashigang District Administration wanted to cover more religious institutions. The project was therefore modified, with 10 institutions receiving 2 stoves instead. This meant that each institution still had to retain one traditional stove in order to meet all its cooking needs.In the end,the local authorities were pleased with the project results and interested in promoting the stoves further. However, their support during the project might have been greater if they had been approached at an earlier stage.

LESSONS LEARNED

Environmental Management

Both projects illustrate significant decreases in the amount of wood used as a result of the installation of improved stoves.So far, the impact of the household-sized stove project has been far greater than that of the institutional stoves project. This comparison is a reminder that while individual households may have a small impact on their own, if a project is successful in reaching many households its impact can be significant. However, the evaluation indicates the lack of a baseline on how much wood was being used prior to implementation, which would have helped greatly in conducting impact assessments.

Barrier Removal

Information/Knowledge: The choice to work first with religious institutions in the Trashigang region seems to have been particularly helpful in raising awareness, because of the great respect accorded to these institutions in the region and because the large number of visitors coming for religious festivals can help

spread the word. Awareness programs in schools have also supported the effort to improve local knowledge about this type of technology. In Tsirang, on the other hand, women have been very successful promoters of the stoves. The project trained women from many villages, which helped spread information about the stoves.

Scaling Up

In Trashigang, the project has caught the interest of the district administration, which now wishes to expand the project to other community kitchens, such as in schools, monasteries and army camps. Through this project, enough interest has been generated in the cookstoves among individual households that demand has grown for household-sized improved stoves. Recently SGP has approved a project to introduce household improved stoves in a remote area of Trashigang. In Tsirang, on the other hand, the local government has already invested significant resources in the project itself, and is therefore very committed to continuing the project's successful efforts at promoting household stoves.

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Community-Based Rural Micro Hydro Project, India

Themes

★ Renewable energy
⁜ Linkages with other environmental goals
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Micro-Hydel Project
Implementing Organization: Mallanadu Development Society (NGO)
Location: Kerala, India
SGP contribution: $26,883
Start Date: September 1999

ENERGY OVERVIEW

Energy Resource: water
Technology: micro hydro (two turbines installed)
Application: lighting, television/radio, water pumping
Sector: domestic, public, small-scale enterprises
Cost of power per inhabitant: approximately $2 per month for four 10W compact fluorescent light bulbs; extra for the 25 families owning color or black and white televisions
Total power provided: 16 kW (20 kW installed capacity)
Households served: 161 connections (146 domestic, 10 shops, 5 institutions)

BACKGROUND

Thulappaly is a remote village in the western part of the state of Kerala, located along the Naranamthode, a tributary of the Pampa River. This tributary begins in the Ernakulam and Thalapparakotta forest reserves.The village site is very hilly, and households are located in small clusters of 5-15 houses,spread out over a large area.Given its isolation,the village is unlikely to receive grid power anytime soon.The community is composed of people from Hindu, Christian and Muslim backgrounds, and land holdings are small and marginal. Agriculture is the main source of livelihood, mainly via small household gardens, with some animal husbandry as well. Prior to the project, all households used kerosene for lighting,and many also cut down trees for firewood. Women and children also walked considerable distances to fetch and carry water back to their homes.

PROJECT DESCRIPTION

Overview

This project used a process-based, learning-by-doing approach to building and operating a micro hydro plant in this community. The community invested a significant amount in the project, both financially and in-kind, with an estimated contribution of approximately $22,000.The community now runs and maintains its own power system,and is more interested in preserving the local forest than previously. Community members pay for electricity charges, and compared to state-run operations are more likely to pay their bills on time. In addition,since electricity generation is local, there is little waste of electricity via transmission losses.

Implementation

The implementation steps included establishing a community committee for the project, conducting a feasibility study to assess the best location for the plant, building the plant and the electricity distribution system, and then operating and maintaining the plant.

The power system is owned by all power consumers,called the General Body. This Body elects a nine-member executive committee, which manages the power system.A village electrician, a local youth, is appointed by the General Body, and is paid a monthly sum of Rs. 1500, or approximately $60.The electricity generated by the plant is used for lighting, water pumping, television and radio.The system involves 10km of distribution lines laid by the community. The water storage system for electricity generation helps recharge the groundwater, which has improved irrigation.

Technology

The micro hydro system has an installed capacity of 20kW. A weir was constructed about 700 meters from the powerhouse, and water is diverted through an 8-inch pipe for 600 meters, then through a 6-inch pipe into the powerhouse and generator. There is a 50m3 forebay tank at the end of the head channel, which is also used as a de-silting tank.The system uses two synchronous, 50 Hz generators with horizontal shafts, and a horizontal shaft pelton wheel turbine. Using the two turbines during months in which there is sufficient water, 16kW can be generated. However, during the summer months the water supply is insufficient,and therefore the project installed a 15kW diesel generator for use during that time. Electricity is generated and distributed from 5am to 6:30am, and from 6:30pm to 10:30pm.

Environmental Benefits

Global: Since the village previously depended upon kerosene and sometimes firewood for lighting, the installation of electrical connections in 200 households has reduced their use of these fuels, thereby reducing greenhouse gas emissions. However, during the summer months,water in the river is insufficient to generate hydro-power, so during this time the community relies on a diesel generator. This generator was installed by the project, and it is not clear whether this generator emits more or less greenhouse gases than was formerly emitted through kerosene use.

Local: Because the local watershed is now the source of power, the community is more interested in protecting the forest. Community members have begun planting trees, and have reduced the number chopped down.

Livelihood Benefits

Health: The reduced use of kerosene and firewood means that

indoor air quality is improved,which can lead to a reduced incidence of respiratory illnesses.

Education: Due to the improved indoor lighting, children have an easier time studying at night.

Income generation: Many households are spending less on electricity now than they used to spend on kerosene. However, this varies according to the household.

Reduced drudgery: Since the power system helps bring water closer to the community, women and children have to carry water on their heads for a shorter distance.

Agricultural productivity: The system of storing water for purposes of electricity generation may contribute to improved agricultural productivity, because this improves the groundwater recharge rates.This means that irrigation of crops is easier.

Community empowerment: Through this project, the community's ability to work together on common projects has been improved.

Capacity Development

This project has resulted in an improved local capacity for people in the community to find solutions to their problems.The establishment of a community committee to manage the project was the first step, and the overall participation of the community in the process has helped people realize their ability to manage their own resources and improve their situation.

Beneficiaries

The primary project beneficiaries are the 146 households in this village that now have lighting and access to television and radio. In addition, 10 small enterprises and 5 institutions have benefited from an improved power supply. Women and children particularly benefit since water must be carried for a shorter distance.

Partners

The Mallanadu Development Society worked closely with the community, which established a community committee to manage the project. The community members also contributed financially and helped build the new power system.

LESSONS LEARNED

Environmental Management

This project illustrates the link between micro hydro power and protection of local forests. Since the community now depends upon the river to provide power, community members are now more interested in preserving the watershed. However, education and awareness about this connection is necessary if community members are to take action.

Barrier Removal

Institutional: The project illustrates the importance of working with a community so the residents feel they have an ownership in the project.Reports about the project suggest that the institutional development conducted through this project has spilled over into other community efforts, although there are no specifics about this. If this is the case, then institutional barriers at the community level have indeed been reduced.

Information/awareness: The community is now aware of impacts on the local watershed, and is motivated to protect it.

Scaling Up

SGP reports indicate strong potential for replicating this project in other areas. SGP in India has discussed the possibility of larger grants from UNDP and/or GEF for similar efforts, and has contacted India's Ministry of Renewable Resources concerning an assessment of the effectiveness of this project. A cost-benefit analysis may be performed. Similar micro hydro systems have been developed in two other villages of Kerala: Moolakkayam (Pathanamthitta district) and Koinadu (Idukki district).

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Shifting from Conventional to Solar Water Heaters, India

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Awareness,culture, and practices

PROJECT DATA

Name: Transformation of Users of Conventional Water Heaters to Solar Water Heaters
Implementing Organization: Sardar Patel Renewable Energy Research Institute, SPRERI (NGO)
Location: Gujarat, India
SGP Contribution: $23,627 ($8,555 used for purchase of equipment, which is 28% of total equipment cost for 50 solar water heaters)
Start date: March 2002

ENERGY OVERVIEW

Energy Resource: solar
Technology: solar water heaters
Application: water heating
Sector: commercial, domestic
Cost of the system: average cost $618 per unit installed through this project
Total capacity per system: 100-750 liters per day (average size is 225 liters per day), at 60 °C
Households/manufacturers served: 50 solar water heaters installed via 3 manufacturers

BACKGROUND

Each year, an additional 15,000 wood-fired water heaters are installed in the Anand District of the Indian state of Gujarat alone. Between 4-6 other districts in Gujarat have similar use levels of wood-fired water heaters. Households usually have 40-liter, wood-fired systems, which cost approximately $75 each and provide hot water for about 5 people. Larger households might have a 100-liter capacity system,which costs about $130. Women must collect or purchase the firewood, and burning the wood produces significant indoor air pollution. If 6 kg of firewood are used each day, fuel costs would be $4 per month.Solar water heaters,on the other hand,have higher capital costs, and generally have a higher capacity, with a minimum of about 100 liters per day. The smallest solar system costs about $375, about 3 times the cost of a wood-fired heater. However, fuel wood costs are saved, and indoor pollution is reduced.

PROJECT DESCRIPTION

Overview

This project has collected baseline information from wood-fired water heater manufacturers and users,and provided training to manufacturers and assistance to users to help introduce solar water heaters as an alternative. The goal is to educate both manufacturers and consumers about the advantages of solar water heaters, and to identify the most important barriers to expanding their use more widely.

Implementation

The grantee, Sardar Patel Renewable Energy Research Institute (SPRERI), undertook a survey of more than 55 industrial manufacturers of wood-fired water heaters. The survey collected information about the use pattern, cost, sales and service of these water heaters. An interactive meeting between SPRERI, and manufacturers helped introduce solar water heaters to the manufacturers.In addition,SPRERI identified key users of water heaters, and their needs, and monitored the thermal efficiency and pollution data related to the use of wood-fired water heaters. Two solar-powered systems were obtained from NRG Technologies and Steel Hacks Industries, and SPRERI conducted experiments to assess how these water heaters could meet users'needs.An interactive meeting with users helped develop an appropriate incentive scheme to promote the use of solar water heaters. As a result of these efforts, 12 manufacturers now supply solar water heaters, and 50 solar water heaters have been installed with users contributing about 75% of the cost of the equipment.The subsidy offer was advertised in local newspapers, and beneficiaries were selected after a site visit to determine the feasibility and cost of installation. The subsidy offered was $111 for a system of up to 150 liters per day, and $167 for systems above 200 liters per day. If the user was replacing an old wood-fired heater, an additional buyback amount was paid to the user, which ranged from $78 for a new wood-fired system (which is approximately the market cost of a 40-liter system) to $11 for a 4-year-old system.

The project sought to overcome certain attitudes and assumptions about solar water heaters through this initial set of installations. For example, many people believed that solar water heaters could not provide hot water on cold or rainy days.On the other hand, many households were unaware of any alternatives to the smoky wood-fired systems that required a constant supply of firewood.The project has since set a goal of disseminating the solar water heaters more widely, to replace 10% of the 15,000 wood-fired water heaters installed in the district every year. In order to achieve this,SPRERI plans to work more closely with government entities.

Technology

The solar water heaters promoted in this project have capacities ranging from 100-750 liters per day. Under good conditions,the water is heated to 60 °C. The system consists of a flat plate collector, a storage tank and a piping system.The collector is made from an array of conduits placed on an absorber plate which is painted black and fitted with a glass cover. It is surrounded by insulation to reduce heat loss. Water is heated by solar rays, moved to the storage tank through a thermosyphonic effect, and stored in the tank for later use. A particular local adaptation is the incorporation of heat exchangers to pre-

vent mineral deposits, which build up easily in Gujarat due to the high mineral content of the water. In addition, the possibility of damage to glass parts by monkeys had to be taken into consideration in technology design.

During approximately two months of the year, solar energy is not sufficient to heat water. During these periods, electricity or LPG is used to heat water.

Environmental Benefits

Global: Each household previously used 5-7 kg of firewood every day for water heating. By replacing this with solar water heaters, households save this amount of firewood, thus reducing carbon dioxide emissions.

Local: Wood-fired water heaters produce smoke, which causes local air pollution.The introduction of solar water heaters can help reduce this problem. In addition, local forests may suffer fewer threats as a result of decreased demand for firewood.

Livelihood Benefits

Health: Reduced smoke due to the use of solar water heaters can help reduce respiratory problems, which are experienced primarily by women and children exposed to indoor air pollution. Improved access to hot water can provide additional health benefits.

Savings: Although initially more expensive, solar water heaters may save households money over the longer term, therefore enabling them to use more of their income to meet other needs.However, since solar water heaters seem to be so much more expensive than wood-fired ones, whether solar water heaters actually save money may depend upon the lifetime of the equipment,the local cost of firewood,and other similar factors.A more in-depth analysis would be required to assess this. Project organizers note that solar water heaters are more competitive with electric water heaters than with wood-fired ones.

Beneficiaries

The primary beneficiaries are local users of water heaters. So far, 50 households have installed solar water heaters.In addition, manufacturers benefit from increased awareness about solar water heaters.

Capacity Development

The project provides training to local industries making wood-fired water heaters to encourage them to build solar water heaters. Training includes technical know-how, third party testing,and assistance in quality control.

Partners

SPRERI has partnered closely with manufacturers and users by involving them substantially in the development of plans to promote solar water heaters. Close collaboration with these groups has enabled the project to test solar water heater use in the area, and the initial set of manufacturers and users have a very important role to play in the further dissemination of solar water heating technology.

LESSONS LEARNED

Environmental Management

By conducting a careful baseline study that documents the thermal efficiency and pollution produced by wood-fired water heaters, this project contributes to a better understanding of how current use patterns are impacting the environment, and how the introduction of solar water heaters can result in improvements.The surveys and meetings with users and manufacturers also gathered critical information necessary to adapt solar water heating technologies to work under local conditions.

Barrier Removal

Information/awareness: This is the primary barrier targeted by this project. Information and awareness barriers have been identified and addressed among users and manufacturers through an interactive approach. SPRERI organized meetings with both groups to learn about their concerns and needs.The project also identified particular awareness barriers,such as the notion that solar water heaters could not work at all on rainy or cold day.

Technical: Local companies that used to produce only wood-fired water heaters are now producing solar water heaters as well. By involving existing local companies, this project helps generate local,sustainable production of this new technology.

Financial: Financial barriers were addressed only for the initial group of 50 households installing solar water heaters. In fact, the SGP grant provided a direct subsidy for the equipment costs. If the benefits of this technology, both financial and otherwise, are very strong and are adequately demonstrated by the initial 50 solar water heaters,using grant funds for a subsidy might be justified.The need to address financial barriers on a wider scale was recognized, but this project does not yet attempt this. It will be important to assess the effectiveness of the subsidy approach in helping to generate a more widespread reduction in financial barriers, since clearly grant funds will not continue to be available for this purpose.

Policy: A lack of appropriate incentives to adopt solar water heaters was also identified as a barrier to their widespread use. The project intends to address this barrier in its next steps.

Scaling Up

Through its activities, this project has been developing a plan for expanding the use of solar water heaters across the district and eventually to other districts as well.This was the intention behind conducting a baseline study, holding meetings with stakeholders, and testing implementation in 50 households. Next steps for this project include the selection of particular segments of consumers who can begin using solar water heaters, and the collection of further information based on their experiences.Attention will be paid to how policies could

be changed in order to better promote the use of solar water heaters. However, it appears that while solar water heaters are competitive cost-wise with electric water heaters, they are relatively expensive compared to wood-fired water heaters.

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Connecting Micro-hydro Power to the National Grid, Indonesia

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Institutional capacity development
❖ Policy and legislation
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Upgrading the Capacity of Micro-hydro Facility to Enhance Economic Activities and the Development of the Local Community
Implementing organization: Konsorsium Seloliman (CBO)
Location: Seloliman, East Java, Indonesia
SGP contribution: $27,388
Start date: August 2000

ENERGY OVERVIEW

Energy resource: water
Technology: micro-hydro power; 90% local content; 10% imported (i.e., control panel)
Application: lighting, TV/radio, rice cookers, blowing cotton, crushing paper, selling electricity to the grid
Sector: domestic, commercial, public
Total capacity: 23kW (10kW used by the community)
Number served: 45 households, an environmental learning center, a small business and two boarding schools

BACKGROUND

There is significant potential for micro-hydro systems to meet the energy needs of rural and remote communities in Indonesia. The estimated potential for micro- and mini-hydro is about 500MW, whereas so far only an estimated 5 MW capacity has been installed in rural areas, and only 1MW of this is actually being used.

In 1995, a law was passed to allow small power producers to sell power to the national grid. The power must be sold to Indonesia's national power company (PLN). The Small Power Purchase Tariff outlines the payments, and the circumstances under which they are made. However, until recently the policy has not actually implemented, due to a lack of political will and capacity at PLN. In 2002, new regulations finally made it feasible for small-scale independent power providers to sell to the grid.

PROJECT DESCRIPTION

Overview

This project upgraded the electricity supply for the Seloliman area to meet local domestic, public and commercial needs. In doing so, excess power was generated. The project has since worked to build the capacity of the local cooperative that owns and operates the micro-hydro plant to take advantage of

A micro-hydro power penstock carrying water through terraced ricefields to the powerhouse (Seloliman, East Java, Indonesia).

Indonesia's new policy permitting small-scale producers to sell power to the grid, testing this option as a possibility for other communities in Indonesia.

Implementation

Prior to SGP's involvement, the German development agency, GTZ, sponsored a project to build a micro-hydro system for a major environmental education center in Seloliman. The system was not sufficient to meet all of the community's needs, and SGP's support helped expand the system's capacity. Now, water from the Maron River provides power to the three small villages of Seloliman, including Kali Maron. In addition, the environmental center, called the Center for Environmental Learning, and two Muslim boarding schools receive electricity. One of the boarding schools uses power to blow cotton to make mattresses, and to power a paper crusher. The micro-hydro power system is owned by a cooperative made up of local villagers.

Recently, the cooperative has embarked upon procedures to sell excess power to the grid. The site is not far from the grid, so selling to the grid is feasible, and the cooperative was recently legally registered. The Center for Environmental Learning is currently managing the process, but is training the local cooperative members to take over. The community is in the process of deciding how it will use the funds generated by the sale of power. Initially they intended to waive electricity use fees for local community members, but in a recent community meeting decided instead to keep the fee in place for the time being. After a year of negotiation, the Maron River cooperative received a certificate and license to provide electricity for PLN.

Technology

The micro-hydro power plant produces 23kW total capacity,

but only 10kW are used by the community at night and 5-6 kW during daylight. The system uses an old irrigation ditch, built by the government to irrigate the rice fields, to channel the water approximately 700 meters toward the powerhouse. A large pipe then carries the water down through terraced rice fields into the powerhouse. The equipment used in the powerhouse includes a T14 cross-flow turbine with a capacity of 23 kW, and a speed of 428 revolutions per minute (rpm) for an 11.7 meter net head. The system is designed for a flow of 300 liters per second, and uses a 3-phase AVK synchronous generator.

Environmental Benefits

Global: The presence of the micro-hydro power system means that previous sources of power, which included kerosene, diesel and firewood, are not relied upon as heavily. This leads to reduced greenhouse gas emissions.

Local: Local environmental benefits include reduced pressure on local forests from firewood collection.

Livelihood Benefits

Health: Reduced use of kerosene for lighting, and firewood for cooking rice, means improved indoor air quality, which is likely to bring health improvements, especially for women and children.

Reduced drudgery/improved opportunities for women and children: Now that women and children spend less time searching for firewood, they have more time to participate in community activities, and children have more time to play and to study.

Income generation: The small enterprise in mattress-making at the local Muslim boarding school was developed just after the introduction of the micro-hydro power. Each mattress can be sold by the school for $25-$30 apiece. In addition, the cooperative running the micro-hydro plant is planning to sell power to the grid. The cooperative estimates that the venture with PLN will produce about $400-$450 per month of income. This revenue will be used to establish a capital fund for village development projects.

National Benefits

It appears that this will be the first time a community-run micro-hydro plant has sold its power to the national grid. This will test the practicality of this approach, and open up this possibility for other Indonesian communities. In addition, the national grid operators will have additional sources of power generation.

Beneficiaries

The 45 households (about 250-300 people) of Kali Maron, and other inhabitants of the region, are the primary beneficiaries. In addition, the 10,000 annual visitors to the Center for Environmental Learning benefit from power and additional learning opportunities, and about 50 students at the Muslim boarding school benefit from the additional income generated through the sale of mattresses.

Capacity Development

Capacity development is on-going for community members involved in managing the micro-hydro plant. Mainly, the Center for Environmental Learning has been supporting them in their plans for the sale of power, and the goal is that they would be able to manage this on their own soon.

Partners

The most important partners in the current effort to sell power to the grid are the community members, represented by the Konsorsium Seloliman (the grantee), and the Center for Environmental Learning. This is a major center for learning, receiving 10,000 visitors per year. It is also highly independent, receiving 90% of its funds from private sources. This has meant that the center had the freedom it needed to engage in this innovative effort. Several other agencies have also been involved, including the German development agency GTZ, Lem21 and an Indonesian group, Yayasan Bina Usaha Lingkungan.

LESSONS LEARNED

Environmental Management

This project illustrates one possible future way to link livelihoods of communities with environmental management. Since micro-hydro power has little or no environmental impact, and often watershed conservation follows their installation, the possibility that communities could sell this power to the grid is quite interesting. This project will be interesting to follow up on as this sale takes shape. In particular, it will be interesting to note what happens if the community does indeed remove all local tariffs for power use due to the revenues from the power sales. One might anticipate that this would cause the over-use of power, since it would cost nothing to users. However, it appears that for the time being, villagers will still pay for their power.

Barrier Removal

Policy: The project makes use of an existing policy framework that allows for the sale of power by small-scale producers to the grid. However, this project may very well assist in reducing barriers for community-based micro-hydro schemes wishing to participate in this opportunity. It is believed that this is the first such project to take advantage of this, and therefore it is likely to encounter some challenges along the way. Learning from these challenges could help make this policy more widely usable for communities in other areas of the country. It may also serve as an example to encourage other countries to implement similar policies.

Institutional/Cultural: The project also addresses barriers of fear among community members. Three decades of centralized government have left communities with passive attitudes. Embarking upon a self-organized power generation project was not an easy step to take. It will take a continuing effort to maintain the organization and build the sustainability of this new venture. Many lessons are still left to learn, but already the community and local organizations have seen the value of working

together to overcome unfavorable institutional arrangements and cultural barriers.

Scaling Up

As mentioned above, this project could serve as an example for other Indonesian communities. However, this will depend upon the ability to track and communicate the results and impacts of this effort. The Center for Environmental Education will likely be key to achieving this.

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A New Micro-Credit System for Solar Panels in Remote Villages, Nepal

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Solar Village Electrification Demonstration Project (SOVED), and Paper and Power Project, part of the Home Employment and Lighting Package (HELPTM)
Implementing Organization: Himalayan Light Foundation (NGO)
Location: District of Baglung, Nepal
SGP Contribution: $50,000 (SOVED), $49,000 (Paper and Power Project)
Start Date: December 1999 (SOVED), September 2001 (Paper and Power Project)

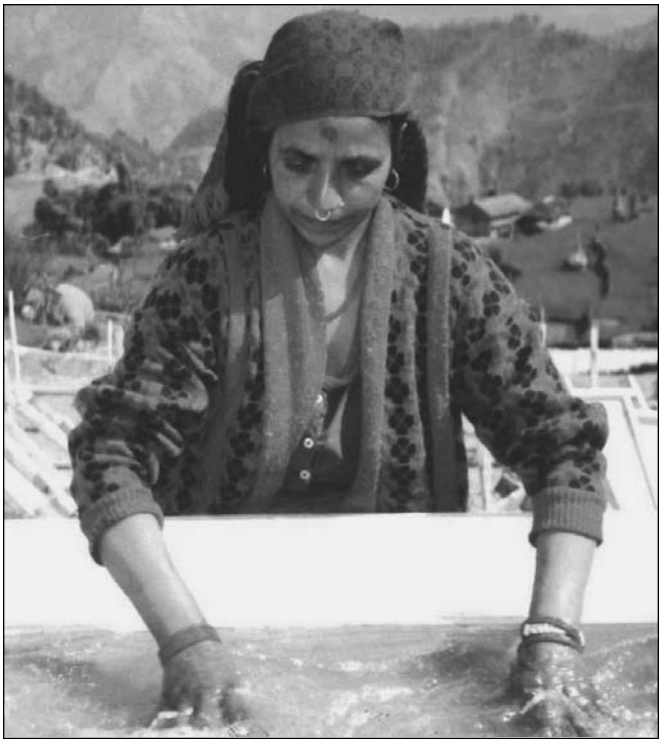
ENERGY OVERVIEW

Energy Resource: solar
Technology: individual photovoltaic systems
Application: indoor lighting
Sector: domestic
Cost of each system: $342.The first 75 systems received a government subsidy of approximately $150 each, and beneficiaries paid $192. Current subsidy rates for these solar home systems are now $93, so villagers must cover a higher proportion.
Total power provided: 3.4 kW (198 panels of 20Wp each)
Households Served: 198

BACKGROUND

Nepal is a mountainous and predominantly rural country in which only about 3% of the rural population has access to modern energy services.Extending the electricity grid is expensive, costing between $10,000 and $30,000 per kilometer due to the rugged terrain. On the other hand,most areas in Nepal receive high levels of sunlight throughout the year. Thus, individual solar photovoltaic panels are well adapted to meet rural energy needs. In 1996, the government established the Alternative Energy Promotion Centre (AEPC), which provides subsidies covering up to 50% of the cost of a solar home system. Between January 2001 and November 2002,AEPC committed approximately $1.8 million for such subsidies.There are more than 20 private companies supplying solar home systems in Nepal.These suppliers import panels and batteries and manufacture control boxes other solar home system components domestically.

However, even with the subsidy – for which demand far exceeds supply – the poorest villagers do not have the cash to pay for the rest of the panel's cost, and do not have collateral to obtain a loan. Only the most well-off villagers can access loans,and therefore they obtain the subsidies as well.The poorest have little option but to continue buying and hauling kerosene, which must be imported using precious foreign exchange. Kerosene contributes to the global problem of climate change, and creates serious local air quality problems. Households also purchase dry cell batteries to power radios and flashlights,which are generally not disposed of properly.The purchase of kerosene and batteries accounts for about 20% of a village household's income. Villagers in project areas also harvest and use diyalo, a highly resinous fat wood, for lighting - at the rate of four trees per family per year. Diyalo sticks are stuck in the floors of homes and lit up, producing a dim and extremely sooty flame which causes respiratory and eye problems for villagers.



A woman makes paper products to generate income and pay for solar panels (Nepal).

PROJECT DESCRIPTION

Overview

This project primarily addresses the financial barriers to renewable energy. It demonstrates a flexible credit scheme that enables the poorest members of Nepalese villages, who have little cash and no collateral, to obtain solar photovoltaic panels and enjoy their benefits.At the same time, the project creates a source of long-term income by building the skills and capacity of villagers to produce handicraft goods for sale.

Implementation

The grantee, the Himalayan Light Foundation (HLF) developed a flexible payment scheme to enable villagers to access solar panels through the production and sale of handicraft products

sold over the Internet. This concept, called the Home Employment and Lighting Package (HELP, was developed with the support of a private solar panel distributor, Lotus Energy, Ltd. SGP provided support for HLF to initiate the Solar Village Electrification Demonstration Project (SOVED), which is based on the HELP model.

In SOVED, women commit to knitting one traditionally designed bag per month to pay off the loan for the solar panel. Participants in the program are also granted access to the AEPC subsidy. After knitting 24 bags over two years,the loan is paid off, and income from the sale of bags returns directly to the household. Until the Internet accessible E-shop on the Himalayan Light Foundation's website became operational in mid-2003,the bags were sold via conventional means in Nepal. Now, international sales are possible via the E-shop (http://www.hlf.org.np).The funds from sales are placed in a revolving fund under the control of the villagers, called the Revolving Electrification and Income Enterprise Fund (RELIEF). Once the fund is large enough, villagers who don't have solar panels yet can borrow from the fund and pay the loan back by producing bags. Through a separate program run by the Himalayan Light Foundation called the Solar Sisters, the local health post has also received solar lighting.This program brings in volunteer donors from abroad to fund and help install solar panels for specific buildings. Finally, HLF has started a new project, called the "Paper and Power Project," also funded by SGP. This project is located near a forest where raw materials for paper products grow. The management of the forest is being transferred to the villagers, who will sustainably harvest these raw materials.They have been trained in making paper products,and will produce them for sale in order to repay loans for solar panels.These paper products are also sold via the E-shop, along with the bags.

Environmental benefits

Global: A total of 106 solar panels have been installed in the village that produces knitted bags. In the "paper and power" village, 92 solar panels have been installed.Carbon emissions have been reduced since the panels replace kerosene as the primary lighting source.

Local: Dry cell batteries are no longer used in the village. Instead,villagers use a small Ni-Cad battery recharged via their solar panel.Thus, any local ecosystem impacts from improper battery disposal have been substantially reduced.

Local Livelihood benefits

Health: The elimination of kerosene use in the home greatly reduced the incidence of respiratory and eye problems. In Bongadovan, the health worker also reports reduced incidences of bronchitis and pneumonia, as well as reduced drinking. (Drinking is banned in the village, and now it is harder to hide the practice since there is better light at home.) In addition, the health clinic now has better lighting via the panels installed by the Solar Sisters. On the negative side, more women have complained of sore fingers from the knitting, although this problem reportedly has since declined.

Poverty alleviation: First,households no longer need to purchase kerosene or batteries. This saves as much as 20% of their income. Second, once the loans are paid off for the solar panels, the income from the sale of bags returns to the women themselves, providing an average supplemental income of $110.The additional light provides extra time in the evenings for productive activities, and the HELP program has provided micro-enterprise training to local villagers to enable them make use of the better light to increase their incomes.

Education: Evening activities are now possible; children can study in the evenings,and women are now pursuing evening literacy classes at the newly-lit health post.

Reduced drudgery: Villagers no longer need to haul heavy loads of kerosene to their homes. In addition, the improved lighting makes daily tasks – like sorting rice – easier. However, it should be noted that making the bags to pay off the solar panel loan adds to women's work,since each bag takes 70 hours to complete.

Improved local opportunities: The village economy is very minimal; agriculture, herb collection and making paper do not provide sufficient income. Therefore, most young people have left the villages for the cities, hoping for greater economic opportunities there. This project helps bring new economic opportunities to the village, hopefully re-opening the option for young people to stay.

National benefits

Reduced dependency upon imported kerosene: In the early 1990s, about 24% of Nepal's foreign exchange was used to import fossil fuels. Increased use of solar energy reduced the need to import kerosene, thereby saving foreign exchange for other purposes.However, foreign exchange is also necessary to import solar panels and batteries,so it is unclear how much foreign exchange is actually saved. In any event, reduced dependence on fossil fuels should decrease the impact of fuel price shocks on the Nepalese economy.

Capacity Development

Technical: All recipients of solar panels were trained in their proper use. In addition, two technicians were given in-depth training to enable them to maintain and repair the panels.

Micro-enterprise: The project leader for the community attended a micro-enterprise training organized by the Peace Corps.

Social Mobilization: Two social mobilizers, both women, attended this training.

Handicraft Product Training: All beneficiaries attended this training, which is essential for quality production. During the training,beneficiaries learned the type, style, colors and size of products acceptable for paying off the loan.In addition,beneficiaries and project leaders mutually agreed upon the number and price of products required to pay off the loan.

Beneficiaries

Women are the primary beneficiaries,since they work most in

the home, but everyone in the household benefits from improved air quality and better lighting.

Partners

The Himalayan Light Foundation collaborates closely with the community, government and private solar home system companies.

Government: The Alternative Energy Promotion Centre (AEPC) makes the subsidy for purchase of the solar panel available to participants in the bag-selling scheme. HLF negotiated this arrangement directly with AEPC.

Community: Nepal has very strong community involvement in a decentralized scheme of government. The Village Development Committee (VDC) of Bongadovan and the District Development Committee of Baglung were critical partners in the program, as they provided a local infrastructure for organizing the work. For example, a Solar Development Committee (SDC) within the VDC was created to make decisions about the implementation of the solar project.

Private sector: The project purchased the solar home systems via Lotus Energy Systems,a local private supplier in Nepal. The company also provided installation and training assistance.

LESSONS LEARNED

Environmental management

This project illustrates the potential for solar photovoltaic panels to meet energy needs in remote and sparsely populated areas. Since electricity grid extension to these areas may indeed be very costly, sustainable methods for disseminating solar panels in these areas is one possible solution. However, as this project demonstrates, creative ways of lowering financial barriers need to be found if this approach is to be viable.

In addition, very careful training of users and technicians is critical if decentralized energy systems such as these are to be successful. This project has heavily emphasized training. Even prior to the arrival of the equipment,HLF provided preliminary training, including an overview of how solar panels work and how they are maintained. They also alerted participants that they would need to have a few items ready for the installation: a pole for mounting the panel,a hole in the ground,and coal and salt for grounding. When the company providing the panels, Lotus Energy Pvt. Ltd., arrived to install them, the beneficiaries were involved in the process, helping to mount and wire the panels.

Another training was held during installation, and yet another after the installation, reiterating proper handling and maintenance. The two local technicians participated in these trainings, and in addition traveled to Kathmandu to receive in-depth training on maintenance and repair at the company's office. All of this training helps to ensure that the solar home systems last as long as possible.

Barrier Removal

Financial: Despite the fact that the Nepal Government offers subsidies to individual villagers acquiring solar home systems, the subsidy has only reached the rich members of the society who can pay cash for the balance of the system cost after the subsidy, or who qualify for government loans due to landholding status or other substantial collateral. The poor members, who are the majority of the potential market for solar home systems, cannot enjoy the benefits of the subsidy, as they cannot raise the balance.

This project is designed to overcome this barrier. HLF offers villagers access government subsidized solar panels, accepting as collateral the promise to produce a certain amount and quality of products.

The approach shows that flexible payment schemes can make a big difference in the ability of the poorest members of a village to access solar technology and its benefits. However, such systems must be carefully planned in order to be effective. This project has chosen Internet sales as its method of turning goods into cash. Some critical elements of HELP's strategy are:

Close involvement of an NGO or a company able to make the upfront investment in the solar panels. This organization must assume the responsibility of selling the products and recouping the funds over a long period of time. In this case, the Himalayan Light Foundation is responsible for selling the products, and it takes two years to recoup the funds from each solar panel. HLF has plans to transfer this activity to a private company;a memorandum of understanding has been drafted between HLF and the Organic Village, a Nepalese company.

Careful study of market demand for the items made for sale. The HLF conducted a feasibility study before launching HELP, which determined the actual and potential demand for handicraft items from developing countries, particularly Nepal. The study identified bags and paper products as having significant worldwide market potential. The choice of products must also take into consideration whether the raw materials are readily available in the villages. The study also sought future partners that could eventually take product sales to a scale that will help propel various HELP program start-ups in remote villages through market forces.

Means for marketing and distributing the products. If the product being produced does not have a local market, provision must be made for advertising the products, transporting them and receiving funds for their purchase. In this case, HELP is making use of the Internet to access the world market. HLF contracted with the College of Software Engineering to develop the software and the website for selling handbags. After many months of development and testing, the E-shop is now operational. However, this took a significant investment of time and effort. HLF hopes to use this same web site for other HELP program products throughout the South Asia region.

Sufficient training for villagers who make the products to ensure that consistent standards of quality and style are met. HELP has provided "Handicraft Product Training" for all beneficiaries,and also has arranged for additional training through the Small Cottage Industry Development Board, to help participants organize themselves to produce quality products in larg-

er numbers while meeting deadlines.This aspect is also being scaled up as HLF is developing relations with the Forward Leap Foundation, a U.S.- based NGO, and The Organic Village to develop a large marketing campaign for HELP product sales .

Strong relationships between the NGO handling the project and villagers receiving solar panels and making products for sale. As with any micro-credit scheme, "social collateral"is crucial. Each household must somehow be held accountable for making a bag per month for the next two years. Each bag initially takes 70 hours to make, although production time decreases with proficiency. Thus, the women of the household must invest a relatively large amount of time on top of their already very long working day. Participants must therefore be strongly motivated to participate. The Himalayan Light Foundation's project officer had to work hard to establish the trust of the villagers,ensuring that they actually did produce the required bags. Solar panels, which are durable items, can be removed from households who do not keep their end of the bargain.This, fortunately, has not happened, but the knowledge that this is possible may help motivate villagers to cooperate.

Financial barriers still remain for villages in Nepal to access solar panels.The current scheme depends upon a subsidy funded by AEPC, which lowers the cost to users by about $100 and therefore reduces the number of bags that must be completed to pay off the loan. However, the subsidy funds are finite, and are reduced in size each year. Without them villagers would have to produce a greater number of bags,or make items that can be sold for a higher price. Requiring the production of one bag per month for two years is already a heavy commitment for the hard-working women in this village. Suggestions that men take on some of the work that women used to do has met with a great deal of resistance from the men. However, according to the HLF, the men have in fact taken on several tasks which they normally did not do in order to increase the women's available time for making handicraft products. Thus, financial and cultural barriers are intertwined.

Institutional/cultural: Collaborating with and strengthening local institutions,such as the Village Development Committee in this project, is crucial to success. Staff from the Himalayan Light Foundation helped build the village's capacity to take on group projects, such as the solar panel installation. A Solar Development Committee (SDC) was formed within the VDC to be responsible for decision-making and organization of the project. However, this capacity building – how to manage projects and finances – seems to have spilled over into other development projects.The village has started to organize itself to build a new toilet in the health compound, and has received training on building smokeless stoves. Thus, while this project seeks to demonstrate the potential for spreading solar panels to other villages,it also seems to have reduced institutional barriers to implementing other projects to improve livelihoods and the environment.The start of the SDC also catalyzed several other village works such a road building and sanitary facility construction.

Cultural and gender barriers proved to be the most challenging for this project. The divisions of labor between men and women seem sacrosanct, at least so far. Perhaps these simply take longer to change; over time, the improved lighting, and new economic opportunities associated with it, may result in a greater re-distribution of labor.

Scaling Up

This project is being scaled up through several avenues. After SOVED, SGP funded the Paper and Power Project. SGP and HLF are also working together to put together a proposal for a GEF medium-sized proposal. In addition, HLF is creating a regional NGO consortium to scale up the model regionally. So far, members include the Sewalanka Foundation in Sri Lanka and the Tarayana Foundation in Bhutan.

The Internet marketing capability is also key to scaling up this project. Once the E-shop exists, it becomes easy to add new products,as HLF has done by adding the paper products being produced by the Paper and Power Project. HLF also believes "energy branding" is important: that is, if purchasers know that the product is contributing to energy access in Nepal,they may be willing to pay more. This is one of the reasons why HLF has trademarked the names of its programs:HELP, RELIEF and Solar Sisters.HLF hopes these names will come to be associated with clean energy and improved livelihoods, and in addition will signal a willingness to commercialize its efforts in the hope that eventually a private company could take over the enterprise.

Essentially, an E-shop cannot be expected to demonstrate major market draw without an adequate variety of quality controlled products, so product diversification from several village is essential for healthy web-based sales. In addition to the knitted bags and the paper products, Thangkas (Buddhist scroll paintings) have also been added to the E-shop. These Thangkas originate from another HELP village in Ko-Timal which received support from Himalayan Light Foundation, the Solar Development Fund, and the Japan Virtual Foundation. Solar systems for the advanced students from the village Thangka painting school called the Tri Ratna Buddhist Arts School are being paid for using Thangkas rather than cash.

A general barrier related to scaling up is the relatively high cost of solar panels, and the administrative costs for operating the program. Staff at the Himalayan Light Foundation forecast that by expanding the number of villages in Nepal participating in the program, they will be able to purchase the solar panels for less, thereby reducing the burden upon women. Although in some circumstances increased demand might cause prices to increase rather than decrease, in this case there are a relatively large number of solar panel suppliers in Nepal,so there is not a supply bottleneck. In addition, as the installation density increases,the per system cost for things like training and installation decreases, thereby lowering the cost to the user. Moreover, by developing partnerships for scale-up, the costs for reaching remote villages (the primary cost of the HELPprogram) will decrease by using the infrastructure and field presence of existing similar NGO efforts.

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Fuel-Efficient Smokeless Stoves, Pakistan

Themes

★ Energy efficiency
✲ Linkages with other environmental goals
❖ Technical capacity development
❖ Institutional capacity development
❖ Awareness,culture and practices
✷ Poverty alleviation (MDG 1)
✷ Gender equity and empowerment (MDG 3)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Fuel Efficient Smokeless Stoves
Implementing Organization: Escorts Foundation (NGO)
Location: Changa Manga region near Lahore, Pakistan
SGP contribution: $7,500 (July 1995) and $32,698 (November 1999)
Start Date: July 1995

ENERGY OVERVIEW

Energy Resource: firewood
Technology: efficient stoves
Application: cooking
Sector: domestic
Efficiency improvement: use 50% less wood than traditional stove
Households Served: 11,728 (70% adoption rate) in 54 villages

BACKGROUND

The Changa Manga region, about 80 km from Lahore, includes about 55 villages surrounding one of the largest man-made forest reserves in Pakistan, the Changa Manga Forest Reserve. There are also six villages located within the forest, and additional "squatter" settlements in the general area.The reserve is a protected area, but is subject to pressure from local inhabitants who depend upon firewood for cooking.These communities are very poor, with very low literacy rates.There is a high rate of theft of wood from the protected area, with some villagers selling firewood from the forest to generate income. Women use traditional stoves for cooking, which produce smoke and soot, leaving their kitchens, cooking utensils and hands coated with soot.Women also suffer from a variety of illnesses and pains related to smoke inhalation.

PROJECT DESCRIPTION

Overview

This project spread the use of smokeless stoves among women in these villages in order to reduce their dependence upon firewood and improve their health and general living conditions. The grantee, the Escorts Foundation,was founded by a private company in Lahore, and focuses its efforts specifically upon the development of the Changa Manga region. Thanks to the Foundation's high level of success in this area, it is now hosting training sessions for other NGOs interested in carrying on similar projects elsewhere in Pakistan. In Pakistan, SGP has funded seven other organizations to participate in training offered by the Escorts Foundation.

Implementation

The Escorts Foundation made use of a stove construction and dissemination model successfully implemented by the Family Planning Association of Pakistan, which in turn was adapted from work on improved stoves in India. However, unlike projects in India, the Escorts Foundation does not subsidize the stoves at all,believing that users must invest in the stoves if they are to continue using them and promote their use to other villagers.

In any village, the implementation process begins through conversations with the village leader which lead to discussions with various stakeholders and planning for the training.The next step involves canvassing the village, collecting population, fuel use and other data while distributing advertising for the training. Then the training itself is provided. Originally, the project began by training two women from each of six villages, and then encouraging those women to go back to spread the stoves around their villages. However, this approach was unsuccessful. Although the women were paid a small amount – about $1 – per stove they constructed, adoption rates were low because traditionally the rural women make their stoves themselves and were not willing to pay anybody for constructing their stoves. A site visit by SGP staff led to the suggestion that the women conduct public demonstrations, boiling water with the old and the new stoves, and measuring the differences in the time needed to boil the water and the amount of fuel used. This proved helpful, but the Escorts Foundation also decided to change its approach and train more women per village. In the project area,a typical household consists of four or five families sharing a compound but maintaining separate kitchens, so the Escorts Foundation started training one woman from each compound, who would in turn construct stoves for other residents in her compound, and in doing so would train them to make these stoves.At the end of each training session,two particularly motivated women would be chosen from each village to take home construction kits. These women would be responsible for motivating other women to use the stoves,and for evaluating and monitoring post-construction use of the stoves.Project staff also make three follow-up visits to each village to help ensure proper maintenance and encourage expanded use. Using this refined approach, adoption rates are now at 70%.

Technology

This stove is modeled after the Naada stove, named for the village in Pakistan in which it was first developed and implemented.This stove has been further refined for local needs in the process of the Escorts Foundation's work in Changa Manga. The stove has two burners and a chimney that conducts smoke out of the home. It is made out of locally-available and inexpensive materials, such as concrete-mud, a mould to make the 10 bricks needed for the stove, some tin cans for a chimney,

and some metal rods.It must be cleaned every one-two weeks in order to continue to function properly. When used properly, this stove uses 50% less firewood, and does not produce indoor smoke.

Environmental Benefits

Global: The major global benefit is the reduction in greenhouse gas emissions from burning fuel wood.In 2000,the project estimated that the project avoided at 10.84 Gt of carbon dioxide emissions annually through the 5,476 stoves in use in 24 villages at that time. (Subsequent increases in the number of stoves used have substantially added to the estimated emissions avoided.) The estimates were based on an average usage rate of 5-6 kg of wood per day with traditional stoves, which the improved stoves would cut in half.

Local: The local forest reserve is now less subject to illegal wood-cutting.This is a benefit to the diverse flora and fauna located in the reserve.

Livelihood Benefits

Health: Women who use the stove now breathe in less smoke. Although no official health studies have been done to illustrate the exact impacts,there seems to be a general improvement in women's health since the implementation of the project. In addition, hygiene is improved, since women now have an easier time keeping their hands, cooking utensils and walls clean in the kitchen due to less smoke.This also saves water, which can then be used for other purposes.

Income: Many families buy wood for cooking. Now, they need to buy 50% less than before, resulting in saved income that can be used to meet other needs.

Social: Women have reported more satisfactory relationships with men,since meals are cooked more quickly using two burners, and the food tastes better.

Gender equity: The project has opened up new possibilities for women in an area where traditionally women have few opportunities.The project employs local women to run the smokeless stoves project.These young women originally faced social pressure not to work for the project, but the situation has changed significantly; now families come to them to help their daughters get jobs.

Beneficiaries

Women are the direct beneficiaries of the project, since the project trains women to construct and use the stoves and women are primarily responsible for cooking. However, entire families benefit from better food and reduced smoke.

Capacity Development

The entire project is geared around building women's capacity to build and disseminate the improved stoves,thereby enabling women to take action to improve their own well-being and that of their families.The Escorts Foundation has introduced several new ways to support women in achieving these goals, including:

- Condensing the training sessions from five days to three days, to make it possible for more women to participate.
- Inviting more women from a single village to a workshop to be trained to make the stoves. Even though only two of these women are selected to be promoters of the stove after the workshop, having a larger group of women in that village with knowledge about the stove provides needed support to the promoters and in general results in greater adoption rates.

Partners

In addition to the communities themselves, SGP has been an important partner. On several occasions, monitoring visits by SGP staff resulted in suggestions for improvements,which were implemented by the foundation with positive results. In addition,since the Escorts Foundation's success in getting the stoves adopted, it has begun training other agencies, some of whom have been funded by SGP grants to participate in training sessions.These agencies include CARITAS Pakistan, Punjab Rural Support Programme, Shaheen Welfare Society, Rural Development Project, Haripur and the Shahbaz Welfare Foundation.The Escorts Foundation has also trained the staff of the Pakistan Community Development Project for Rehabilitation of Saline and Waterlogged Land – a UNDP and AusAid funded project.

LESSONS LEARNED

Environmental Management

Many stove projects around the world have met with only moderate success in achieving goals of reducing fuel wood use. One reason for this is that stoves have not always been designed to meet the particular needs of a community. This project has taken care to adapt the stove to meet local needs. In fact, at several points during implementation the technology of the stove has been refined to make it easier to build and use given local conditions.

Barrier Removal

Technical: By training local women to build – and teach others to build – the improved stoves, the project does help remove technical barriers to the widespread use of these stoves. In addition, the Escorts Foundation has been training other NGOs,who now have the technical knowledge to build stoves as well.

Financial: While the project does not subsidize the purchase of stoves,it has made every effort to keep the stoves low-cost by using locally available materials and tools.

Information/awareness: Information about the stoves is now more readily available in the villages.The women who attend the training are provided with illustrative materials to help share the technology with others. However, there is little evidence that the project helps increase awareness of the global environmental benefits that the project produces, namely, greenhouse gas emissions reductions.

Scaling Up

The project's efforts to train other NGOs to start similar projects elsewhere are an important step toward scaling up this project.At present, other NGOs are promoting these stoves in 12 districts of Pakistan.

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Improving Energy Efficiency through Building Materials, Pakistan

Themes

★ Energy Efficiency
⁕ Linkages with other environmental goals
⁕ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDG 4-6)

PROJECT DATA

Project Name: Building and Construction Improvement Program
Implementing Organization: Aga Khan Foundation – Pakistan (NGO)
Project Location: Nathiagali and Gilgit areas, northern Pakistan
SGP Contribution: $50,000
Start Date: April 2002

ENERGY OVERVIEW

Energy Resource: biomass
Technology: roof hatch window, fuel efficient stove, water warming facility
Application: cooking, heating
Sector: residential, commercial (construction sector)
Cost of technology: $17-31 (roof hatch window); $10-$19 (fuel efficient stove); $33 (water-warming facility)
Number Served: 62 entrepreneurs trained to produce BACIP products; 7 businesses established to sell BACIP products; 135 promotional models installed; activities in 13 villages

BACKGROUND

The area targeted by this project includes Northern Areas, Chitral and Nathiagali region of the high mountain ranges of Hindukush,Karakoram and Himalayas of Northern Pakistan.The target area is spread over 74,000 square kilometers with a total population of about 1 million.The region experiences very cold winters, with temperatures falling to –30 °C. Biomass is the primary source of energy. Women and children spend significant periods of time searching for fuel wood and other biomass for cooking and heating, which places immense pressure on local ecosystems.Heavy biomass use also generates smoke, leading to poor indoor air quality and related health problems. Traditional houses in these areas are dark, smoky, unventilated and damp. They also have poor storage and sanitation facilities. Much energy could be saved, and livelihoods greatly improved, through the improved use of space and different building and cooking techniques.The Building and Construction Improvement Programme (BACIP), a project of the Aga Khan Housing Board in Pakistan, has been conducting applied research since 1997 on improved products and building techniques to address these problems.The challenge remains, however, to make these products accessible to local residents and integrate them into local patterns of life.

PROJECT DESCRIPTION

Overview

The goal of the SGP-BACIP collaboration was to introduce specific, energy-efficient products into communities in the Nathiagali and Gilgit areas of northern Pakistan. By installing demonstration models and training local entrepreneurs to produce these products, BACIP seeks to initiate wide replication of these products in a self-sustaining manner. In particular, BACIP does not subsidize the cost of any of its products, and instead seeks to integrate these products into local economies and develop credit mechanisms to help users overcome initial purchase costs.

Implementation

The BACIP Program of the Aga Khan Foundation has conducted extensive research and developed about 60 techniques for reducing energy use in cooking and heating homes. This research has been carried out with community participation in order to come up with usable techniques and solutions; some products have gone through as many as 7 variations between the first and final prototypes.Training modules and construction manuals have been developed for each product or technique.

The SGP grant mainly supports the dissemination of three specific products: the roof-hatch window (RHW), fuel-efficient stoves (FEW) and a water-warming facility (WWF), which is connected to the stove. In addition,the project promotes thermal wall insulation, roof and floor treatment for thermal efficiency and also timber free house construction techniques for rural houses. To disseminate products in a village, BACIP staff work with existing village institutions, including women's organizations. Two resource persons from the village are nominated to coordinate project activities there. Then, BACIP identifies a few households in which to install models of these products; only these models are fully paid for by BACIP.These households are selected for their ability to promote the products. BACIP also helps organize complementary awareness-raising activities, including a road show of various building techniques. At the same time, local entrepreneurs are trained in how to produce these products, and in basic business management. BACIP works with these entrepreneurs in supplying needed materials and ensuring product quality.

BACIP also works with other development agencies, some of which are also active in the Gilgit and Nathiagali areas. One challenge facing BACIP is the fact that other agencies introducing the products are providing subsidies, while BACIP itself has decided against this approach. This may be slowing the dissemination of products by BACIP; some community members have reportedly held off on purchasing a product in the hope of obtaining it for less elsewhere. Nonetheless, together, all the agencies' efforts, including those of SGP-funded BACIP, have resulted in 819 BACIP products installed or replicated in the project area, and over 2,500 products manufactured or sold by entrepreneurs both inside and outside the project area.

Technology

The technologies supported by the SGP project include:

- Fuel efficient stoves (FEW), which include a water-warming facility (WWF) that can be used while cooking (reduces 50% energy needs)
- Roof hatch windows (RHW), which allow more sunlight in the home but reduce heat loss
- Light roofs and efficient construction techniques which use 60% less timber in construction, and due to their thermal efficiency reduce up to 65% firewood needed to heat homes in the winter. These techniques also help reduce hazard risks during earthquakes.
- Insulation and other thermally-efficient housing construction techniques which reduce energy use by up to 70%
- Roof treatment techniques and the introduction of stabilized mud blocks to improve the thermal efficiency of houses in rural mountain environments

Technical descriptions of three techniques – the wire-mesh knotting equipment, galvanized wire-mesh wall reinforcement, and the house planning tool – are available at the following website: http://www.icimod.org.np/focus/risks_hazards/bacip1.htm

Environmental Benefits

Global: The reduced use of biomass energy decreases carbon dioxide emissions that contribute to climate change. The project evaluation estimates that the use of fuel-efficient stoves with water-warming facilities in 2,500 households (the current estimate of project impact), would reduce fuel wood consumption by 862,500 kg per month. This is equivalent to 10 tons of fuel wood per year, and 30 tons of carbon emissions avoided over a six-year product life.

Local: Although no studies of this impact are available, the reduced collection of fuel wood and other biomass should lessen pressure on local forest ecosystems.

Local Livelihood Benefits

Health: Reduced use of biomass in the home for cooking and heating improves air quality and lessens the risk of eye and respiratory problems, especially for women and children. Homes are warmer in the winter and overall have better temperature control. The BACIP project evaluation indicates a 50% reduction in illnesses (a 4.3% illness rate in homes with BACIP interventions compared to a 9% illness rate in non-BACIP households).

Reduced drudgery: Women and childrens' workloads are lessened by reducing the amount of firewood that must be collected for cooking and heating.

Income generation: The project has increased employment opportunities in the construction sector. Some entrepreneurs have been able to start their own businesses selling BACIP products; for some, selling BACIP stoves is their sole source of income.

Increased savings: In Gilgit, 42% of the people buy firewood, and 58% collect it for free. Those who purchase wood and now use the fuel-efficient stove and water warmer save about $0.70 per day on firewood (1 kg costs approximately $0.06). In Nathiagali, wood is about half the price and only 20% of households purchase it, so savings are lower.

Capacity Development

Since the project trains local artisans, the major emphasis of the project is on capacity building. Technical training components are highly developed due to BACIP's detailed training modules and instruction manuals for each product or technique. Entrepreneurs are also trained in basic business management, although this training appears to be less detailed. Many entrepreneurs already have their own businesses, and are simply integrating BACIP products into their work.

Partners

The Aga Khan Housing Board in Pakistan, which has implemented the project, is partnering with SGP in its efforts to initiate and spread the use of these innovations. BACIP also works with other development agencies in this area, including the World Wide Fund for Nature-Pakistan (WWF-P) and the Natural Resource Conservation Project. It appears that coordination of efforts is fairly good, except in the approach to subsidies. BACIP does not provide them, while the others do, which may undercut somewhat BACIP's efforts to create markets for these interventions. A key partner for the future will be the First Micro Finance Bank (FMFB), which with BACIP is planning a credit scheme to enable households to purchase equipment upfront and pay back loans over time using savings in fuel costs.

LESSONS LEARNED

Environmental Management

The project takes a comprehensive approach to integrating natural resource management with the built environment in this remote region. While introducing renewable energy technologies would also reduce carbon dioxide emissions and alleviate reliance on traditional biomass energy sources, the energy efficiency interventions promoted through this project may indeed have an equal or even greater impact on carbon dioxide emissions and livelihood improvements. One advantage this project has is that it uses local materials and relies on local artisans who are already involved in housing construction; therefore, they may be able to easily integrate these techniques into their work. This is in contrast to some renewable energy projects, which require the introduction of completely new technologies for which technicians must be trained from scratch and spare parts must somehow be obtained. An efficiency approach using existing energy sources may be just as valuable as introducing renewable energy technologies. Greater study may be necessary as to the conditions under which one may be preferable over the other.

Barrier Removal

Technical: BACIP has documented its research very well, and

developed significant written materials that describe its products,their construction and installation.The BACIP-SGP collaboration reduces technical barriers to energy efficient housing and cooking products by training entrepreneurs to produce them. One key to success appears to be a willingness to adapt and re-adapt the products, tailoring them to each setting. For example, through this project it became apparent that the stove model used in Gilgit did not work well at all in Nathiagali, which is a more remote and colder region.In fact,introduction of the Gilgit model there actually resulted in increased fuel wood use. BACIP had to work with local Nathiagali entrepreneurs and households to specially adapt the stove to local conditions;the new model introduced in November 2002 appears to work much better.

Institutional: Institutional barriers are being addressed,since the program does involve local village structures and organizations in disseminating the products. However, BACIP is still working to establish the institutions necessary for a flexible, decentralized market-based mechanism for product dissemination. Currently, BACIP is quite centralized in how it handles supply procurement, manufacturing and promotion. Trading networks need to be established to ensure that local entrepreneurs can access the supplies they need; BACIP plans to establish regional centers to work with local entrepreneurs in marketing and distribution. BACIP intends its role to evolve into that of a facilitator, with its primary concern being the maintenance of product quality. In many ways, BACIP's approach is similar to that of ADESOL in the Dominican Republic, an SGP-supported project that has built a network of small enterprises that sell solar panels. Based on ADESOL's experience, developing a decentralized network of small enterprises can be very effective (ADESOL has reached over 5,000 households), but ADESOL still plays a critical role in assuring product quality and conducting random accounting audits.

Financial: The project does not provide funding to residents to finance the implementation of these new techniques.Residents must make these improvements themselves, using their own finances and labor. Some products require a coordinated purchase involving a number of potential users, and in these cases local NGOs are helping facilitate this. BACIP is also developing a new partnership with a micro-finance institution, which will help overcome financial barriers as well.Again,the comparison with ADESOL in the Dominican Republic is interesting.Instead of developing a relationship with a separate micro-finance institution, ADESOL established its own revolving loan fund to which all of its enterprises have access.

Scaling Up

Ensuring the widespread use of these efficient cooking and housing innovations is the ultimate goal of this project. So far, the producers have already been trained in constructing new materials, and they are beginning to integrate these new products into their regular production patterns. Demand for these products and services is expected to increase as a result of the awareness-raising efforts undertaken by BACIP. The project evaluation recommends that BACIP focus more on particular products rather than pursuing many different products and techniques at the same time. BACIP has developed a 5-year marketing plan, and it will take some more time to determine the degree to which success has been achieved.

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Micro Hydro Power and Watershed Protection, The Philippines

Themes

★ Renewable energy
✲ Linkages with other environmental goals
❖ Technical capacity development
❖ Institutional capacity development
❖ Awareness,culture and practices
✷ Poverty alleviation (MDG 1)
✷ Education (MDG 2)
✷ Gender equity and empowerment (MDG 3)

PROJECT DATA

Name: Community based watershed management and water resource utilization for hydro power
Implementing organizations: Yamog Renewable Energy Development Group, Inc. (NGO), and the Polocón Farmers Association (CBO)
Location: Polocón, outskirts of Davao City, Philippines
SGP Contribution: $44,914.00
Start Date: September 1998

ENERGY OVERVIEW

Energy resource: water power
Technology: micro hydro
Application: lighting, information access, entertainment, hulling and milling, battery-charging
Sector: Residential, public spaces (related to education), and income generation (agro-processing and battery charging)
Size of micro-hydro system: 15kW
Per person energy tariff: 2 PHP ($0.04) per watt per day; average household use of 40W costs approximately $1.50 per day for lighting, and more to have a television or cassette player.
Households Served: 110

BACKGROUND

Polocón is a small farming community of around 100 households located in the southernmost part of the Philippines. Polocón, and other communities like it, were established in the 1960s and 70s when logging companies opened roads and began deforesting this tropical region. Today, the original forest is nearly gone, and instead the area is covered with secondary forest and farmland.Although it is technically part of the country's third-largest metropolis, Davao City, the city's electric grid ends 20 kilometers away, and there is little hope for its extension in coming years. Prior to the project, only a few families in Polocón had access to electricity via a shared diesel generator. Others used car batteries to power radios, but had to lug them 20 kilometers on the "jeepney," the only available public transportation,to the nearest battery charging post.The closest telephone is also 20 kilometers away. The circumstances in surrounding settlements are similar; about half of the rural communities on the island of Mindanao lack electricity. Overall, in the Philippines, about 1.5 million people do not have access to electricity.

PROJECT DESCRIPTION

Overview

The main goal of this project was to reduce technical, institutional, and informational barriers to the implementation of community-managed micro hydro schemes. This project demonstrates the significant environmental and livelihood benefits associated with the establishment of community-based renewable energy projects in this area.

Implementation

The community was integrally involved in the design, building, operation and maintenance of the 15kW micro hydro system in Polocón.The community gained the capacity to manage the micro hydro plant and has integrated it into the overall development of the community by channeling funds from milling and battery charging services into the local school and other community needs. Restoring and protecting the watershed is also incorporated into the project, since without the 70-hectare watershed, the river's flow would decrease and the micro hydro plant would not work.

Environmental Benefits

Global: 110 households, as well as most public spaces, have electricity without any carbon dioxide emissions.The old diesel generator and kerosene for indoor lighting are no longer used, and batteries no longer need to be charged via fossil fuel powered electricity. In addition, people in neighboring villages can now recharge their batteries and grind their corn using renewable instead of fossil fuel power. Finally, conserving the watershed helps store carbon in the newly growing forest there.

Local: Conserving the watershed helps maintain a good water supply for Polocón and the communities downstream. Local pastures and farmland have been reforested with native species and fruit trees, helping restore the local ecosystem following decades of government reforestation with exotic species.The community has re-planted 25 of the 70 hectares in the watershed region. The community has institutionalized watershed protection, requiring each elementary school student to plant and care for 10 trees in order to graduate. Project leaders are coordinating with the Department of the Environment and Natural Resources to reforest the areas more distant from Polocón.

Local livelihood benefits

Health: 110 households now have electricity, replacing kerosene lamps.This reduces the risk of respiratory and eye problems.

Poverty alleviation: The micro hydro plant has helped alleviate poverty in many ways.First,the corn mill powered by the plant allows Polocón residents to grind their corn (a major crop in the region) for less money.They can also sell grinding services to people from neighboring communities. The coffee hulling

machine and the battery charging post similarly reduce costs for these activities for residents and generate income from selling these services to neighboring communities. Since a community-based power cooperative owns and operates the plant, its revenues are invested in community projects that help improve life in Polocón. Tariffs for corn milling and other uses are set at a level to cover maintenance costs, the salaries of the couple that operates the plant, and a set-aside for community development projects. Funds have already been invested in the local school, and other planned projects include a bakery run by a women's group that runs a community store and was instrumental in initiating the hydroelectric project.

Education: The local elementary school, which used to get dark in the afternoons, now has lights. Students can study in the evenings using lights at home. The school has benefited from funds raised through the sale of grinding and hulling services at the hydropower plant. Environmental education is incorporated into the curriculum by involving students in watershed protection efforts.

Reduced drudgery: Residents of Polocón, as well as neighboring communities, no longer face 20-kilometer journeys to the battery charging station, or 12-kilometer journeys to a corn mill. Women's work at home is easier since the homes have better lighting.

Improved local opportunities: Life has changed in Polocón since the lights went on; as the treasurer of the hydropower plant cooperative put it, "It is very bright." In addition to improved educational and economic conditions and opportunities,community life has blossomed. The town can have Christmas lights at Christmas, and social events in the evenings.Finally, the town also has far better access to information via television and radio, helping townspeople keep abreast of local, national and international events. TV shows related to agricultural technology help Polocón's farmers learn about the latest farming methods. All of this makes life in Polocón a bit more attractive to young people, helping to stem rural to urban migration. "Now we feel we are in the city," says the cooperative's bookkeeper.

National livelihood benefits

A model for rural electrification: Rural electrification is a priority for the government; on Mindanao alone about half of rural communities have no electricity. However, government programs have made little progress toward changing this. Projects like the one in Polocón help demonstrate the possibility and the benefits of renewably powered electricity, particularly hydropower. As described below, the project collaborated with several government agencies, which may help to spread awareness in the government of the possibilities. In fact, the successes in Polocón achieved national recognition when it was awarded a prize from the Society for the Advancement of Technology Management in the Philippines for the "Most Innovative New and Renewable Energy System" in August of 2000.

Capacity Development

Capacity building played a central role in this project. The community received training in the following areas:

Technical: Designing, building and maintaining the hydroelectric plant

Institutional: Managing the plant, including setting fees for services, good book-keeping practices and financial management, and choosing and managing new income generating efforts using hydropower

Environmental management: All aspects of restoring the watershed, including planting and caring for saplings, and developing and running a nursery

Beneficiaries

The main beneficiaries are the residents of Polocón.Secondary beneficiaries are residents of surrounding communities who can now access milling, hulling and battery charging services locally for a lower price than before. Further beneficiaries are all those who depend upon this watershed for their water supply;the restoration efforts will help maintain water quality over time.

Partners

The Yamog Renewable Energy Group, the NGO receiving the SGP grant, built exceptionally strong partnerships with the local community as well as with relevant government agencies and a diverse set of funders.

Community: The Polocón People's Power Cooperative owns and operates the hydropower plant,and was formed by members of the local farmer's association and the Polocón Women's Group. However, the entire community of Polocón took ownership of the project during its design and construction. Each family spent an estimated 13 weeks working on the construction,which involved arduous tasks such as burying hundreds of meters of pipe, hauling bags of gravel, sand and cement up muddy slopes, and even hauling the generator for three kilometers.

Government: Yamog linked with Davao City's Environment and Natural Resources Office (CENRO), which provided seedlings and expertise in tree planting. A federal agency, the Department of the Environment and Natural Resources, is involved in reforestation in areas of the watershed far from Polocón.

Funders: In addition to support from SGP, Yamog found funding from two North American foundations, Green Empowerment and EnerGreen, to install an electrical load controller to facilitate corn milling. UNDP connections put Yamog in touch with the Japanese embassy, which contributed funds for the corn mill itself.

LESSONS LEARNED

Environmental Management

This project has successfully linked watershed protection to basic energy services.When possible, this can be a very effective way to motivate conservation efforts; the preservation of the forest area is essential to maintaining access to electricity. Also, maintenance of the watershed helps maintain water qual-

ity. However, the community cannot fully protect the 70-hectare watershed on its own. It needs government collaboration and assistance to reforest areas far away from the community but critical for their maintaining their water flow. Yamog was able to help the community make links with key government agencies to achieve this goal. This is one of the key roles that NGOs can play to help facilitate effective environmental protection.

Barrier removal

Technical: Very extensive community involvement and capacity building efforts have built up technical understanding among local inhabitants about the construction, operation and maintenance of micro hydro plants. The people of Polocón can now manage the plant on their own.

Institutional: The Polocón micro hydropower plant is exceptionally well integrated into the Polocón community. The community has committed to long-term efforts to preserve the watershed to maintain their power source, and the benefits of productive activities powered by the plant are returned to the community. Some keys elements of Yamog's strategy to achieve this are:

Building a broad sense of community ownership through community participation, beginning even before the project was conceptualized. The entire community played a role in building the plant, investing considerable amounts of time and effort. This appears to have been critical for sustaining community involvement over the long term, which is especially important for watershed preservation efforts.

Allowing sufficient time for integrating the community into project development. The project leader, Nazario Cacayan of Yamog emphasized this, saying "It's a really long process to enhance the community's capacity to manage a project like this."

Encouraging the community infrastructure necessary to manage the power plant to emerge from existing community groups. In this case, the Polocón People's Power Cooperative was formed by joining the local farmer's association with the local women's group. Without the power cooperative's integration into the community, the cooperative would not be setting aside funds for community development.

Financial: Polocón has established a tariff structure not only to pay for continued maintenance of the plant, but also to fund other productive uses of micro-hydro power. Fees for corn milling and other services include a set-aside fund for community development. Ideas include a cacao bean sheller and a women-run bakery. However, most of the up-front cash costs of this project were funded by grants, while the community itself contributed all the labor.

Informational: In order for the community to even consider undertaking this project, Yamog had to educate them about micro hydropower and its connection to the preservation of the watershed. This initial education was institutionalized in the community by integrating some environmental education into school programs, ensuring that students all learn why it is important to preserve the watershed.

Scaling Up

The above discussion about technical, institutional, financial and informational barrier removal applies only to Polocón itself. As this is a demonstration project, it should be expected to help remove these barriers for other similar communities.

A critical barrier to overcome when scaling up is the financial one: how are the up-front costs for construction to be paid? As mentioned before, most of the up-front costs for equipment in this project were funded by grants. Yamog has begun similar projects in two other communities – Megkawayan and Saloy – and has completed feasibility studies for several others. However, it appears that these projects also depend upon grants for the purchase of equipment. The director of Yamog suggests that one way to address these financial barriers is to connect micro hydro power strongly to income generation, for example by using it to power ice-making. Loans could be taken out against this future income. However, sufficient credit market must exist for this to be possible.

The effectiveness of a demonstration project also depends critically upon sufficient information-sharing about how the project was carried out and lessons learned in the process. There are several key ways in which scaling up may occur, including:

Learning on the part of government agencies involved as partners. The Polocón project involved both local and federal government agencies, which may be encouraged by this experience to provide additional funding or other resources on a broad scale for projects similar to that carried out in Polocón. The director of Yamog notes that the local government's interest in micro hydro has increased since its involvement with the project. In April 2001, the Department of Energy in the Philippines, with the support of USAID, has produced a guide for communities seeking to establish small-scale power cooperatives. However, the production of this guide cannot be specifically linked to the success of the Polocón project.

Specific efforts by the people of Polocón to provide technical assistance to other communities seeking to establish similar projects. Polocón residents, especially the couple that runs the power plant, can provide valuable assistance to neighboring communities. Yamog is in the process of organizing a group of trainers from Polocón and other communities with experience in micro hydro to help other communities through the process.

Media coverage of the project. The project won an award for excellence from the Society for the Advancement of Technology Management in 2000. This may have generated media coverage, but no specific information is available to gauge this.

Gender Aspects

The Polocón Women's Group played a key role in the community's experience with micro hydro development. The women's group helped initiate the effort, and helped form the

basis of the power cooperative itself, in conjunction with the farmer's association. Three members of the cooperative's board are women. It seems that one way to facilitate women's leadership and involvement in energy projects is to involve existing women's organizations in the development of the project so their leadership stems naturally from existing local institutions.

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Solar Energy for Battery Charging, Batanes, Philippines

Themes

★ Renewable energy
✲ Technical capacity development

PROJECT DATA

Name: Batanes Alternative Energy and Enhancement Project
Implementing organization: Batanes Development Foundation, Inc. (NGO)
Location: Batanes Islands, Philippines
SGP contribution: $42,183
Start Date: July 1995

ENERGY OVERVIEW

Energy resource: solar photovoltaic
Technology: battery charging station,solar refrigeration
Application: battery charging for household use, refrigeration of fish
Sector: domestic, commercial
Cost of equipment: approx. $31,000 total for battery charging station
Capacity: 900Wp capacity for battery charging station; unknown for cold fish storage
Number of People Served: 50 households using battery charging station,unknown number for two cold storage units for fish

BACKGROUND

The Batanes Islands form the northernmost province of the Philippines.These three islands experience rough seas and frequent typhoons, making transportation to and from the mainland unpredictable. Currently, diesel generators produce electricity on the island, but they only provide power between 8am and midnight in the capital city. Other areas are not connected to any electric grid and must use batteries.Access to power has limited economic growth possibilities in the islands,whose population includes the indigenous Ivatan people. The high cost of power generation and grid extension as well as the isolation of the Batanes islands make renewable energy a competitive option.

PROJECT DESCRIPTION

Overview

This project installed a community solar battery charging (CSBC) station on one island, and a solar generator for cold storage on another island.The project encouraged community management of decentralized renewable energy sources.The solar powered cold storage systems,used to store fish for sale, were also linked to expanded opportunities for income generation through the establishment of a local fish market at the site of the cold storage equipment.

Implementation

The grantee was the Batanes Development Foundation, Inc. (BDFI), one of the main NGOs on the islands. BDFI worked with two barangays (communities): Raele on the island of Itbayat, and Sumnanga on the island of Sabtang. Solar Electric, Inc., installed the equipment and provided technical assistance to train community members in maintenance and proper use. The battery charging station was implemented in Raele, and the cold storage units in Sumnanga. In the former community, the Raele Power Users Association was formed to manage the 15-outlet battery charging station.The cold fish storage units in Sumnanga were accompanied by efforts to expand the fish market in the area.However, SGP reports indicate that internal problems existed in the community organizations involved in the project.Also, the cold storage units were a very new technology in the Philippines at the time, and there are indications that more testing was necessary to determine optimum conditions for ice production. However, since this project was implemented in 1995,Batanes government officials,in particular representative Florencio Abad, have promoted renewable energy on the islands. Currently, wind power capabilities are being developed to expand the availability of electricity on the islands.

Solar battery charging station for fish refrigeration and other community needs (Batanes, Philippines).

Environmental Benefits

Global: Instead of making use of batteries and kerosene for lighting, approximately 50 non-electrified households can recharge batteries using solar energy.This reduces their greenhouse gas emissions. In addition, solar energy, instead of diesel alternatives,is used to keep fish cold.

Livelihood Benefits

Income generation: The community in which cold storage units were installed benefited through increased possibilities for selling fish. Income generating applications were also developed in the Raele barangay in conjunction with the solar battery charging station, which is operated by a community group. However,

no details are available about the nature of these income-generating activities. It is not clear that community solar battery charging stations save households money over regular battery use. Batteries still must be purchased and replaced regularly. However, if residents previously traveled far to a grid-based charging station,the travel time and costs may be eliminated.

Technology

The solar battery charging station installed in Raele barangay is a 900Wp system with 15 charging outlets.Car batteries are the main type of battery charged in this system. According to Silverio Navarro of Solar Electric, Inc., solar battery charging in the Philippines is less expensive than charging batteries via grid-based electricity; grid-based charging costs $1.07/kWh plus transportation, while solar charging costs $0.97/kWh. According to an SGP-funded report by Sibol Ng Aghan at Teknolohiya (SIBAT), a renewable energy technology NGO in the Philippines, as of 1998 approximately 27 community solar battery charging stations had been installed in the Philippines, 13 of which were working in 1998 at the time of the study. These were mainly used in poor communities engaged in either upland farming or fishing in remote areas. However, evidence from SIBAT's study suggests that maintenance of the charging system and proper use are essential, as is regular battery replacement, if the system is to continue running effectively. Communities must therefore have easy access to replacement batteries, and must be educated about proper battery disposal. Provisions for this must be made up front when designing these systems. If the systems are community-owned and run, community organizations must be strong and have sufficient training and capacity for handling these issues.

Beneficiaries

The primary beneficiaries of this project are the residents of the two barangays, Raele and Sumnanga. Other beneficiaries include those now able to buy fish locally, or who may be benefiting from the new income-generating activities made possible by the battery charging station.

Capacity Development

The project built new community organizations at both sites.In Raele, the Raele Power Users Association was formed to manage the solar battery charging station.The Sumnanga Marine Resource Association manages the fish market and the cold storage units. Solar Electric, Inc., which installed the systems, trained community members to use them properly. However, SGP reports indicate there is still room for improvement in these organizations' capacities to maintain and trouble-shoot these systems. SGP reports also suggest that BDFI, the NGO grantee, should continue supporting these communities to try to resolve internal problems.

Partners

Partners for this project include BDFI and the two community organizations, Raele Power Users Association and Sumnanga Marine Resource Association. Solar Electric, Inc.,which installed the equipment and provided technical assistance, was another partner.The NGO brought management capacity, the communities brought human resources for continued maintenance of the systems, and Solar Electric, Inc. brought equipment and technical knowledge to the effort.

LESSONS LEARNED

Environmental Management

This project illustrates the possible use of community solar battery charging stations as an energy solution.These charging stations may be appropriate in tightly clustered communities that are far from the grid.In these cases,they are preferred to grid-based charging systems since they save transport time. In addition, overall costs are lower than installing solar panels on individual homes, although the level of energy service provided is also lower.

Barrier Removal

Information/Knowledge:This project may have removed some technical barriers to implementing renewable energy systems on the islands of Batanes. Solar Electric, Inc., has been involved in energy services there beyond this project, and presented its work in Batanes at the 1998 Village Power conference at the World Bank in Washington, DC. In addition, government officials in Batanes have shown great interest in promoting renewables, both solar and wind, on the islands.This may or may not be due to the initiation of these projects. BDFI has since received government support for implementing renewable energy projects on the islands.

Scaling Up

It is not likely that these specific community efforts are being scaled up beyond these communities.The cold storage units appear to have required additional testing,and both communities may have encountered some problems in managing these systems. However, partnerships with Solar Electric, Inc., and BDFI may have helped open the possibility for government funding for renewables, which has apparently been quite substantial.

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Household-size Wind Turbines, Sri Lanka

Themes

★ Renewable energy
⁂ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Small wind energy systems for villages in Sri Lanka
Grantee: Manawa Sampath Saha Parisara Surakum Sanvidanaya (community group); Intermediate Technology Development Group-South Asia
Location: Hambantota district, southern province of Sri Lanka, with planned clusters in southern, eastern and north-western provinces
SGP Contribution: $10,378 (September 2000);$39,546.00 (September 2002)
Start Date: September 2000

ENERGY OVERVIEW

Energy Resource: wind
Technology: small wind system (single household units)
Application: battery charging, lighting
Sector: residential, public spaces (related to education), and income generation (agro-processing and battery charging)
Size of turbines: 250W
Per unit cost: $550, including a 1-year guarantee
Households Served: 6 (pilot phase)

BACKGROUND

Approximately 80% of Sri Lanka's population lives in rural areas.The population is widely distributed across about 25,000 villages with an average population of 500. Currently, about 55% of Sri Lankan households have access to electricity, mostly in the Western Province. The eight remaining provinces, which are predominantly rural, have much lower rates of electrification. In un-electrified villages, automobile batteries are often the primary source of power for radios and television sets.These must be transported over long distances to charging centers. Kerosene is used for lighting. Although Sri Lanka's annual grid extension rate is relatively high (around 3%), many remote villages will not receive electric power for many years to come. Wind conditions in Sri Lanka are variable, but the Hambantota district on the southwestern coast, where this project is located,offers good conditions for wind power, as do the eastern and north-western provinces. Under the right conditions, wind power offers good power output and quality compared to solar home systems.

PROJECT DESCRIPTION

Overview

This project seeks to demonstrate the potential for small wind systems to provide battery-charging services to rural areas in Sri Lanka, thereby improving local livelihoods. Technical and institutional barriers to the local production of small wind systems, as well as financial barriers to their purchase, are being addressed through this project.

Local manufacturers producing a small wind system, using local materials (Hambantota district,Sri Lanka).

Implementation

The grantee, ITDG-South Asia, has coordinated with other local NGOs, a local manufacturer, an engineering consultant in the United Kingdom, and local government entities. Project activities have included:assessing local wind conditions;studying the potential local market for small wind systems and estimating individual willingness to pay for the systems;and designing a small wind system that meets local needs and conditions and can be constructed using local materials. ITDG has estimated the willingness to pay in this region at Rs. 3000-5000 for an initial investment and Rs. 500 per month thereafter. However, to make the upfront investment villagers would need loans covering approximately 60% of the capital cost. ITDG estimates the size of the market to be over 60,000 households in un-electrified fishing villages.

Technology

The small wind system that has been designed for this potential market in Sri Lanka is approximately 12 meters tall, produces 250W at a rated wind speed of 8 meters per second, costs approximately $550, and should last about 20 years. ITDG hopes to bring the cost down to $400. It is designed to meet the energy needs of an individual household, powering compact fluorescent light bulbs, a radio, and/or a television. At peak wind times there is excess power that can be used to sell battery-charging services to others. This cost is comparable with, and slightly cheaper than, a solar home system in Sri Lanka, and current battery charging costs. A diesel generator-powered micro-grid is still cheaper, but would require community mobilization, whereas the wind power option is designed for individual ownership.

ITDG trained small manufacturers to produce this small wind system using local materials. In September 2002,SGP provided a second grant related to this effort to ITDG,which is working with local manufacturers to produce an additional 18 small-scale turbines. The manufacturers sell the systems to local entrepreneurs, who distribute them in three chosen pilot sites. GIDES, another local NGO, helped choose the pilot sites, and established a revolving credit scheme through several local self-help societies. GIDES serves as a link between local entrepreneurs who purchase the systems and the manufacturers.

Environmental Benefits

Global: Wind power is replacing kerosene use for lighting,which reduces greenhouse gas emissions. So far, 15 households have the wind systems.

Local: Small wind systems reduce air pollution from kerosene use, and do not impose any significant local environmental problems. Although large wind systems generate noise that drives away birds, these household-size wind systems do not generate such noise.

Local Livelihood Benefits

Health: Reduced use of kerosene improves indoor air quality, which greatly reduces the risk of respiratory and eye problems, especially for women and children.

Poverty alleviation: Families that have purchased the wind systems now sell battery-charging services to neighbors. In addition, the previous use of dry cell batteries for torches, necessary at night to avoid attacks from wild animals, has been decreased.These expensive disposable dry cell batteries are no longer necessary, because villagers can now use a rechargeable motorcycle battery attached to the end of the torch. In this way, villagers also save money as a result of the project.

Education: Due to better lighting at night, children can study in the evenings more effectively.

Reduced drudgery: Villagers used to travel over two hours to recharge automobile batteries. Now this is unnecessary, not only for those who have wind systems, but also for those living nearby who can now recharge their batteries locally.

Improved local opportunities: Improved access to energy has led to lifestyle changes in the villages. Now, families without wind turbines visit the homes of those with the turbines to watch television and listen to the radio at night.Thus, the project has improved the villagers'ability to obtain battery charging services and information locally, instead of traveling to the nearest town.

Safety: Elephants often cause damage to houses in rural areas. However, when lights are lit in the outskirts of a village, elephants are reluctant to go nearer to the houses.

National Benefits

New method of expanding electricity access:Sri Lanka now has access to a new way to expand access to electricity to its rural population. Small wind system technology did not previously exist in the country, but it has the potential to meet the needs of many rural villages. There have been discussions with the Renewable Energy Ministry to incorporate small wind systems into the government's rural electrification plan in future years.

Capacity Development

ITDG develops the capacity of four distinct groups that are directly involved with the wind systems.

- Users of the systems learn operation and maintenance.
- Technicians in the localities are also trained to service and repair the systems.
- Manufacturers are taught how to fabricate the wind systems.
- Technology designers learn new technologies and improvements to the existing systems. (These activities are not directly funded by SGP.)
- Training is continuing on a rotating basis. Six manufacturers were trained in 2001, of whom only two are active now. Another training course for manufacturers is planned for February 2004, and a training program for designers is scheduled for December 2003.

Partners

NGOs: ITDG provided the technical expertise for the project, including the participation of an engineer from the United Kingdom.GIDES,a local development NGO, helped make contacts in the villages and established a revolving credit scheme so that villagers can purchase the systems. A presentation about the project was made to a consortium of NGOs in the Hambantota district, which the project leaders hope will be involved in future commercial applications of the wind systems.

Government: The project has made connections with the 3MW wind project implemented by the Ceylon Electricity Board to share experiences.

Industry: The project is closely linked with several manufacturers who have been trained to build the small wind systems. Their participation was essential to ensure the local production of the technology.

Funders: Funding was received from SGP and the United Kingdom's Department for International Development, as well as local sources. Future funding is being sought from the Sri Lankan government.

LESSONS LEARNED

Environmental Management

The research on wind characteristics in Sri Lanka demonstrated the potential applicability of small-scale wind power, and market research has demonstrated the existence of sufficient willingness to pay for the system,if there is adequate access to credit.

Barrier Removal

Technical: The project has successfully reduced barriers to accessing wind power via small-scale systems in Sri Lanka. Key

elements of the project that contributed to this were their study of wind characteristics, which was carried out with the help of the Ceylon Electricity Board, the close study of local energy needs and willingness to pay, and the design of a wind system that is specially adapted to local conditions.The training and involvement of local manufacturers throughout the process was essential,since otherwise the project would not be sustainable or replicable.This training and information exchange process is still on-going. For example, ITDG has planned a workshop for November 2003 for the users of the wind systems to discuss their problems and exchange their experiences. All users of small wind systems, manufacturers, technicians and wind energy experts are to take part.This enables stakeholders to understand on-the-ground realities,and to develop ways to improve the equipment and services.

Financial: The project's use of revolving credit schemes helped reduce financial barriers to the purchase of the wind systems. The key step here was to involve GIDES,a development group with good local contacts in villages. GIDES was able to build credit resources using local institutions - the village self-help societies.

Institutional: A key institutional barrier was the link between manufacturers and the potential market. Again, GIDES played an important role here, finding local individuals who would be good local entrepreneurs to distribute the wind systems after purchasing them from the manufacturers.

Scaling Up

Several elements of ITDG's strategy were key to facilitating the scaling up of the project:

- *Good relationships with government entities:*. ITDG worked with the Ministry of Power and Energy, the Ceylon Electricity Board,and local government entities.As a result,the Ministry of Power and Energy can help integrate the wind systems into the government's rural electrification plans, and the Ceylon Electricity Board could use its resources and technical capacity to study wind characteristics to get a sense of the possible areas in which small scale wind systems would be viable.
- *Training local manufacturers:* This key element of the project enables the expansion of the project through the market. In order to convince manufacturers to be involved, however, studies of potential market size, including willingness to pay, are critical. In addition, links to customers, as provides by GIDES, are often necessary to help establish the market.
- *Publicity:* The government broadcasting service interviewed a local beneficiary of the project,thereby helping to spread the word about small-scale wind systems in the South Province of Sri Lanka. Such publicity efforts go hand-in-hand with efforts to establish local production capacity and increase potential buyers.
- *Demonstration of the units:* The potential for use of small wind systems is not known by all communities. In addition to the awareness creation programs, demonstration units are vital to scaling up. ITDG has taken steps to develop visuals describing the technology and applications of the wind systems suitable for demonstration purposes.In addition, ITDG has developed a manual and poster for the users of wind systems on operation and maintenance aspects.

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Rice Paddy Husk as an Alternative Fuel for Bakeries, Sri Lanka

Themes

★ Renewable energy
⁜ Linkages with other environmental goals
⁜ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Introduction of paddy husk as an alternative to firewood for the operation of bakeries
Implementing organization: Integrated Development Association, IDEA (NGO)
Location: Polonnaruwa district, Sri Lanka
SGP contribution: $7,497
Start date: September 2000

ENERGY OVERVIEW

Energy resource: biomass (rice paddy husk)
Technology: paddy husk oven
Application: baking bread
Sector: commercial
Cost of oven: $570
Cost of fuel: approximately $2.50/month in electricity;paddy husk currently free
Number served: 5 bakeries through SGP project; 15 additional bakeries through a second phase

BACKGROUND

More than 90% of Sri Lanka's bakeries use firewood to fuel their ovens, accounting for 9% of total biomass fuel used in the country as of 1995.A medium-sized bakery uses about 3 cubic feet of firewood per day; a single medium-sized free provides about 4 cubic feet. Some firewood is taken illegally from protected forests. Only 23% of Sri Lanka's forest cover remains. However, rice mills regularly discard paddy husk, dumping it along roadsides and stream banks.Due to its high silica content, paddy husk takes a long time to decompose, so the "mountains" of paddy husk are eventually burned, which releases carbon dioxide as well as lightweight ash. Paddy husk also attracts wild elephants, which sometimes cause property damage.

PROJECT DESCRIPTION

Overview

This project tested the use of a converted bakery oven that burns rice paddy husk instead of fuel wood, thereby reducing impacts on forests and alleviating the problem of paddy husk accumulation.Since the converted oven also costs less to operate, it can increase income to bakers.

Implementation

The National Engineering Research and Development Centre of the Ministry of Science and Technology had conducted a pilot study on the possibility of converting bakery ovens to use paddy husk as fuel, but had encountered problems in maintaining a minimum temperature due to the lightweight nature of paddy husk. However, a Sri Lankan baker had developed such an oven, testing and perfecting it over a period of five years. The implementing agency, IDEA, learned of this and received his permission to disseminate the invention even though Mr. Divulgane had obtained patent rights to its use. Prior to implementation, IDEA conducted a baseline study in the Polonnaruwa district, determining the number and size of bakeries and rice mills, bakers' income levels, firewood use and paddy husk discharge rates. A workshop was organized to advertise the new oven, which was well received.Five bakeries were selected as test sites for the oven.The oven uses a small amount of electricity to operate a huller, which breaks up the paddy husk, and a blower that sends the husk into the combustion chamber.When electricity is not working a hand-tractor can be used to power the huller and blower manually.

Motor for improved bakery oven using rice paddy husk as fuel (Sri Lanka).

Previously, bakeries were spending about $4 per day to purchase 3 cubic feet of firewood. The new oven costs about $2.50 per month in electricity costs to operate, and paddy husk is currently available for free from rice mills; at most, transportation costs must be paid and these amount to about $0.20/day. However, an up-front investment of about $570 is necessary to purchase the oven. During the pilot project, the cost of ovens was split equally between the bakery owner and IDEA.

A few difficulties arose during the pilot project, but all were successfully addressed. For example, one bakery received complaints from a neighbor about ash emitted from the oven's chimney landing on his property. The problem was solved by

raising the height of the chimney to 18 feet, which ensures that the ash settles back into the fire chamber. The ash is then expelled from the chamber into a collection area. A productive use has been found for the ash – the "black ash" can be used as a fertilizer in paddy farming, and the "white ash" in banana and other vegetable cultivation. The higher chimneys also ensure that the smoke rises high enough into the air not to cause local problems.

Following the initial installations in 5 bakeries, the grantee undertook a second project phase through which 15 additional bakeries were fitted with stoves. Four bakeries are from the Polonnaruwa District, the original project site, and 11 are from the Anuradhapura District. So far, all 15 new stoves are functioning properly.

Environmental Benefits:

Global: The ovens substitute discarded paddy husk for fuel wood. Each oven in the pilot project now no longer uses 3 cubic feet of firewood per day as before. Together, the five bakeries in the pilot project therefore save 15 cubic feet (almost 4 trees) of fuel wood every day. With at least 15 additional bakeries converted, more trees will be saved. Discarded paddy husk, if it decomposes, produces methane, which is a worse greenhouse gas than carbon dioxide produced by burning it. There is a positive net effect to the environment.

Local: The use of paddy husk by bakeries avoids the local environmental problems produced by discarded paddy husk decomposing in public places. In addition, the project benefits local forest ecosystems which otherwise might be felled for firewood. Finally, measures have been taken to minimize local environmental impacts of the ash and smoke. However, it is not known if raising the chimneys has simply transferred smoke problems to other places. .

Local Livelihood Benefits:

Poverty alleviation: Use of the ovens substantially reduces expenditures on fuel to produce bread. While the equipment requires about $570 up front, the cost of firewood (about $4 per day) is avoided. The electricity costs of running the huller and blower to send paddy husk into the oven is quite low, only about $2.30 per month. Currently, the paddy husk is provided for free by rice mills. Thus, the savings are substantial. The project's baseline study collected information about bakers' income levels. About 45% have a monthly income of approximately $140, while the remaining 55% make less than this, with some making less than $60 per month. During the pilot project, IDEA covered 50% of the investment cost and the bakers assumed the other 50%. During the project expansion to 15 additional bakeries, bakers assumed 90% of the cost of the converted oven, while IDEA covered the remaining 10%.

National Benefits

Each bakery that switches to paddy ash as a fuel saves about one medium-sized tree per day. If scaled up, this project offers Sri Lanka one good way impact on its forests.

Capacity Development

The project organized a workshop for 50 bakers in the region to educate them about the stove, but only 5 of these were selected for the pilot project. These five received training in how to operate the oven. The inventor, himself, was involved in training bakers how to operate and maintain the ovens.

Partners

In addition to IDEA, bakeries are the most important partners. They have covered half the cost of installing the converted ovens and, following an assessment of the project, are now covering 90% of the costs in the project expansion phase. SGP is a key player, having provided the funds to support the effort, and the National Steering Committee has been involved in monitoring results. Finally, government officials have agreed to help spread word about the ovens to other districts.

LESSONS LEARNED

Environmental Management

The project illustrates one way in which biomass waste products can be substituted for firewood, thereby decreasing net carbon dioxide emissions. A key element of the approach taken by this project is its use of a baseline study. This provides critical information for targeting the project to the right areas, and has been used in assessing possibilities for scaling up the project.

The SGP national coordinator has noted the importance of starting with a small number of bakeries in the pilot project, due to the need to pay close attention to every detail and problem that arose in the process, and also suggested that an assessment be conducted of the extent to which the project has achieved increased awareness of climate change and biodiversity.

Barrier Removal

Technical: The project is built around a local invention, which now may be widely implemented in rice-producing regions of the country thanks to the successful pilot project. Partnership with the inventor has broken the technical barriers of using a patented product for a common purpose rather than the individual inventor's personal benefit.

Financial: This demonstration project's approach was to split investment costs between the NGO and the users. At an initial stage of technology introduction, such an approach may be well justified since it reduces the risk to the bakers but they still have some incentive, having invested some funds, in making the best use of the oven. This co-financing of equipment during the pilot phase was made more valuable by the IDEA's collection of baseline data, which made assessing impacts and benefits much more possible. It is a very good sign that in the expansion to 15 additional bakeries, the bakers took on a higher percentage of the costs (90%). Apparently, even though the monthly income of bakers is substantially less than the initial investment cost most bakers have access to capital for the up front payment, either via savings or bank loans.

Informational

The project addresses informational barriers on two levels:

- ***Increased awareness on the part of local bakers of the benefits of the converted paddy husk-powered oven.*** This was achieved via the initial workshop and visit to the inventor's bakery. 94% of the 50 workshop participants wanted to try the ovens. This workshop allowed IDEA to accomplish two things at one time: identify good candidates for the pilot project, and raise overall awareness about the ovens so that should the project be scaled up there would be some level of demand already.
- ***Helped facilitate access to patented information about the oven.*** The inventor agreed to allow IDEA to conduct the pilot project without charging for patent rights he had already obtained, in IDEA's words "as a service to the nation." Therefore, IDEA as the implementing NGO may have played a key role in making this happen,since possibly otherwise the inventor would not have foregone returns on his patent rights. Perhaps IDEA's willingness to conduct a well-organized pilot project, to help ensure success, convinced the inventor give out his patented information freely.

Scaling Up

This project illustrates several good practices in planning for scaling up. They include:

- ***Conducting a baseline study.*** This is essential to gaining good data on project results later on. Collection of some baseline data should be incorporated into most kinds of projects, but especially those that seek to demonstrate the benefits of a new technology or process.This project collected baseline information about the number and size of bakeries and rice mills, the income levels of bakers, the amount of firewood currently used, and the amount of paddy husk produced.All of this information was critical to implementing the project and to estimating size of the potential market for the ovens. It is also essential for evaluating the project's environmental and livelihood impacts.
- ***Conducting an evaluation and assessment.*** The project conducted a second workshop, including bakers, the SGP National Steering Committee, and government officials, to evaluate results and assess the potential for scaling up the project. The involvement of all key stakeholders in such a meeting is essential so that good decisions can be made about expansion.A decision was made to expand, including to another district.

One issue that will have to be assessed if the project is scaled up even further is the potential cost of paddy husk.Apparently, during the pilot project rice mill owners have offered paddy husk for free, only charging a minimal fee for delivery, if that. However, if large numbers of bakeries begin using paddy husk it seems unlikely that the rice mills would continue offering this husk for free. The possible price of paddy husk, therefore, should be considered in assessing the viability of implementing this project on a large scale, as well as the need for credit mechanisms for the purchase of the oven.

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Building a Market for Efficient Cookstoves, Thailand

Themes

★ Energy efficiency
⛭ Linkages with other environmental goals
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Awareness, culture and practices
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: High Energy Efficiency and the Promotion of Sustainable Agriculture
Implementing Organization: Institute for Sustainable Agriculture Development (NGO)
Location: Thailand, Sunsai District, Chiangmai Province
SGP Contribution: $7,234.00 (Phase 1), $11,656 (Phase 2)
Start Date: March 2000 (Phase 1), December 2002 (Phase 2)

ENERGY OVERVIEW

Energy Resource: fuel wood
Technology: efficient clay stoves, kilns from steel drums
Application: cooking
Sector: residential,commercial
Cost of stove: $3.20 each
Households Served: 50 initially, now selling 400 stoves per month

BACKGROUND

Cooking in the Sunsai district of northern Thailand is done using firewood. Charcoal is also produced in the region from wood in local forests.In the Tambol Mae Tha area, encompassing seven villages, firewood is becoming increasingly scarce. Women must travel further to get it,or pay more for it.Forest destruction is a problem nationally; 75% of Thailand's original forests are gone.

PROJECT DESCRIPTION

Overview

The project sought to reduce impacts on the forest and provide local livelihood benefits, especially for women, by improving cooking and charcoal production processes. Both are strongly connected to income-generating activities.

Implementation

Initially 50 farmers built stoves for their own use. The terra cotta stoves use less wood and cook food faster, and a high demand for them was created among local women. Now, stoves are constructed and sold locally; men build the stoves and women are responsible for selling them. In order to sell them, women demonstrate their use in the marketplace, cooking two meals side by side on an open fire and a new stove to show the difference. Women have also begun to use the stoves to make snack foods,like rice puffs, which they also at the market.The other aspect of the project relates to changes in the local production of charcoal. The community has generated income from charcoal production for years,but this has severely impacted local forests.The project introduced fast-growing trees that the community could harvest in a sustainable manner. In addition, a new method of making charcoal was introduced using airtight steel drums as kilns. This also produces "wood vinegar" as a by-product, which happens to be a good fertilizer. Charcoal producers now sell this product by the bottle for use in gardens and compost,decreasing the need for fertilizers.

Training enabled Ban Mae Pa Haen community members to build an energy saving stove to generate curing steam for community services (Sunsai District,Chiangmai Province, Thailand).

In a second stage of the project, the Office of Renewable Energy Development is heavily involved in promoting and increasing stove production.The government has engaged an advertising firm to sell 60,000 stoves per year, of which 5,000 are to be sold in the project area. The advertising firm has worked out a deal for local producers enabling them to sell at a lower price than retail shops, and to offer a special in which for every 10 stoves bought, one stove is free.

Environmental Benefits

Global: Greenhouse gas emissions from burning wood are reduced by spreading the use of the efficient clay stoves. Approximately 400 stoves are produced and sold per month. In the second phase of the project, the Office of Renewable Energy Development is assisting local production of stoves to meet a goal of 60,000 stoves per year. In addition,planting trees that are managed and harvested in a sustainable manner by the community for charcoal production also reduces net greenhouse gas emissions.

Local: Forests in the region are impacted less by wood collection.This benefits local ecosystems and may also help protect local water supplies via the forests' natural filtering capacities.In addition, wood vinegar is now available as an organic fertilizer. To the extent that it replaces the use of non-organic fertilizers it offers positive local environmental benefits.

Local Livelihood Benefits

Poverty alleviation: The project has impacted income generation in a number of ways:

- *Reduced need for firewood:* To the extent that women buy firewood, they now need to buy less of it.
- *Sale of stoves:* The local community now produces and sells stoves at a rate of 150 per month.
- *Sale of snacks:* Women now use the stoves to bake and sell snacks.
- *Sale of wood vinegar:* Charcoal producers now sell this additional product.

Reduced drudgery: Women now save time both in collecting firewood and in cooking, which is faster on the new stove.

Partners

The NGO implementing the project, the Institute for Sustainable Agriculture Development (ISAD), has helped bring in several other entities to partner with the community in an effort to address energy use and livelihood issues. For example, the Sustainable Agriculture Network, of which ISAD is a member, has provided technical assistance to the community. Government entities have also been involved. The government's Agricultural Research and Development Office has assisted in developing local organic gardens, which make use of the wood vinegar. The Department of Energy Development and Planning has also taught a course on solar ovens, building upon existing cooking-related project activities.

Capacity Development

The project has made use of a participatory process in which community members take the lead, with the NGO offering support and suggestions. According to an ISAD staff member, "We just formulate the process so that the community will realize there is a problem and participate in activities to correct it."

LESSONS LEARNED

Environmental Management

The project has introduced new innovative approaches to reducing forest impacts, including the efficient clay stove, and the steel drum charcoal kiln, which is complemented by an income-generating by-product of wood vinegar. The project has also introduced forestry techniques that help minimize the impact of charcoal production.

Barrier Removal

Technical: Possibly the most significant barrier addressed through this project is technological. Without the project, the new stove might not have been introduced. Yet, now 400 are being produced and sold per month, which must mean that there are a sufficient number of people for whom this stove is affordable and provides livelihood benefits in addition to environmental ones. Thus, technology seems to have been a main barrier.

Financial: This project has been exceptionally creative in finding ways to generate income from more environmentally friendly cooking and charcoal producing activities. Such links make these adjustments financially viable and therefore more sustainable over time.

Scaling Up

The project has scaled up already in a very important sense. While it began by 50 farmers constructing stoves for their own use, a market has now developed for the stoves, spreading them to nearby communities. Further efforts are underway to scale up the kinds of income-generating activities that are made possible for women with the new stoves, such as selling snacks. In addition, a second phase of the project has strong government support for increasing sales. Through this effort, an advertising firm is helping market the stoves per year.

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Community-Scale Solar Water Pumping, Thailand

Themes

★ Renewable energy
❖ Technical capacity development
❖ Institutional capacity development

PROJECT DATA

Name: Community-scale solar water pumping
Implementing Organization: Hin-Ngome Tambol Administrative Organization (CBO)
Location: Thailand, Sangkhorm District, Udornthani Province
SGP contribution: $12,857
Start Date: February 2000

ENERGY OVERVIEW

Energy Resource: solar
Technology: photovoltaic panels
Application: pumping water
Sector: domestic
Total capacity: two solar-powered pumps; capacity unknown
Number of People Served: 80 families in three villages

BACKGROUND

Ban Hin Hgome and two other villages in northeast Thailand rely upon rain and the Mekong River system for irrigating their rice plots, but drinking water must be pumped out of deep wells.This village is connected to the grid,and the water pumps are powered by electricity.The local administrative organization is responsible for paying the electricity bill and distributing the cost among the villagers via the water bill.Other energy needs in the village, such as streetlights, have not been met by electricity distributors.

PROJECT DESCRIPTION

Overview

This project has demonstrated the use of solar water pumps to reduce grid-connected electricity use in pumping water for domestic consumption, thereby decreasing carbon dioxide emissions and allowing the villagers to reduce their electricity costs.

Implementation

The project idea was conceived when the secretary of the Tambol Administrative Organization (TAO) heard about the possibilities of solar water pumping during a talk by the SGP National Coordinator. After TAO had applied and received a grant from GEF to try the idea, TAO invited two solar water pump companies to submit bids, and selected one of them for the project. New wells had to be dug in order to use the solar pumps,and this funding was provided by government agencies. Training about solar energy uses and technologies was provided to ten community leaders by a university in Thailand that specializes in renewable energy. The solar energy company, Solartron, Ltd, then came to install the pumps, with the assistance of the newly trained community leaders.School children were made aware of the project,and of the importance of not playing football near the panels. In December 2000,the pumps began working, and by January, the first cost savings were realized. A decision was made by the TAO to continue to collect the same amount for electricity at least for the first year, but to use the savings in electricity costs to establish a community development fund. Community leaders have decided to begin by investing the savings in photovoltaic panels for outdoor lighting at night.The TAO now plans to install five additional solar water pumps to serve the other villages under its jurisdiction. In July 2003,the community decided not to use electricity from the grid to pump water for one of the pumping stations, and instead rely completely on solar energy for pumping water.

Solar photovoltaic panels providing power for water pumping (Thailand,Sangkhorm District, Udornthani Province).

Technology

Two solar water pumps were installed by Solartron, Ltd.The pumps are submersible, and are attached to elevated water storage tanks.The systems are also designed to catch rainwater as well. When there is not sufficient sunlight to operate the solar pumps, electricity from the grid connection is used.

Environmental Benefits

When there is sufficient sunlight, the community uses water pumped using solar energy instead of grid-connected electricity. During the first month, the community used about a third less electricity for water pumping. According to one report,this translates into a reduction of 374 kg of carbon dioxide emissions per month. Most recently, in July 2003, the community decided to switch off the electricity for one of the pumps, and just rely on solar energy, which should result in close to a 50% reduction in the use of grid-connected electricity.

Livelihood Benefits

Savings: By using solar energy, the cost of electricity for water pumping has decreased. During the first month (December 2000),the electricity bill for the whole community was reduced from 2,400 Baht to 1,600 Baht. The Tambol Administrative Organization (TAO) has continued to collect the same amount for water use as before, but puts these savings aside for a community development fund.This fund is being used for purchasing outdoor solar lighting, a long-time community priority. The community has agreed to continue accumulating these savings in the community development fund for at least one year, after which time they may consider reducing water rates. However, one concern about doing this is the possible incentive to waste water.

Income Generation: The new pumps have also been more effective in providing a steady supply of water. This has led community members to embark upon other income-generating activities, such as growing medicinal plants and then making medicines, shampoos and drinks with them.With TAO's help, community members are exploring the use of solar energy for processing these items.

Capacity Development

This project has been led by TAO, whose members are elected by the local community. Ten community members have received education and training in renewable energy. This training has greatly improved their ability to manage village energy use effectively. For example, during a two-day training in May 2000 at the Naruesuan University, ten community members learned about how solar technology works, how to maintain the equipment, and how much the equipment costs. This awareness has helped them understand other possible applications of solar energy, as well as its limitations, given its relatively high cost.

Beneficiaries

The beneficiaries of this project are the 80 community members in the three villages that are now being served by solar water pumps.Future beneficiaries are those living in nearby villages over which TAO has jurisdiction; TAO plans to install solar water pumps in these communities as well.

Partners

This project involves several beneficial partnerships in addition to SGP.

Universities: This project made use of connections at Naruesuan University to provide training to community members on renewable energy and maintenance of the solar water pumps.

Private companies: The community contracted with a private company, Solartron, Ltd., to install the water pumps. This company was one of two that placed bids on the project.Solartron trained community members selected for maintaining and operating the pumps.

Government agencies: Upon the advice of Solartron, the community dug two new wells for these pumps.The community contacted and received financial assistance from office of Accelerated Rural Development in the Ministry of Interior, as well as from the Department of Mineral Resources in the Ministry of Industry. In addition, the Sangkhorm District Office has designated TAO as the central organization for energy conservation and the environment among the four other organizations under its jurisdiction. This means that TAO's experience with solar energy can easily be disseminated throughout the District.

LESSONS LEARNED

Environmental Management

This project illustrates the potential for solar energy to reduce the use of grid-connected electricity. However, it should be noted that solar energy is still relatively expensive compared to grid electricity, so this will not make sense in many situations.In this case, the SGP grant helped cover the initial costs of purchasing the solar equipment, which enabled the community to realize the savings so quickly after installing the solar water pumps.In addition,care should be taken that the installation of solar water pumps does not increase the use of groundwater so that supplies are depleted.

Barrier Removal

Information/awareness: This project has greatly improved this community's awareness and understanding of solar energy and its applications. This has opened many possibilities for other applications besides water pumping.The community's success has gained the attention of other communities, who are now also interested in using solar energy.

Financial: This project lowered financial barriers for accessing solar energy, but only with respect to this community. The SGP grant helped cover some of the initial equipment costs so that the community could quickly realize savings, which they are now using to cover the costs of other solar energy applications, in particular, outdoor lighting. However, it is unclear how other communities outside of TAO's jurisdiction will be able to access solar energy without another SGP grant.

Policy: Due to TAO's success with the solar pumps, the Sangkhorm District Office has designated TAO from among the four organizations under its jurisdiction as the central organization for environment and energy conservation. This will allow TAO to share its knowledge about renewable energy projects and energy conservation efforts throughout the District.

Scaling Up

This project has potential for scaling up via several avenues. First, TAO plans to install five more solar water pumps to meet the needs of all the villages in its jurisdiction. Second, this demonstration of the use of solar energy has caught the interest of village residents in using solar energy for other applications, such as drying and processing of medicinal plants.Third, other communities outside of TAO's jurisdiction are learning about solar energy applications. One community 15km away

has applied for and received a grant from SGP to combine solar energy with biomass burning for drying and boiling agro-products.

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Water Power for Rice Milling,Thailand

Themes

★ Renewable energy
✲ Linkages with other environmental goals
✲ Innovative technology applications
❖ Technical capacity development

PROJECT DATA

Project Name: Rice Milling by Water Power for Sustainable Development
Implementing Organization: Karen Conservation Group (CBO)
SGP contribution: $10,916
Start Date: February 2002

ENERGY OVERVIEW

Project Location: 3 villages in Doi Inthanon National Park, Chomthong District,Chiangmai Province,Thailand
Energy Resource: hydraulic power
Technology: water powered rice mill
Application: milling rice
Sector: commercial
Total capacity: 300 kg of rice milled in 8 hours
Number of People Served: 3 villages,200 families

BACKGROUND

In the northern region of Thailand,200 families live in three villages in a very remote area in the mountainous Doi Inthanon National Park. These mountains are a critical watershed for much of the northern area of Thailand.The three villages are composed of people from the "Karen"minority group, and primarily speak their own dialect, Kareni.They are permitted to live in the park only under strict conditions regarding the impact they may have on their surroundings. The main economic activity is growing rice, but this requires milling services. The nearest mill is 27 km away, a trip that requires significant time and expense, so the community has been relying on manual milling when the trip is not possible.

PROJECT DESCRIPTION

Overview

The project has helped this remote, minority community to install a water powered rice mill.The community has established fees for milling services, which provides a financial return to members of a rice-milling cooperative and also supports a revolving fund for indigent community members.

Implementation

The development of this project illustrates the benefits of prior consultation and site visits in the project design process.Initially, the community group had submitted a proposal to the Northern Thailand Research Fund to install a hydroelectric or diesel-powered mill in the area. Following this, the SGP National Coordinator in Thailand,Thailand Research Fund staff, and interested university researchers made a site visit in March 2001 to examine the site and assess feasibility. The experience of another SGP-funded project was considered during the site visit. That project developed a manually-powered rice mill which allowed 10 men working alternately over a period of 8 hours to mill 350 kg of rice. Instead of the hydroelectric or diesel options, which would require more labor or might create a greater disturbance in this national park area, the site visit sparked the idea of using the mechanical energy from falling water to power the mill.

Water power for rice milling (Thailand).
SGP Thailand National Coordinator, Boonsin Sreesangkom

The mill is operated by the three community members who have been trained to run it. A March 2003 site visit indicated that additional people should be trained in order to increase the output of the mill.Certain community members involved in the project have organized a cooperative to manage the mill. It has been recently been agreed that members participating in the cooperative would receive 30% of the revenues of the mill, and the rest would be placed into a revolving fund to be used to meet the needs of indigent community members.Rice husk is a by-product of the milling process, and will be used as a fertilizer for rice paddies. In addition, there are plans to use the rice husk in cooking to reduce firewood consumption, as has been demonstrated in another SGP project in Thailand.There is also interest in the communities in building a micro-hydro power system to supply electricity for village needs.

Technology

The rice mill is powered by mechanical energy from falling water, and can process 300 kg of rice in 8 hours with minimal physical labor. According to the report of a March 2003 site visit, the mill was working correctly, but could produce even more if more community members were trained to use it.

Environmental Benefits

Global: To mill 300 kg of rice in 8 hours,an estimated 3.3 liters of diesel would be required.Thus, by using mechanical energy

instead of diesel, the greenhouse gases resulting from burning that amount of diesel fuel are avoided each day.

Local: By avoiding the use of diesel fuel,this water-powered rice mill avoids the emission of local pollutants from diesel-burning engines.

Livelihood Benefits

Income generation: The project increases income generation in this community, which otherwise had great difficulty accessing a rice mill. Indigent community members also benefit from the revolving fund, to which 30% of the payments for milling services are paid. Rice husk is also used to improve rice paddy fertility, which may improve rice crop yields.

Reduced drudgery: The presence of the rice mill eliminates the drudgery involved in milling rice manually and the need to travel 27 km for mechanized milling.

Beneficiaries

The project beneficiaries are the 200 households living in the three villages in this area.

Capacity Development

The project has built the capacity of village members to operate the rice mill and manage a cooperative. Increasing the number of local people with the skill to run the mill was identified as a priority at the evaluation of the project in March 2003.

Partners

Several have been important to the success of this project:

SGP: SGP's participation in an initial field visit to assess the feasibility of the project helped shape the eventual outcome. Instead of pursuing an hydro-power or diesel-powered mill,the experience of another SGP-funded project that used a manually-powered rice mill helped generate the idea to use falling water to power the mill directly.

Thailand Research Fund: This entity originally identified these remote communities as sites for work, and also helped to fund the project.

Chiangmai University: Members of the Department of Mechanical Engineering participated in the development of this project, and in particular helped to come up with the design for the water powered rice mill. Following the initial site visits,members of the university made a more thorough assessment before proceeding with the proposal to SGP for the project funds.

LESSONS LEARNED

Environmental Management

This project illustrates the potential use of hydraulic power to meet development needs. Capturing the mechanical power in falling water can be a very efficient way to produce energy for agro-processing or other purposes. Particularly in a protected area,this technology requires a minimal intervention to achieve results.

Barrier Removal

Technical: This project helped a remote, minority community access power that makes a great difference in their livelihood capacity. For this community, technical barriers to the introduction of renewable energy alternatives were reduced.This project does not appear to reduce them in a broader sense, although the university's involvement may help transfer lessons from the implementation of this technology in this community to other locations where hydraulic power should be considered as an option for power generation.

Information/Knowledge: This project illustrates how SGP projects can contribute to meeting the energy needs of some of the most remote and isolated communities. Most people living here do not speak or write Thai, and all community visits and the project evaluation had to be translated in Kareni for most community members. During the evaluation, one relatively well-educated community member explained the phenomenon of global warming to the others in the Kareni dialect.

Scaling Up

If the community's experience with hydraulic power is documented by the Chiangmai University staff members and by SGP, through them lessons from this community may be transferred to others seeking to implement other similar small-scale efforts.In an effort to share experiences,SGP invited other current SGP grantees to the project evaluation in March 2003. After all,this project itself benefited from another SGP project's experience elsewhere. In this sense, "scaling up" is occurring through each of these small community efforts.

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Improving Small Scale Brick Kiln Efficiency, Viet Nam

Themes

★ Energy efficiency
⁕ Innovative technology applications
⁕ Linkages with other environmental goals
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Policy and legislation
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Developing a model of a vertical brick kiln with high efficiency
Implementing organization: Vietnam Thermal Technology and Science Association,VTTSA (NGO)
Location: Hung Yen Province, Viet Nam
SGP contribution: $32,145
Start Date: June 2001

ENERGY OVERVIEW

Energy resource: coal
Technology: efficient kilns
Application: brick-making
Sector: small-scale commercial
Cost of each system: $7,200 – $9,200 per unit
Efficiency: reduces coal use in brick-making by 45-50%
Units produced: six vertical shaft brick kilns (Hung Yen Province),15 (Hai Duong Province)

BACKGROUND

Brick-making is one of the most important industries in Viet Nam. It is also traditionally carried out on a small scale by family-run businesses in rural areas. In 1998, there were over 300 brick-making enterprises, of which 200 were privately owned and predominantly small-scale, and accounted for approximately 70% of total brick production. At the same time, brick production is one of the most environmentally damaging activities in the construction sector. Brick kilns tend to be highly inefficient, and make use of low-quality coal with high sulfur content. This leads to intense local air pollution, as well as a significant contribution to greenhouse gas emissions. Recently, the government of Viet Nam issued a decree that all traditional brick kilns in cities must be phased out by 2005, and in rural areas by 2010. Another type of kiln already used in Viet Nam is the "tunnel" kiln, which is very large and costly (over $60,000). Small scale producers cannot afford this, and currently only state enterprises use them. A single company under the Ministry of Construction, called Viglacera, builds these.

Improved and more efficient brick kilns have been developed in China, and there is great potential for adopting this technology in Viet Nam. This project is located in the Xuan Quan commune in the Hung Yen province, where family-scale producers are very important. In this area, local authorities recently issued strict limits on the polluting brick kilns. Thus, there is a great need for improved and more efficient brick-making technology.

PROJECT DESCRIPTION

Overview

This project demonstrates a model of the vertical shaft brick kiln that could be used in this region. In doing so, the project also raises awareness among local brick-makers about the technology, and also educates the local authorities on the effects of local pollution and greenhouse gases.

Implementation

This project began its work by meeting with and organizing training workshops for local government officials as well as community members. The goal was to work closely with the community and with the government in developing a model for an efficient brick kiln that would be usable in this community, as well as in other rural areas of Viet Nam. The VTTSA, with technical assistance from the University of Technology, provided supervision and management for community members who were involved in designing the model, and then conducted an independent assessment of the model's efficiency. The final step of the project was to share the experience of developing this kiln with brick-makers in other communities via training and study tours. The project organized 3 such training and study tours. Media, both local and national, including television and the Voice of Viet Nam, have publicized the results of the project.

Technology

The technology is called the "vertical shaft brick kiln," and is adapted from Chinese models. Local brick-makers were heavily involved in adapting and testing the model for Viet Nam. After one kiln was produced for a brick producer, he tested it and suggested adaptations. He has now become an expert in this technology. One example of an adaptation involved reducing the percentage of broken brick, which for this technology was quite high at 7%. Local brick makers tried different ways of adding fresh brick to the kiln, and added some coal to the clay for making fresh brick. Tests have shown that the percentage of broken brick has been reduced to 4%.

Environmental Benefits

Global: This project reduces greenhouse gas emissions by making more efficient use of coal in brick kilns. So far, six kilns have been built by this project. The neighboring Hai Duong Province has since financed the production of 15 more kilns. In addition, the model has also been replicated in other areas through brick producer investment.

Local: Since less coal is required to produce bricks, local air pollution problems stemming from coal burning in brick kilns are reduced.

Local Livelihood Benefits

Health: Reduced local air pollution can have important health benefits, especially in reducing respiratory illnesses.

Income generation: Since brick kilns are run by small, family busi-

nesses, improved efficiency means they need to purchase less coal in order to produce the same amount of bricks. In addition, since the local authorities have expressed concern about the air pollution produced by brick kilns,access to this technology provides these small businesses with an option to continue to produce bricks but with less pollution.

National Benefits

Given the large scale of the brick-making industry and its widely dispersed nature, there is a great benefit to the country as a whole in testing this technology, in conjunction with local officials and community members.The country may benefit if use of the more efficient vertical shaft brick kiln becomes widespread throughout Viet Nam.

Capacity Development

The project has sought to develop the capacity of the Vietnam Thermal Technology and Science Association to manage environmental projects and work with local stakeholders. In addition,local government officials are gaining additional knowledge and understanding of energy and environmental issues related to the brick kilns.

Beneficiaries

Local brick-makers will be the direct beneficiaries of the project. In addition, the entire community will benefit from improved air quality.

Partners

The grantee has worked closely with the local community and with local authorities as their primary partners.The University of Technology provides technical expertise to the grantee and to support community members in developing an improved vertical shaft brick kiln.Community members have offered their expertise and experience in suggesting ways to adapt the kiln to local conditions, and in testing the use of the kilns. Local authorities have been supportive, and in the Hai Duong Province have financed 15 additional kilns.

LESSONS LEARNED

Environmental Management

This project illustrates the great potential that exists within the brick-making industry, as in many aspects of the construction sector, to improve energy use efficiency. Unlike some industries, this one has a large percentage of small scale producers.This means that the technology must work on a small scale, and therefore be adapted to and tested at that scale. Thus, there is a great need for work directly with communities like this one in order to adapt to local needs.

The project illustrates a situation in which local air pollution problems are strongly linked with greenhouse gas emissions. The government's new policies related to brick kilns were motivated by local air pollution problems, but this project demonstrates how such problems can be addressed while also reducing greenhouse gas emissions.

Barrier Removal

Technical: This project is designed to reduce the technical barriers to the widespread use of the more efficient vertical shaft brick kilns. It has been largely successful; additional kilns have been financed by the neighboring Hai Duong Province, and through private investment in other parts of the country. Many brick makers are now waiting for the vertical shaft brick kiln to become widely available, and have even canceled their contracts for building tunnel brick kilns as a result.

Policy: At the local level, this project made a specific effort to educate and work with local authorities in their efforts to reduce air pollution while ensuring that brick-makers can still maintain a livelihood.It also seems that this project began a dialogue with policy-makers from the start,making their improved awareness and understanding of energy and pollution issues a very important element of the project. This local effort to involve local policymakers seems to have been quite successful.

It is important to bear in mind the national policy context in which this project emerged. The national government had recently placed deadlines for the phase-out of the traditional brick kilns.This provides a serious impetus to find new, efficient technologies to meet the needs of the very large number of small scale brick producers throughout the country.

Scaling Up

Given the vast number of small scale brick producers and the current policy environment, there appears to be a great need to scale up such efforts.The project itself appears to have produced a model that is well-adapted to small scale needs and local conditions through many rounds of testing and significant input from users.The low cost of the technology makes it possible for small scale producers to purchase it.

There are initial signs that the project results are catching on; one province has already taken steps to finance further production, as are some private investors. In November 2003, the vertical shaft brick kiln was one of four technologies included in a workshop sponsored by the Global Environment Facility as part of an effort to support small and medium scale enterprises in adopting energy-efficient technology.

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Photovoltaics for Water Supply in Rural Areas,Albania

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Photovoltaics Use for Water Supply to Rural Areas in Albania
Implementing Organization: Albania – EU Energy Efficiency Center (NGO)
Location: rural Albania
SGP contribution: $29,960
Start Date: June 2002

ENERGY OVERVIEW

Energy Resource: solar
Technology: photovoltaic panels
Application: water pumping
Sector: domestic, agriculture (irrigation)
Number Served: 2 communities

BACKGROUND

Albania is undergoing a serious energy crisis due to insufficient investment in power generation and distribution, combined with a major increase in energy demand. Prices have been rising, putting pressure on those who have low incomes. At the same time, usage limits are also becoming stricter. Very little, if any, solar energy is being harnessed in Albania to meet this demand.

PROJECT DESCRIPTION

Overview

This project tested the viability of using solar energy to pump water in two villages in Albania. In one village, solar photovoltaic panels were installed to pump water, and in the other, they were used for irrigation. The communities were trained in maintenance, and an awareness campaign was initiated to spread information about photovoltaics. The results of the project suggest that while solar panels have benefits, other methods, such as improved efficiency and possibly solar water heating, may address Albania's energy crisis more cost-effectively.

Implementation

The Energy Efficiency Center (EEC), the grantee, first selected the two villages in which the photovoltaic panels would be tested. After researching the market, they selected a supplier of the photovoltaic equipment. The villages had some existing water supply infrastructure that had been put in place by a development agency, CAFOD. The project made as much use of this infrastructure as possible. In addition, instead of installing battery systems for storing electricity, it turned out to be more cost-effective in both villages to construct water reservoirs in order to deal with peak hours of water consumption. After receiving training from the supplier, members of EEC installed the water supply systems, and then trained villagers to maintain and operate them. In the village in which photovoltaics are used for irrigation, the panels were mounted on a farmer's roof, and he was responsible for maintaining them. The other village decided to pay someone to take care of maintenance. Installation was followed by an awareness campaign and a survey of the villages to assess the impacts of the systems impact on their lives.

Technology

The supplier of the panels was Helios Technology. EEC designed and installed the systems, including the control unit, main switch, pumps, and supporting cable.

Environmental Benefits

Global: These two villages now use solar energy to pump their water, which means they do not need to rely on fossil-fuel powered electricity for this purpose, thereby avoiding emissions of greenhouse gases.

Livelihood Benefits

Income generation: The improved water supply for irrigation has increased farmers' ability to grow crops, thereby improving their income generating capacity.

Health: The village with improved access to potable water may have benefited from improved sanitation.

Beneficiaries

The primary beneficiaries are the residents of the two villages receiving water via solar water pumps. In addition, members of EEC have also benefited from the training and experience they through this project, which will help them implement other solar energy projects and also better assess all options for addressing the energy situation in Albania.

Capacity Development

NGO: EEC members received 4 days of intensive training by the supplier in the basics of solar energy, photovoltaics, and specific applications such as water pumping. They also made site visits to see how installed PV systems operate. Finally, they received on-site training in how to assemble the systems. This training is of immense benefit to the NGO, since its ability to assess options for meeting Albania's energy crisis is greatly improved.

Villages: The individuals selected in each village to maintain the systems were then trained by EEC. EEC also prepared written materials for them. These capacity building efforts were supplemented with an awareness campaign, which involved a documentary film, television roundtable discussions, and wide dissemination of materials.

Partners

The major partners in this case have been the implementing NGO, the technology supplier, and the communities. It does not appear that government or other NGOs have been involved.

LESSONS LEARNED

Environmental Management

This project tested the viability of using photovoltaic panels to address a lack of power supply in rural areas of Albania. While response to solar energy systems has been good in these two villages, it is also observed that compared to other options, such as improving centralized heating efficiency, insulating houses, or using passive solar applications such as water heating, photovoltaics may be too expensive. There are many opportunities for efficiency improvements in Albania, since much infrastructure already exists but it is inefficient.

Barrier Removal

Information/Knowledge: This project has focused on improving knowledge and awareness of photovoltaics as an energy option in Albania. Evidence suggests that these are the first solar-powered water pumping systems in Albania. The training received by the Energy Efficiency Center, the materials they have been disseminating, and the awareness efforts they have undertaken all improve the level of knowledge in the country about this technology.

Technical: EEC is now capable of assembling the solar power systems. However, there is still no local supplier for the panels and equipment. Thus, technical barriers still exist for widespread use of this technology in Albania.

Financial: Although residents of the villages responded very positively to the solar panels, and there did appear to be some "willingness to pay" on the part of others nearby, there are insufficient credit schemes available, and there are no government subsidies currently available for installing the technology. Thus, even though there is an estimated 2.0-2.5 year payback period, the initial investment is difficult to meet for farmers in poor regions of Albania, where supply problems are significant.

Scaling Up

The project has been effective in helping these communities, the NGO, and others learn about the possibilities offered by photovoltaics. However, scaling up would require further work to address the financial and technical barriers that remain, as described above. It is not clear whether this option is the most cost-effective one in Albania, which already has significant infrastructure, even though it is inefficient. Investment in improving efficiency of heating systems and better insulation of houses may make more economic sense.

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Reducing Emissions and Protecting Water Quality through Biogas, Kazakhstan

Themes

★ Renewable Energy
✲ Innovative technology applications
❖ Technical capacity development
❖ Linkages with other environmental goals
✷ Poverty Alleviation (MDG 1)

PROJECT DATA

Project Name: Clean Rivers Project
Implementing Organization: Karaganda Ecological Museum (NGO)
Project Location: Karaganda district, Kazakhstan
SGP Contribution: $47,000
Start Date: November 2000

ENERGY OVERVIEW

Energy Resource: biogas
Technology: biogas digester units
Application: cooking,lighting
Sector: agriculture, commercial
Cost per system: $960-$13,000, depending on size. Total cost of equipment in pilot project is $26,400 (5 digesters)
Total energy provided: five digesters with a total capacity of 306 cubic meters; 3 additional digesters currently under construction providing an additional capacity of 156 cubic meters
Number Served: 5 enterprises or institutions, including one home for 40 orphans

BACKGROUND

As a former Soviet state, Kazakhstan has a relatively well-developed electricity grid, which is mainly fossil fuel powered. The system is also old, and many elements require significant repair or replacement. For heating, rural families depend upon coal, spending between $100-$200 per year. Gas for cooking costs about $100 per year. These are significant amounts for individual families. There is currently almost no renewable energy use in the country, except for a few hydropower plants. Kazakhstan also has severe waste management problems,especially in cities and near water sources. The country is largely agricultural, with 2 million square kilometers of land under cultivation, 5 million cattle and about 14 million sheep and goats. Nationwide, there is great potential for biogas development,which can be exploited locally.

PROJECT DESCRIPTION

Overview

This project sought to remove technical and informational barriers to the use of biogas technology in order to help provide low-cost energy from agricultural waste material and reduce contamination of the river due to waste dumping there. To achieve this, the project involved numerous community stakeholders in working to fully integrate biogas use and improved waste management into the community lifestyle and local government policies.

Implementation

The project involved the design,construction and installation of biogas facilities by certain enterprises, farms and institutions in the community. Local farms contributed agricultural waste products, which are used to produce biogas. The farmers received gas to use for cooking and lighting,and also gained fertilizer, which increases crop productivity. Local volunteers cleaned the river beaches, where these materials were previously dumped,and systems of river maintenance were instituted. Finally, the project involved a great deal of public outreach to raise awareness about biogas use and its connection to the river, and to generate support for favorable legislation for biogas use.

Technology

The particular type of biodigester used was adapted from a Chinese model,which is of the flow type with a horizontal oval reactor. A total of 5 digesters, totaling 306 cubic meters in capacity, have been built, and 3 additional digesters with 156 cubic meters of capacity are planned. Based on this project's experience, an 8 cubic meter digester using pig manure can provide enough biogas to meet the cooking needs of a family of five, who previously used natural gas.

Environmental Benefits

Global: Biogas use replaces coal for heating and natural gas for cooking and lighting for the participating farms. This reduces carbon dioxide emissions. In addition, less manure decomposes in the open air, which reduces methane emissions, another greenhouse gas.

Local: The reduced amount of agricultural waste being dumped near the Nura river means that the river suffers less from contamination by ammonia-nitrogen compounds.

Local Livelihood Benefits

Poverty Alleviation:

- *Savings on energy costs:* Farmers can use the gas produced by the biogas facilities for free and save money on energy use. Previously, an average family would spend $100 per year on natural gas for cooking, and $100-$200 on coal for heating. These costs would be avoided; however, an 8 cubic meter digester cost $960 in this project. Without subsidies, the investment would pay off over a period of years, but credit mechanisms would be necessary for the up-front investment.
- *Increased agricultural productivity:* Farmers can use the fertilizer produced as a by-product,which helps improve their crop yields.
- *Increased employment:* Four additional workers were hired to construct biogas facilities,and still others were hired to operate them. In addition, some people received seasonal jobs at private beaches, which could now be used as a result of the cleaner water.

National Benefits

Currently, Kazakhstan has almost no renewable energy capacity, but it is facing the need to invest in its out-of-date electricity grid. This is a good opportunity for the country to begin to meet some of its energy needs through renewable sources, such as biogas which can be an important fuel source for rural, agricultural communities. Thus, the demonstration aspect of this project is very important to the country as a whole; if it is shown to be effective, it could be implemented in many villages throughout the country. The Ecological Museum seeks to create a "biogas center" to spread the technology, which can be used at a variety of scales from single farming households to large scale henneries (5,000-100,000 hens).

Capacity Development

The project trained business people in the production and installation of the new technology, which uses local materials. Farmers were also trained in the use and maintenance of the biogas facilities. In addition, students at the local technical university gained a great deal of experience through their involvement in the project. They helped to design the installations, and are writing their theses on the project.

Beneficiaries

The major beneficiaries are the farmers who now have access to a new form of energy and good fertilizer. In addition, the entire community benefits in that the beaches and water in the river are cleaner, and therefore more pleasant and usable. Young people have been particularly involved in the project, raising awareness throughout the community about the benefits of biogas and the cleaner river.

Partners

Farmers: As the primary users of the energy and fertilizer, the farmers' cooperation and support was essential. Farmers associations were involved and provided in-kind support to the project.

Businesses: Local businesses were involved in beginning to produce the biogas units. Their involvement meant that the product could be marketed, and, with sufficient demand, the dissemination of biogas units could be sustained over time. While the market for small-scale digesters is not large (few farming families could afford to buy them), companies are interested in producing larger scale ones for henneries or other livestock businesses. One company has been in negotiations since July 2002 to supply the components of large digesters. Inputs to construct the digesters for this project, such as concrete, polyethylene film and pipes, come from local companies.

University students: The students have played a critical role, since they have primarily been responsible for designing the biogas units to meet the local conditions.

Local government: Government officials have been involved and are supportive of the project. This is important, so that they can ensure that the local legal framework supports this activity, and when successful results are obtained, that those can be shared with policymakers in other districts and at the national level to support further replication.

Media: The project has reached out extensively to the media. The activities of the project have been covered in radio, TV and print news. This generally helps to raise awareness and can further increase the size of the market for biogas units.

LESSONS LEARNED

Environmental Management

Kazakhstan has a cold climate, and the project has produced technical lessons for adjustments to the technology to adapt biogas for cold-climate countries. To maintain a proper temperature, the biogas systems either use a connection to the house's heating system or, for large digesters, use about 10% of the biogas produced by the digester to heat the system.

Barrier Removal

Technical Barriers: The project has depended upon university students for the technical design for the biogas units. This appears to have worked very well. As the project's posters illustrate, building the digesters is technically complex and requires significant commitment, which the students appear to have maintained. It is also beneficial that the project has involved local companies in the production process, so that the introduction of the systems on the market will be possible later. Already, one company has indicated interest in producing large-scale digesters for henneries and other livestock businesses.

Policy Barriers: the project has worked hard to educate state (oblast) level policy makers about the opportunities for biogas development. The implementing NGO indicates that thanks to heavy media coverage, there is a much greater awareness among policy makers and the general public, and there is support for their idea to create a "biogas center" to train farmers to build and operate the digesters. However, the state does not have funding for this idea, and therefore the Karaganda Ecological Museum is seeking international funds to support this.

Scaling Up

This project has taken a number of critical steps that will facilitate scaling up the project after the completion of the pilot phase:

- *Involved businesses in supplying materials for the pilot project.*
- *Tested digesters of various sizes.* The project now has experience and documentation about how an individual household-sized digester works as well as the larger scale digester that would be appropriate for poultry and livestock businesses. It seems that, to start with, the larger-scale digesters may be more marketable, while the NGO itself will have to work to establish the "biogas center" to help build capacity and financing mechanisms for small-scale farmers to access the technology. But by pursuing both avenues, the project has assured a greater chance of some degree of success in scaling up.

- ***Involved the community*** The project seems to have done a great deal to advertise the potential for biogas by involving many types of community members – students, businesses, farmers and policy-makers. This greatly improves the project's potential for success in developing demand for the product.

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Solar Heating in a Public Institution, Kazakhstan

Themes

★ Renewable Energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Awareness,culture and practices
✷ Health (MDGs 4-6)

PROJECT DATA

Project Name: Demonstration of solar energy use alternatives in infant orphanage
Implementing Organization: EcoEducation (NGO)
Project Location: Kyzylorda, Kazakhstan
SGP Contribution: $26,730
Start Date: February 2002

ENERGY OVERVIEW

Energy Resource: solar
Technology: thermal collectors
Application: water heating, floor heating
Sector: health
Project Type: demonstration
Households Served: one infant orphanage

BACKGROUND

As a former Soviet state, Kazakhstan has a relatively well-developed electricity grid, which is mainly fossil fuel powered.The system is also old, and many elements require significant repair or replacement. In some areas with an insufficient supply of energy, biomass resources are also being used, contributing to land degradation and desertification.There is currently almost no renewable energy use in the country, except for a few hydropower plants.

PROJECT DESCRIPTION

Overview

This project demonstrates the use of solar heating to help meet the energy needs of a public institution,thereby both raising awareness about the potential of solar energy and stimulating local manufacturing of the technology.

Implementation

Solar water heating equipment is being installed in an infant orphanage in the town of Kyzylorda.A private company held the patents for the equipment required to do this and agreed to allow their technology to be used for this purpose and to let local companies manufacture the equipment in Kyzylorda. Installing the equipment in the infant orphanage will serve as an opportunity to educate and involve the local community with regard to the possibilities offered by such technology.The project had originally intended to operate in a maternity house, providing hot water and heated floors there. However, arrangements with the maternity ward administration did not work out, in part because the installation of the equipment would have required that the facility be shut down for a period of time, which in the end was not acceptable to the maternity house.

Solar water heating system installed on an infant orphanage (Kyzylorda,Kazakhstan).

Environmental Benefits

Global: The infant orphanage will be able to reduce its use of its unreliable, coal-powered heating system, and also of wood, thereby reducing carbon dioxide emissions.

Local: Reduced use of coal-fired power plants improves local air quality. The reduced use of wood helps protect local ecosystems,slowing land degradation and desertification.

Local Livelihood Benefits

Health: The use of solar water heaters will increase the availability of hot water for bathing infants, washing utensils and laundry, and heating floors in the winter. Previously, the orphanage had an unreliable water heating system, and thus the new solar water heating systems will result in improved care.

Poverty Alleviation: The orphanage will also reduce its payments for coal-powered fuel, and also maintenance costs.These savings can be channeled to meet other needs.

Education: Schoolteachers, who are mostly women, are involved in the project.They will be helping to educate local school children and others about how solar energy works and its relationship to environmental protection.Thus, the project contributes to the education of local children.

National Benefits

Improved access to renewable technologies: Through this project, local companies now have permission to manufacture patented solar energy technologies. Since Kazakhstan currently has unmet energy needs, improving its access to solar energy technology can provide a national benefit.

Capacity Development

Access to three patented solar energy technologies, including the engineering specifications and technical documentation required for their manufacture, will help build local capacity to produce renewable energy technology.

Partners

Government: Local authorities have been involved in project planning and preparations.

Private sector: A private company has contributed by making three patented technologies available for local production and use in orphanage.

Community members: The community has been integrally involved in the planning and implementation of the project. In particular, school teachers are involved in educating the community about the benefits of renewable technology via lectures at schools, brochures and booklets, and an exhibition on climate change. TV and radio coverage of the project is also being sought.

LESSONS LEARNED

Environmental Management

This project shows that renewable energy can play a role in countries undergoing economic transition that are otherwise investing large amounts of money in restoring old and inefficient energy systems. Such opportunities can be pursued in many former planned economies with out-dated, fossil fuel powered electricity systems.

Barrier Removal

Technical: This project addresses a particular type of technical barrier that may become increasingly significant in developing countries – that of patents on technology. The project successfully convinced a private company to allow patented technology to be used in Kyzylorda. The details of this arrangement need to be analyzed along with attempts in other regions to address similar problems to gain a better understanding of how patent barriers can be successfully addressed.

Institutional: This project is building cooperation among government authorities, the private sector, NGOs, academic structures and the community. Such an approach is critical to building a strong base for support for the introduction and use of renewable technologies.

Informational: This project is a "demonstration" in the truest sense of the word. Sometimes, "demonstration" projects simply implement technology in a single location, but fail to complement this with adequate educational and outreach efforts. This project appears to have a solid plan of action to raise awareness about the uses of solar energy and its relation to the local and global environment. A successful education program must be built upon strong community involvement, which this project clearly has had from the start.

Scaling Up

While this project's implementation is still underway and replication has not yet been attempted, the project has already taken some key steps toward making widespread use of this technology possible. First, the involvement of a diverse set of stakeholders, including the local community, government and the private sector, combined with a strong education and outreach effort, bode well for its success. Second, the project seeks to establish local ability to manufacture the technologies by involving local companies. Together, these two elements lay the groundwork for a market by stimulating both local demand and production.

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Biogas and Micro Hydro Hybrid Energy System, Kyrgyzstan

Themes

★ Renewable energy
★ Energy efficiency
✲ Innovative technology applications
❖ Technical capacity development
❖ Poverty alleviation (MDG 1)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Establishment of Combined Biogas Units and Small Hydroelectric station in Kizil-Charba Village on Urmaral River
Implementing Organization:Association of Water Consumers "DAN" (CBO)
Location: Talas region, northern Kyrgyzstan
SGP contribution: $7463
Start Date: April 2002

ENERGY OVERVIEW

Energy Resource: biogas and water; efficiency improvements
Technology: biogas reactor and micro hydro power station; ceiling heat isolation using basalt fiber PB-80
Application: cooking, heating and lighting; heating efficiency
Sector: domestic
Cost of each system: a locally produced, 5 m3 biogas system costs $232. Basalt fiber PB-80 for insulation costs $2.60 per square meter, or $156 per average-sized house.
Total capacity: 5 kW from micro-hydro plant and 6-8 m^3 biogas per day in each of the four biogas units (under normal conditions); 15,000 m^3 of fertilizer per year
Number Served: 22 households (4 biogas units connected to the micro hydro station); 5 additional biogas digesters manufactured for local consumers

BACKGROUND

The Talas region, located in northern Kyrgyzstan, is one of the poorest in the country. In a recent participatory poverty assessment conducted by the World Bank,local people from the Talas region identified an inadequate power supply as a major problem,especially since electric heaters are used in the wintertime. Normally, residents use firewood to cook. During long periods in which electricity was not available, they depended upon kerosene lamps for lighting. The area depends heavily upon agriculture for its income, but fertilizers are very expensive, and many farmers can only barely cover the costs of cultivation through the sale of produce.

PROJECT DESCRIPTION

Overview

This project makes use of an innovative combination of renewable energy sources to adapt to local conditions and meet livelihood needs. A hybrid biogas and micro hydro plant provides power to 22 households, and provides fertilizer as a useful byproduct.The electricity from the micro hydro power system heats the biogas unit in the winter, when January temperatures are usually around -6° C, so that biogas can be produced. In the summertime, the excess electricity from the micro hydro system can be used to meet other power needs. Houses involved in the project are also insulated to improve energy efficiency. In addition, the project promotes tree planting – 15,000 saplings – in order to meet construction needs while sparing the forest in the watershed area.

Micro hydro unit,provides power to villagers and heating for biogas digesters (Kizil-Charba Village, Kyrgyzstan).

Implementation

The local population is integrally involved in implementing the project.Locals are helping to measure heat loss from houses in order to improve insulation, and are involved in building and operating the micro hydro plant and four biogas units.Seminars and media stories emphasize the importance of preserving the forest, and the benefits of the new power systems in terms of local air and water pollution. So far, two seminars have been held, involving 18 participants, and two newspaper stories and a television story have spread the word about the project.

Technology

The grantee, DAN, built the micro hydro power station from second-hand equipment, including some old tractor parts.The system can work continuously for 20 hours,but then must cool down for the next four hours.Water falls over seven meters at a rate of 150 liters/hour, creating 5 kW of power.

Four biogas digester units are connected to the micro hydro system, which generates electricity to heat the biogas units in the winter: the temperature must be brought up to at least 32° C in order for the biogas units to operate.The four biogas units have a capacity of 12m3and use a mixture of manure mixed with silt.The gasholder has a capacity of 4.5m3, and produces

on average 6-8 m3 per day;under ideal conditions it produces a maximum of 20-25 m3 per day. The system also produces 100-120 liters of fertilizer per day. DAN now runs a workshop in the area where these energy systems are produced. So far, they have produced 5 additional biogas digesters for local consumers at a cost of approximately $232 each. For improving house heating efficiency, the project undertook ceiling insulation using basalt fiber PB-80, which costs $2.60 per square meter.

Environmental Benefits

Global: Biogas can be used for cooking, heating and lighting, replacing traditional fuel wood or electricity from fossil fuel powered electric plants. A total of 22 families are able to reduce their dependence upon fossil fuel energy sources as a result of this project. In addition, these households are more energy-efficient because their homes have been insulated with basalt fiber. Finally, 15,000 saplings have been planted by village inhabitants. If they are managed sustainably, reduced cutting of local forests will contribute to improved carbon storage and reduced greenhouse gas emissions.

Local: The use of biogas may be improving local water quality, since less manure and other biological waste is left to rot, and instead is used to make biogas. In addition, local planting of 15,000 saplings improves local forest cover. Finally, increased access to fertilizer, a by-product of the biogas systems,may help improve soil quality.

Livelihood Benefits

Health: Indoor air quality is improved when families use biogas for cooking instead of traditional sources such as firewood. Women and children see particular health benefits, as they are the ones most often involved in cooking.

Income generation: Families save money on heating their houses, since they are insulated and now depend upon biogas instead of electricity. In addition,the fertilizer produced as a by-product of the biogas system may help improve agricultural yields,and avoid the need to buy expensive fertilizers. Fertilizer produced as a by-product of the biogas systems is cheap, costing approximately $0.02 per cubic meter. Finally, residents who tend the saplings that have been planted in the state forest area are allowed to grow beans in the spaces between the rows of trees.This supplements their income and/or household food supply.

Capacity Development

In addition to involving local community members in building and operating these energy systems,this project has carried out two seminars involving 18 people in order to educate them about the connection between the energy use and the local environment, including the need to protect local forests. DAN has also started a local workshop for constructing these systems, and runs a training class for biogas operators.

Beneficiaries

Primary project beneficiaries are the 22 families receiving energy services through this project.Other inhabitants of the village also benefit to the extent that water quality improves, and the newly planted saplings provide a ready supply of wood for construction needs without resorting to cutting down trees in the local forests.

Partners

DAN has worked closely with community members, who have donated labor, property and money in order to construct the biogas units.The involved households help in measuring their energy use and the efficiency improvements resulting from the insulation.

Local authorities have played an important role in facilitating this project.First,local government officials donated two tanker-reactors for biogas installations.The regional and district government heads helped to conduct on-site seminars and also to generate media coverage. Second, an agreement with the local Bakai-Ata state forest range allows residents to plant saplings on unused lands owned by the forest range. The state forest pays for land taxes,and covers the costs of water for irrigation. Residents are also permitted to plant beans between the rows of trees.This arrangement benefits the villagers, and also the environment, since the trees can be used as a sustainable source of firewood,as well as wood for construction purposes.

LESSONS LEARNED

Environmental Management

This project offers a unique combination of renewable energy sources to adapt to local conditions.The micro hydro system provides electricity and heats the biogas units in the winter, since they cannot operate at low temperatures.Biogas is a useful energy source because it also disposes of the large quantities of manure available in this agricultural and livestock region, and produces fertilizer to boost local agricultural production. In addition, this project has incorporated energy efficiency with conversion to renewable energy sources, an approach that more projects could implement.

Barrier Removal

Technical: The local population, since becoming involved in building and operating this energy equipment, has been learning about how such energy systems work. In addition,the project has provided a useful test of the effectiveness of this type of hybrid energy system.

Information/awareness: This project seeks to improve awareness of biodiversity issues as well as energy and air pollution concerns.The project has produced brochures and has made use of newspaper ads to raise awareness. Since the project uses hydropower, this provides a specific link with the need to protect the forests in the watershed.

Scaling Up

Local production of biogas digesters has begun, and five have been completed. This is a positive start. In order for other regions to begin similar projects, feasibility studies would be

necessary to determine where the combined micro hydro and biogas technologies would work. Perhaps other combinations can be explored,such as solar and biogas.In addition, much can be learned from the project regarding the combination of renewable energy, energy efficiency and growing trees for sustainable use for firewood. However, financial barriers are likely to be a problem in the regions that need this energy system the most, and need to specifically addressed.

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Clean Air for Bishkek City: Electronic Ignition Devices, Kyrgyzstan

Themes

★ Energy efficiency
⁜ Innovative technology applications
❖ Technical capacity development
❖ Awareness,culture and practices
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Clean Air for Bishkek
Implementing Organization: Public Association "Jel Argi" (NGO)
Location: Bishkek, Kyrgyzstan
SGP contribution: $5,000
Start Date: August 2002

ENERGY OVERVIEW

Energy Resource: gasoline
Technology: electronic ignition device
Application: starting cars
Sector: transportation
Cost of each device: $20.60
Efficiency improvement: 10% average improvement in fuel economy
Number Served: 30 devices installed for testing, 270 more planned (to be paid for by customers); 10 people employed by the project, including six blind or deaf men and women

BACKGROUND

There are approximately 200,000 motor vehicles in Kyrgyzstan, and over 800,000 in the Central Asian republics.The city of Bishkek, in northern Kyrgyzstan, has a population of 825,000, and produces close to half of the carbon dioxide emissions for the country. Cars in the city, and in the entire region,tend to be old and in poor working condition, thereby making inefficient use of fuel. However, income levels are low, and most people cannot afford to buy new, more efficient cars.

PROJECT DESCRIPTION

Overview

This project has tested a local Kyrgyz invention – an electronic car ignition device – to help prepare for its widespread marketing and use. This device leads to an average of 10% less fuel used, so car owners can save money while reducing greenhouse gas emissions at the same time.

Implementation

The "Jel Argi"Association has placed this ignition device on 30 cars for free, and has monitored their resulting fuel use and performance. In comparison with a control group of cars that did not receive the device, the preliminary test results showed an average of 10% reduction in fuel consumption as a result of the device. Testing was also done using a gas analyzer called

Assessing auto emissions following installation of improved ignition device (Bishkek, Kyrgyzstan).

"Infralit" imported from Germany and certified by the Kyrgyz State Meteorology Agency as effective in assessing carbon dioxide emissions.

The intention is, following the testing, to sell 270 more devices for the equivalent of $20.60 each. The association established a workshop for building these devices on the premises of the Kyrgyz Society for the Blind and Deaf, and 6 of the 10 people employed by the project are blind or deaf.

The project has an advertising plan to achieve more widespread use of the device. First, stickers have been made to place on cars that have this device installed. Second, television shows have been organized, and two advertisements in the local Bishkek paper have been published.100 booklets and 500 posters are to be produced as well. The project hopes to employ a public relations firm to conduct a large-scale media campaign.This is projected to include shooting a video about the device, showing the video on various television stations, advertising on large billboards,and making high-quality booklets with detailed information about the use of the device.

Technology

This electronic ignition device facilitates starting the car, and improves fuel economy. The preliminary test results show an average of 10% reduction in fuel consumption as a result of the device, but the range is from 5% to 20% depending upon the condition of the car. In addition, the cars were easier to start, even if the battery power was low, less erosion of engine contacts was observed, and cars maintained their power better at decreased speeds.

This device was invented in 1998 by a group of three individuals,Moldokulov, Pecherin and Nizamov. It is specifically designed to improve ignition efficiency for car engines that are 10-20

years old.The device is patented in Kyrgyzstan. It differs from analogs in Japan,Great Britain and Russia due to its simple construction, minimal use of radio-elements, small size and weight, low construction cost,ability to use gasoline of any quality, location of the device inside the engine itself,and the fact that if the device fails the car will continue to run.

Environmental Benefits

Global: According to preliminary test results, the installation of electronic ignition devices in 30 cars resulted in a reduction of 2.91 tons of carbon dioxide, based on a 10% improvement in fuel economy.

Local: Because less gasoline is being used per km of driving, other local air pollutants emitted by cars are also reduced.This may result in an improvement in local air quality once the project is scaled up.

Livelihood Benefits

Income generation: Drivers save money because they can buy 10% less gasoline, which costs between $0.25-0.29 per liter in Kyrgyzstan.

Employment for disadvantaged groups: This project's workshop is located on the premises of the Kyrgyzstan Society for the Deaf and Blind and employs six people who are deaf or blind,including both men and women.

Improved ease of transportation: This project has the potential to reduce problems Bishkek residents have starting and operating their cars.

Partners

Garage cooperative society: Members of this society made their cars available to participate in the initial test of 30 electronic ignition devices.

Kyrgyz Society for the Deaf and Blind: The society has made its premises available for the workshop to build the devices, and six of its constituents are employed there.

Government offices: In June 2003, the project was awarded recognition by the Kyrgyz Patent Agency for its innovation. In May 2003, the project participated in a competition entitled, "Innovative ideas for environment protection and sustainable development of Kyrgyzstan," and was awarded a prize in this competition as well.

Capacity Development

This project develops the local capacity to produce this device, training local people to manufacture them.The invention is a local one, and local manufacturing personnel are involved in building and testing the device.

Beneficiaries

This project has so far benefited those who have been employed to produce the electronic ignition devices and those who have had the device installed in their cars.However, there is great potential to benefit a larger group of car owners who could be spending less on fuel and enjoying improved ability to start their cars, especially during the cold weather in the winter.

LESSONS LEARNED

Environmental Management

This project introduced a new innovation to improve the fuel efficiency as well as the reliable operation of old cars.Although income levels will not permit many Bishkek residents to purchase newer, more clean and efficient automobiles immediately, this device offers an opportunity to improve fuel efficiency for these old cars.There is the potential to expand the use of this device more widely, and if this occurs, the environmental improvements could be noticeable.

Barrier Removal

Technical: This device was invented in Kyrgyzstan, and the project has conducted the first test of its effectiveness. It is also training individuals to construct these devices, and thereby improving local capacity to build them on a larger scale.

Information/awareness: The project's inclusion of a sticker on each vehicle that carries this device is an important way of advertising the product. However, other advertising efforts will also be necessary if its use is to spread widely throughout the city. The grantee hopes to contract with a public relations firm to conduct a media campaign involving television, billboards and other advertising.

Scaling Up

This project has great potential for scaling up, assuming the preliminary test results are accurate and the users do observe a significant enough benefit through the use of the device. The carbon dioxide emissions reductions could be significant if the devices were installed in a significant number of vehicles.The project estimates that there are about 3 million vehicles in Central Asia that could use this device. The grantee also estimates that the device could be produced by existing factories in Kyrgyzstan at a rate of 500,000 devices per year.

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Promotion of Energy Efficiency in Residential Multi-Apartment Buildings, Lithuania

Themes

★ Energy efficiency
❖ Institutional capacity development
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Project Name: Promotion of Energy Efficiency in Residential Multi-Apartment Buildings
Implementing Organization: Housing Advisory Agency (NGO)
Project Location: six largest cities,Lithuania
SGP contribution: $12,547
Start Date: November 2001

ENERGY OVERVIEW

Energy Resource: heating energy (fossil fuel-based)
Technology: techniques for energy efficiency (including computer software for conducting energy use planning)
Application: indoor heating
Sector: domestic
Efficiency improvements: estimated 10% reduction in heat energy use, equivalent to 15% reduction in fuel use (due to distribution and transmission losses)
Number of People Served: 700 individual consultations in the 6 largest Lithuanian cities

BACKGROUND

Approximately 800,000 of the 1.3 million households in Lithuania reside in one of more than 30,000 multi-apartment residential buildings. These buildings, most of which were built during the Soviet period between the 1960s to the 1990s, are in poor condition and energy-inefficient. Studies have shown that the average space heating intensity is above that of most OECD countries, even though the comfort level in Lithuania is lower. However, the European Union, which Lithuania would like to join, has passed energy efficiency standards that must be met by all members.

Heating is one of the most important energy costs for households. Most multi-apartment residential buildings receive heat from regional district heating networks, which import most of their fuel. Approximately half of Lithuania's heating energy is supplied by natural gas, and the rest comes from heavy fuel oil. Energy costs have also been rising, placing a significant burden on households. In fact, in 1996 it was estimated that more than 70% of Lithuanian households had difficulty paying their energy bills.

According to preliminary calculations, improved energy management techniques that do not require significant investment can reduce heat energy use by 10%, which translates into a fuel savings of 15% due to transmission and distribution losses. However, there are significant institutional and informational barriers to implementing such energy-saving techniques. Almost all of apartments in multi-apartment buildings are owner-occupied, but all households jointly own the building infrastructure and common areas. Until recently, there were significant institutional and financial barriers to making investments in this common infrastructure.

In 1995, a law was passed in Lithuania to allow the establishment of homeowner associations (HOAs) that could make decisions about infrastructure investments by majority vote. In 1998, approximately 15%, or 4,500 apartment buildings, were managed by HOAs, and by 2002 this figure had risen to an estimated 6,000 apartment buildings, or 20% of the building stock. The HOAs,primarily located in Lithuania's six largest cities, are in the best position to implement energy-saving investments. It is more difficult in buildings for which HOAs do not exist, since there the responsibility for maintenance is vaguely shared between municipal maintenance companies and homeowners. In addition, some buildings have administrators, municipal or private maintenance companies, which would be responsible for energy-efficiency improvements. Some of these companies have monopolies within specific districts, which means that homeowners have little ability to affect improvements. These companies, as well as homeowners, lack knowledge about energy saving techniques and their benefits.

PROJECT DESCRIPTION

Overview

This project aimed to raise awareness and capacity among apartment owners, municipalities,homeowner associations, and housing maintenance companies about techniques for improving the heating efficiency and energy use in apartments. The goal was to encourage and enable them to implement energy efficiency measures on a voluntary basis as a result of improved information and economic incentives.

Implementation

The Housing Advisory Agency focused its activities in the six largest cities in Lithuania. In each city, it organized seminars and training sessions for apartment owners and homeowner associations, municipalities, and housing maintenance companies on energy management techniques. A total of 627 people attended these sessions and received training materials. During the project, 410 people received free individual consultations, and since the project ended an additional 300 have also been advised. Sophisticated energy management software has been installed in five regional energy-consulting centers for use by the general public. This software can generate certificates indicating the degree of energy efficiency of a building and prepare energy plans for future seasons. Evidence suggests that apartments in which energy efficiency improvements have been implemented have an increased market value. The Housing Advisory Agency (HAA) is applying for a second grant from SGP to begin generating these certificates for certain buildings that make significant energy improvements.

Technology

The educational programmes and the energy management software address heat energy use efficiency. They outline ways to measure heating energy use and suggest ways to improve it. Heat lost through transmission, poor wall, roof and floor insulation, ventilation shafts, windows and inefficient water heating can be measured through this software. The software requests certain information about building construction and materials and equipment used, and then uses formulas to calculate heat usage and preparing plans for future heating seasons. The program is written in Excel, and can be used to estimate potential savings from certain investments. It also generates certificates for apartment buildings to indicate their degree of energy efficiency.

Environmental Benefits

Global: This project reduces heat energy use through efficiency improvements, thereby reducing fossil fuel consumption and carbon dioxide emissions. According to preliminary calculations, improved energy management techniques that do not require significant investment can reduce heat energy use by 10%, which translates into a fuel savings of 15% due to transmission and distribution losses. However, although 700 individual consultations were conducted, the grantee has been unable to verify how many households have actually implemented energy efficiency improvements.

Local: As a result of heating energy savings, there is less combustion of fuel oil, and consequently less air pollution, particularly in the vicinity of cities.

Livelihood Benefits

Income generation: If energy-saving techniques are implemented, a household can save 25-30% in heating bills. In addition, the implementation of energy management techniques usually increases the market price of an apartment, thereby improving the assets of an apartment owner.

Improved comfort: The use of energy management techniques improves the temperature control inside an apartment during the winter.

Capacity Building

This project improves the capacity of apartment owners, municipalities, homeowner associations, and housing maintenance companies to implement energy management techniques. The trainings and seminars, as well as individual consultations, are important tools used by the grantee to improve capacity.

Partners

This project has also received funding and technical assistance from the MATRA Pre-Accession Programme of the Dutch government, via the Energy Research Centre of the Netherlands (ECN). This is because Lithuania must improve energy efficiency in its housing sector in order to gain approval for entry into the European Union.

The Housing Advisory Agency built good partnerships with a variety of entities prior to project implementation, and has worked closely with the municipalities in this project, which are heavily involved in the residential housing sector. The municipalities have gained respect for HAA, and one municipality, which includes the city of Vilnius, has since funded HAA to conduct additional activities. HAA has also worked with homeowners associations, and has encouraged their development in order to facilitate the use of energy management techniques.

Beneficiaries

This project benefits residents of multi-apartment buildings in Lithuania, helping them to save money on their energy bills and also enjoy improved temperature control in their homes. In addition, municipalities are beneficiaries, since they are involved in energy management for some apartment buildings, and are also responsible for subsidizing the energy bills of those families who cannot afford to pay them.

LESSONS LEARNED

Environmental Management

This project introduced energy management techniques, including software for energy management implementation, into the housing sector, where there is great potential for improving energy efficiency. These techniques have great potential to be scaled up throughout the country, at least to the extent that the techniques do not require much up-front investment, but simply greater awareness.

Barrier Removal

Information/Awareness: This project has targeted its efforts toward lowering the informational barriers to implementing energy management techniques. Since implementing these techniques does result in savings, and many techniques do not involve significant investments, information and knowledge are the most important barriers for many apartment buildings. Assessing energy use can be complicated, and the use of computer software that can analyze energy information and estimate the energy savings resulting from certain improvements is a particularly unique and helpful intervention. In addition, the project has conducted media outreach, including with local newspapers, and was also featured during UN Week (October 17-24, 2002), when it received wide national media coverage.

Institutional: The Housing Advisory Agency has been successful in its support for homeowner associations, which are critical to the implementation of energy management techniques in many apartment buildings. The project has resulted in an increased number of homeowner associations, and the Housing Advisory Agency intends to monitor the results of the energy management techniques that they implement.

Scaling Up

The Housing Advisory Agency is now seeking to scale up its efforts from the six largest cities to 20 other smaller Lithuanian cities. It has approached SGP for a second grant, and will also be receiving funds from the Netherlands MATRA programme,

which co-financed the first project as well.The second project would involve continuing seminars and training, and also carrying out audits on 10 houses in different cities, issuing energy certificates for them, and implementing energy management techniques in those houses.These activities would be supplemented by a media outreach campaign to advertise the benefits of energy management.

The Lithuanian government has a strong interest in improving energy efficiency in the housing sector, since progress is necessary in order to obtain entry into the European Union. A World Bank project, called the Energy Efficiency Housing Pilot Project, had targeted these improvements but ended abruptly in June 2002, with few plans for follow-up. This SGP project could be very important for progress toward the goal of improving energy efficiency in residences, if it can demonstrate sufficient success of the households that implement the energy efficiency management and energy efficiency measures. Another important factor would be support for such measures provided by municipalities so as to encourage them to adopt and fund this approach on a wider basis.

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Small Scale Biofuel Production for Farming, Poland

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Institutional capacity development
❖ Policy and legislation
❖ Awareness,culture and practices

PROJECT DATA

Name: Small Scale Production of Biofuel from Rape Seed for Farming
Implementing organizations: Polish Biomass Association (POLBIOM), BARKA Foundation,Village for the XXI Century Foundation (NGOs)
Location: rural northwestern Poland
SGP contribution: $28,581 (one planning and three project grants)
Start date: July 2000

ENERGY OVERVIEW

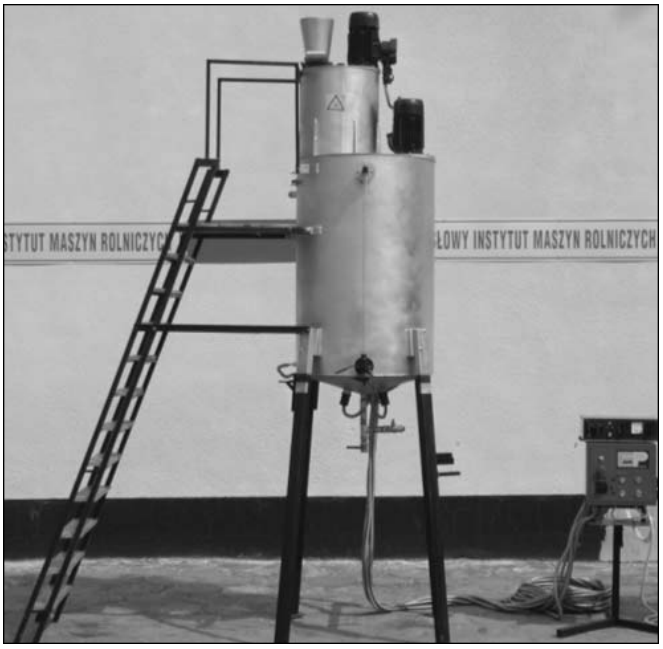
Energy resource: biofuel
Technology: small-scale oil extraction from rapeseed
Application: tractor farming
Sector: agriculture
Cost per installation: $10,000 - $11,000
Total energy provided: 1 hectare of rape straw yields the equivalent of 800 dm^3 of diesel,sufficient to farm 6.7 hectares
Number served: installations in four farming communities

BACKGROUND

In northwestern Poland,the majority of land used to belong to state farms. Farmers were at that time paid by the state, and played a dominant role in rural communities.In the 1990s,state farms were dissolved.These farmers lost not only their jobs, but also their previous status and the social organization to which they had been accustomed. For many, adjusting to new conditions has been difficult, and problems such as alcoholism have increased.

Farmers also face economic and political barriers to obtaining the energy needed to earn a living. Fuel is necessary to run tractors to farm the land, but small farmers have very little cash for most of the year until their crop is harvested. Fossil fuels, including the diesel that farmers use to power their tractors, are very expensive in Poland.This results in a reduced intensity of agricultural production,making farming less profitable than it could be.

Oil crises in Europe have stimulated research on biofuel alternatives to petroleum-based fuels used for transportation.Many European countries now produce biofuel from rapeseeds and vegetables. In the Czech Republic, biofuel is widely used, and



An installation for the small-scale production of rape biofuel (Poland).

many manufacturers of diesel engines,in particular tractor manufacturers, have accepted its use. However, in Poland taxes on the sale of biofuels make them very expensive to produce and they cannot compete with fossil fuels.

PROJECT DESCRIPTION

Overview

This project demonstrated the production and use of biofuel at the individual farm level. By growing rapeseed and making their own fuel, small farmers reduce their dependence on the purchase of highly priced diesel.Each biofuel installation requires a group of farmers to purchase the equipment and share the rapeseed fuel products.Thus, the production of biofuel helps farmers begin to work together again, helping to restore the social fabric of communities.

Implementation:Early efforts to test the small-scale production of biofuel were unsuccessful, but provided key lessons that led to later success.Initially, SGP in Poland supported a group of 50 farmers who agreed to split the installation costs with SGP, to grow rapeseed on their land, and to be trained to make and use the biofuel.After all farmers were trained and it came time to pay for the equipment,only one farmer was willing to pay as agreed. Taking this experience into account, SGP sought another setting in which to test the biofuel installation, and found it in the BARKA Foundation for Mutual Aid in northwestern Poland. BARKA is made up of formerly homeless farmers who now live and work together. These farmers agreed to grow rapeseed on their land, and to test the biofuel in their tractors. This meant accepting some risk that the biofuel would damage their equipment. A small, low-cost fuel making installation was designed by the PROMAR Multi-Trade company, which manufactures vegetable oil extractor presses using materials available in Poland. Once the installation was operational, BARKA farm-

ers then began educating other farmers about its possibilities. During the summer of 2002, 3-10 groups of farmers came to visit per week,some having traveled over 400 km.In November 2002, BARKA demonstrated the technology at an international fair in the town of Poznan,which drew 600 farmers and businesspeople.

So far, four installations have been produced, including the demonstration site at BARKA.One is the result of another SGP project being implemented by the Village for the XXI Century Foundation in northern Poland where there is a high level of unemployment among farmers.The project supports farmers in developing their own association to produce, manage and distribute biofuel among them.The fuel cannot be sold,since so far there are no standards set for small-scale biofuel production, but instead is shared by farmers informally. A third installation was purchased by a single, wealthy individual farmer who could afford the entire cost himself.The fourth installation was sold to a group of farmers in southwestern Poland, but these farmers purchased it at double the price of the installations at BARKA and Village for the XXI Century Foundation.

Technology

To produce rapeseed, farmers grow rape straw on their land. A small scale installation, adapted from a vegetable oil press, is used to extract oil from rapeseeds.After the oil is extracted,it must undergo re-esterification, sedimentation, and filtration before it can be used as fuel.The process of biofuel production has several by-products: rape oilcake, which can be used as a supplement to fodder for livestock, and glycerin, which can be sold to chemical or pharmaceutical companies.The biofuel is mixed with diesel,at a 50-50 or 75-25 ratio, and used in regular tractor engines. During the summer, even 100% biofuel may be used.The biofuel from one hectare of rape straw can be used to work 6.7 hectares of farmland.

Environmental Benefits

The reduced use of diesel results in fewer carbon dioxide emissions, thereby lessening the impact on the global climate. For a farm that uses biofuel to farm all of its land, diesel use for tractors is reduced by 50-75%. In addition, excess rape straw can be used as cooking fuel, replacing coal or oil.

Local Livelihood Benefits

Poverty alleviation: Farmers save money in several ways through this project, thereby freeing up cash for other purposes. First, the need to buy diesel is reduced by 50-75% if all farming is done via biofuel. Second, the oilcake produced in the biofuel extraction process supplements animal fodder, thereby reducing the need to purchase livestock feed.Third,if farms produce biofuel on a regular basis, the glycerin they produce in the process can be sold via long-term contracts with pharmaceutical or chemical companies. Finally, if excess straw is used for cooking,this reduces the need to purchase coal or oil for cooking.

Social empowerment: Although the first SGP biofuel project failed due to a low level of community trust and organization, efforts since then have been much stronger, and are helping restore farmers' confidence and ability to take part in collaborative efforts.

Capacity Development

In addition to training farmers in the technical aspects of producing and using biofuel, these projects are building farmers' capacity to undertake their own initiatives.This capacity may also serve to support other environmental and community efforts in the future.

Partners

The BARKA Foundation for Mutual Aid is a large farmer's organization that operates a farm at Chudobczyce in northwestern Poland. BARKA's involvement in the project has been critical, since it was at BARKA that the first successful demonstration of biofuel was conducted. BARKA's efforts to educate other farmers about biofuel have also been central. PROMAR, the manufacturer of the first installation,is another partner.

LESSONS LEARNED

Environmental Management

These projects demonstrate the possibilities of small scale production of biofuel; most biofuel production is done at a much larger scale. This potential continues to be tested at the farm level through an on-going SGP project. So far, projects have shown that rapeseed oil can provide power for farming almost seven times the amount of land on which rape straw is grown. However, one of the main lessons from experience is that variations in the quality of the rapeseed oil produced at a small scale create the risk that diesel motors may be damaged.So far, this is being addressed by farmers accepting this risk, growing rape straw on their own lands, and sharing the biofuel without offering it for sale.

Barrier Removal

Technical: The design of a small scale biofuel production system has reduced barriers for farmers to access the equipment.The installations are produced by a company, which makes it possible for farmers to order the equipment if they can meet the cost.

Financial: Since farmers no longer need to buy so much diesel fuel, financial barriers to purchasing additional farming equipment,seed,or other materials to help improve their crop yields are reduced. Purchasing the equipment itself usually requires a number of farmers to share costs.

Institutional/Cultural: The production and use of biofuel brings farmers together to undertake initiatives to improve their own situation together. Given the legacy of a centralized government regime, and the poverty and isolation that farmers have experienced since then, the project' impact at this level is perhaps greater than would otherwise have been expected. Although the future activities of these farmers would need to be tracked in order to determine this, the assumption is that these experiences in collaboration and project management will help

enable these farmers to undertake other projects together as well.

Policy

These projects occurred in a particular policy context in Poland. Biofuel taxes are high, and diesel fuel is also expensive. Instead of addressing these barriers directly (for example, by lobbying to reduce taxes),this project's approach is to support small-scale efforts, emphasizing farmers' independent action and promoting collaboration with other small scale farmers. Thus, the project goals have not so much been to affect the policy environment, but to improve the social and economic situation of small-scale farmers.This said, if the project is successful at spreading the small-scale production of biofuel from rapeseed, quality standards may become necessary, especially if these small-scale farmers wish to sell it.Project organizers have been involved in policy discussions about fuel taxes,seeking to ensure that policy makers do not create new barriers to small scale production.The time has not yet come to advocate for quality standards or other policy elements to support small scale production, but organizers hope that by raising awareness in the policy arena now, they may get the necessary support from policy makers later.

Scaling Up

These projects seek to "scale up" not by encouraging larger scale production of biofuel, but by encouraging the spread of small scale production.This approach derives from the social, political and economic context in which the projects have emerged. Following the purely environmental goal of reducing emissions from the use of diesel fuel in the agricultural sector might dictate scaling up in the large scale production sense. However, these efforts are based on an integrated view of environmental, economic and social goals and needs. Spreading small scale production of biofuel can decrease dependence on diesel fuel, and at the same time, these projects hope to show that farmers can also gain skills, an improved ability to earn a living, and a greater sense of empowerment.

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SGP Poland."Collective use of a Farm Installation for the Production of Rape Bio-Fuel." Date unknown.

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Przemek Czajkowski,national coordinator, SGP Poland.Email communications, October and November 2003.

Micro Hydro Power for Agro-Processing in Rural Areas, Bolivia

Themes

★ Renewable energy
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Micro Hydro Power and Processing Plant for Coffee and Chili Powder
Implementing Organization: Camata Community Organization (CBO)
Location: Camata, Department of La Paz, Bolivia
SGP contribution: $32,761.91
Start Date: December 2001

ENERGY OVERVIEW

Energy Resource: water
Technology: micro hydro
Application: lighting, radio, television (domestic and public buildings), coffee roasting, chili dehydrator, grinding mill,chili cutting machine, bag sealer, scale
Sector: domestic, public and commercial
Capacity: 27 kW
Number Served: 70 households, school, police station, public space, agro-processing plant

BACKGROUND

In Bolivia, only about 25% of the rural population has access to electricity. Due to the mountainous terrain and remote locations of many villages, it is unlikely that the grid will be extended to them anytime soon. Micro hydro power, in locations where it is feasible in Bolivia,is the least costly per kW of all the renewable alternatives.However, one common problem is that while hydropower is being generated all day, domestic uses mostly occur in the evenings and at night, and the power generated during the day may not be fully used.Due to this,greater attempts are being made to link micro hydro power installations to productive applications that can make fuller use of this power and generate income for community members.

Camata is a village in the Muñecas Province of the Department of La Paz, 20 km away from Charazani. Its inhabitants make their living through agriculture, primarily growing chilies,coffee, and corn. However, without power people there live only at a subsistence level.

PROJECT DESCRIPTION

Overview

This project built a micro hydro power plant in the village of Camata.The system provides electricity for domestic and public needs, and boosts the local economy by powering an agro-processing unit that enables people in the community to process their own agricultural products and sell them directly to the market. Both the power plant and the agro-processing unit are managed by a community cooperative.

Implementation

The Hydro-electric Program of the Hydraulic and Hydrology Institute determined through an assessment of the region that Camata was a feasible site for a micro hydro plant. In discussions with the community and local authorities, the community expressed willingness to participate. The idea of starting an agro-processing plant to dehydrate local chilies and make chili powder, as well as roast coffee beans,emerged through discussions with the community. The community organized a Committee for Electrification, which took the lead in constructing the micro hydro system and the agro-processing plant. This organization is now responsible for running and maintaining both efforts,and sets the regulations for the use of power and the operation of the plant. The community contributed the labor for the project, while the local municipality contributed materials and transformers for the high-voltage distribution line, and the Prefecture of the Department of La Paz contributed the posts for stringing the distribution lines and outdoor lights in the central square of Camata.

Technology

The infrastructure constructed through this project relates to both micro hydro power generation and agro-processing, including chili powder making and coffee roasting. The micro hydro power system is of 27kW capacity, and uses a Pelton turbine and a tri-phase generator. High-voltage distribution lines are a total of 1km in length. In the agro-processing plant, there is an oven using re-circulating hot water to dry chilies, a grain mill, a chili cutting machine, a coffee roaster and dryer, and a package sealer.

Environmental Benefits

Global: Previously, the community had no electricity and made use of kerosene for lighting. Decreased use of kerosene significantly reduces greenhouse gas emissions.

Local Livelihood Benefits

Health: Since kerosene use is reduced, indoor air pollution should also be reduced,thereby relieving some respiratory and eye problems.

Income generation: The introduction of agro-processing, along with electricity access, greatly improves the community's opportunity to generate income. Whereas previously farmers could only grow and sell enough chilies or coffee beans to meet subsistence needs, now they are planning to sell processed and packaged agricultural goods directly in the city of La Paz.The income from this operation will return to the community via the committee that runs both the micro hydro plant and the processing plant.In addition to the 70 households of Camata,238 households in the surrounding 12 communities benefit from the ability to sell their produce to the plant.

Beneficiaries

Direct project beneficiaries include the 70 households of Camata, who live in a relatively remote region. These community members now have access to electricity in their homes and in public spaces, as well as access to the agro-processing plant to process their agricultural produce. Secondary project beneficiaries include the 12 communities (238 families) in the surrounding area who will now also be able to bring their produce to the agro-processing plant and receive payment. Previously, they had greater difficulty selling their agricultural products.

Capacity Development

The capacity of community members involved in the committee is increased, since they have learned how to manage a micro hydro system and an agro-processing plant. IHH has provided technical assistance in all aspects of this project.

Partners

Partners in this project include:

Institute of Hydraulics and Hydrology: The idea for the project first came from an IHH feasibility study identifying Camata as a possible location for micro hydro power. IHH has provided technical assistance and guidance in building and managing the micro hydro plant and the agro-processing plant.

Committee for Electrification: This community committee has played a key rolein all decisions regarding the micro hydro and agro-processing plants. Partnership with the committee made the construction of the plants possible through the donation of community labor.

Local government: Both the municipality and the department in which Camata is located have contributed to the construction of the micro hydro plant, both donating equipment that serves to distribute electricity. This connection is important, since these government officials may learn through the process how micro hydro plants work and how they can work in certain locations.

LESSONS LEARNED

Environmental Management

This project illustrates one possibility for making use of the power generated by micro-hydro plant during the day. The project created a very targeted economic activity so that the community's raw agricultural materials could be processed and therefore sold at higher prices, improving the community's income generation potential. Indeed, it is not only Camata's prospects that are improved, but those of the surrounding community as well. This option should be considered along with the other options available for making full use of hydropower in rural communities, such as using the running water for irrigation purposes, as illustrated by another SGP project in Bolivia, or selling excess power to the grid, as illustrated by an SGP project in Indonesia. One aspect to bear in mind with respect to this alternative is that actually beginning to sell the finished products on the market may take some time. As of May 2003, the plant was producing the products, but sales had not yet begun in the city of La Paz, since transportation still needed to be arranged. There are a lot of factors to address in ensuring that such operations are sustainable businesses and managed such that they bring the greatest possible benefits to the community. Targeted technical assistance in this area is probably needed.

Barrier Removal

Information/Knowledge: The project raised awareness among government officials about the possibilities offered by micro hydro power. Government officials contributed to the success of the project, so it will be interesting to track whether this might result in their willingness to support or initiate other micro hydro projects.

Financial: The project does not appear to reduce financial barriers relating to this technology on a broader scale than this community, unless the government is motivated to contribute to the distribution of micro hydro systems as result of this project.

SOURCES CONSULTED

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GEF Small Grants Programme, Bolivia. "Proyecto: Microcentral Hidroelectrica y Planta Procesadora de Café y Locoto Camata." May 2003.

Solar-Powered Outdoor Lighting, Bolivia

Themes

★ Renewable energy
⁜ Innovative technology applications
❖ Technical capacity development
❖ Institutional capacity development
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Solar Energy Application in Arampampa
Implementing Organization: Agrobioenergy Assistance Program for Small Farmers (NGO)
Location: inter-Andean valleys north of Potosi, Bolivia
SGP Contribution: $23,351.54
Start Date: November 1997

ENERGY OVERVIEW

Energy Resource: solar
Technology: communal PV systems
Application: outdoor and indoor lighting
Sector: public and residential lighting
Total power provided: 4.8 kW
Households Served: public lighting for entire village, residential lighting for 30% of homes in the village

BACKGROUND

In the high regions of the Andes Mountains, there are numerous poor and remote villages.Many do not have access to electricity, and depend upon candles, batteries and diesel for their energy. Due to their remoteness,it is unlikely the grid will reach these villages any time in the near future.

PROJECT DESCRIPTION

Overview

This project sought to remove technical and institutional barriers to the use of solar electricity in this region of high solar radiation. To this end, the project established an Energy Services Committee in the community, which managed the installation of outdoor lighting, as well as indoor lighting for 30% of the community. In turn,this community has shared its newly-gained technical expertise with 54 neighboring communities also interested in installing this type of system.

Implementation

The project was carried out in three stages. First, the community was organized and motivated for the project. Next, the equipment was installed. Then community members were trained in system management.All of these activities were conducted via participatory workshops, including the design and definition of the network, establishment of administration and management systems, cost calculations and the setting of rates for public and domestic lighting.

Technology

The system used twelve 80Wp panels, 4 batteries, 1 charge regulator and 2,500 meters of aluminum cable.

Environmental Benefits

Global:The project achieved a 70% reduction in the use of candles, batteries and diesel, thereby reducing carbon dioxide emissions.

Local Livelihood Benefits

Health: Due to outdoor lighting, the project has reduced the risk of accidents when people are moving around at night in the town.In addition, for those individual households receiving solar electricity, there are health benefits associated with reduced use of candles and diesel sources of energy.

Education: Nighttime activities are now more possible in the village. This has opened up new educational and cultural opportunities for community members.

Regional/national benefits:

There is great potential for the use of solar energy in this region near the Andes.The region has benefited from the example set by this pilot project, which opens up a new option for meeting energy needs.The community of Arampampa has distributed technical information about their system to 54 neighboring communities who wish to set up similar systems. In addition, it appears that there are plans in the medium term for the electric grid to extend to this region north of Potosi.The community of Arampampa plans to maintain its solar electricity generating system, but in anticipation of the grid's extension, the Energy Services Committee has switched from a direct to an alternating current for compatibility.

Capacity Development

The community learned how to organize itself to manage a communal electricity system through an Energy Services Committee. In particular, four community leaders, four local government members and two members of the Community Supervisory Committee were trained in energy use applications and the maintenance of photovoltaic systems.

Beneficiaries

The entire community of Arampampa has benefited from the new outdoor lighting, and 30% of the households now have indoor electricity as well. In addition,54 neighboring communities now have technical information about how to build systems of their own.

Partners

The community itself was the most critical partner in this project. Local people participated, through workshops, in many aspects of the design and implementation of the project. In addition, local government was integrally involved. This has helped the project in that the new electric system can be well integrated into the overall plan for the development of the village, and the new solar mini-grid can be integrated into regional plans for electrification.

LESSONS LEARNED

Environmental Management

The community seems to have been very successful at reducing the use of candles, batteries and diesel fuel. Outdoor lighting seems to be a good application for a communal PV system because there is little opportunity for some families to take greater advantage of it than others. It also seems that the community has established tariffs for public and domestic electricity use, which also helps ensure proper management of energy use. Finally, communal PV systems have the advantage that they can be more easily integrated into conventional electricity networks, should those be developed at a future time.

Barrier Removal

Institutional: Adequate participation in the decision-making about the design of a mini-grid and the setting of rates are essential. An Energy Services Committee with clear responsibilities and community support made this project possible. It was very helpful that members of the community's existing government were part of this committee. This lent legitimacy to its efforts and also helped facilitate the community's awareness of regional electrification plans so that steps could be taken ahead of time to ensure the integration of the new solar mini-grid instead of allowing it to become obsolete when the new conventionally powered grid was extended.

Scaling Up

The choice of location for this project is one element that can facilitate scaling it up. Arampampa is one among many villages in this Andean region with great solar power potential and a great need for electricity. Thus, Arampampa can serve as an excellent local demonstration project with wide application in the immediate surroundings. The integration of local government officials is also helpful in facilitating the replication or scaling up of projects. These officials lend legitimacy to the community's efforts when promoting them in other communities. In addition, these officials can help the community access government information more readily, which can be very helpful in project planning.

SOURCES CONSULTED

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GEF Small Grants Programme, Bolivia. "De Hombres, Bosques y Montanas: Memoria de 25 proyectos apoyados por el PPD/PNUD-LIDEMA." Bolivia, 1999.

Biodigestors in Rural Communities, Costa Rica

Themes

★ Renewable Energy
⛭ Linkages with other environmental goals
❖ Technical capacity development
✷ Gender equity and empowerment (MDG 3)
✷ Health (MDGS 4-6)

PROJECT DATA

Project Name: Biodigestors in rural communities
Implementing Organizations: Fundación para el Desarollo de las Comunidades del Sur (FUDECOSUR) and Fundación Union y Desarollo de las Comunidades Campesinas (FUNDECOCA)
Project Location: Brunca region, southern Costa Rica; Huetar region, northern Costa Rica
SGP contribution: $40,000 ($25,000 FUDECOSUR, $15,000 FUNDECOCA)
Start Date: September 1997 (FUDECOSUR); April 1999 (FUNDECOCA)

ENERGY OVERVIEW

Energy Resource: biogas
Technology: biodigestors
Application: cooking
Sector: domestic
Cost of each system: $150
Households Served: approximately 340 as of October 2001 (FUDECOSUR 300; FUNDECOCA 40)

BACKGROUND

These two biogas-related projects are located in two different regions of Costa Rica: the Brunca region in the south (FUDECOSUR),and the Huetar region in the north (FUNDECOCA). In both regions, families already keep livestock, such as pigs, goats and cows. However, foul odors, flies, and water contamination resulting from animal waste are problems. In addition, most families cook primarily with wood, which causes air pollution. Some families also use gas or electricity when they can afford to and when it is available. Some families construct kitchens outside their houses in order to avoid the smoke, but this is costly.

PROJECT DESCRIPTION

Overview

Both projects sought to train local farmers to build and use biodigestors, fueled by livestock waste to produce biogas for cooking, thereby reducing the burning of wood for cooking, decreasing carbon dioxide and methane emissions, protecting water sources and local forests, and improving livelihoods.

Biodigester construction and related training (Costa Rica).

Implementation

Farmers receive loans in order to build biodigestors and participate in training sessions to learn how to construct, operate and maintain them. FUDECOSUR began its work first, and FUNDECOCA sought to implement a similar model of work in a different region, and received technical assistance from FUDECOSUR. In FUDECOSUR's project, loans were given to households that had livestock operations and were willing for their farm to be visited by those wishing to learn how biodigestors work. During the project period, 93 biodigestors were installed, and 150 people were trained, about a third of whom were women.Since the project ended,approximately 200 additional biodigestors have been built,including some in Nicaragua and Panama. FUNDECOCA's project was smaller – so far 40 biodigestors have been built – but focused more on training women.

Technology

The biodigestors are above ground and made of plastic. FUDECOSUR, while providing technical assistance for FUNDECOCA, made some technical improvements upon the biodigestor model. For example, they added a fine wire screen over the valve from which gases exit to help reduce noxious fumes, a device to eliminate the coating of scum that prevents the biogas from exiting; and a sieve over the opening through which organic matter so that rocks do not get in and break the plastic.

Benefits and Impacts

A report on the environmental and livelihood benefits of these two projects was prepared for the SGP office in Costa Rica, which involved interviews with biogas users,both organizations, and local community leaders.The description of benefits below is based on this report, issued in October 2001. Most of these benefits were confirmed, at least qualitatively, by field visits.

Environmental Benefits

Global: The use of animal waste to produce fuel means that greenhouse gases are reduced in two ways: 1) methane is no longer emitted from animal waste that lies unused;and 2) fuelwood burning is reduced since almost all cooking is now done via biogas.

Local: The use of biogas reduces pressure on local forests, thereby helping to protect local biodiversity. Furthermore, the contamination of water sources by animal waste is reduced. In addition,agricultural waste, such as from yucca plants) that previously was dumped is now being fed to livestock.

Livelihood Benefits

Health: Interviews with local women indicate that the reduced smoke has improved their health. For example, women said their breathing problems had gone away, and the condition of women with lupus in the community has improved. In addition, foul odors and flies associated with livestock waste have decreased,since the waste is now quickly removed and placed in the biodigestor.

Savings: Families have saved money as a result of the biodigestors, although there is no evidence of how much. Savings come from reduced need to buy gas, electricity or wood for cooking.

Capacity Development

In FUDECOSUR's project, 150 people have participated in training sessions.In addition to learning how to construct biodigestors,these training sessions have covered topics such as why environmental protection is important, livestock management techniques, economic management for sustainability, women's issues,and health. Furthermore, some of those who participated in trainings and built biodigestors have since become trainers themselves, and have even traveled to Nicaragua and Panama to help implement similar efforts there.

In FUNDECOCA's project, FUDECOSUR helped provide technical assistance, and helped to construct the first four biodigestors. Certain ways to improve the technology of the biodigestor were also identified (see below under "Lessons Learned.") FUNDECOCA's project does not seem to have organized specific trainings, but instead incorporated training and education about biodigestors into workdays in the field, during which the construction and use of biodigestors was demonstrated,and their advantages were shared and discussed.

Beneficiaries

The primary beneficiaries are farming families in these two regions of Costa Rica. In FUDECOSUR's project, an estimated 3 out of 10 training participants were women. In FUNDECOCA's project, there was a greater emphasis on involving women.In addition, FUDECOSUR's efforts have been replicated in Nicaragua and Panama.

Partners

International NGOs: FUDECOSUR was founded in 1993, with the support of CARE International.

Domestic NGOs: FUNDECOCA has had support and technical assistance from FUDECOSUR.

Local communities: In each location, community members have played important roles, since farmers themselves must build the biodigestors. FUDECOSUR has issued loans to farmers in 31 communities to build biodigestors. FUNDECOCA was active in 14 communities, and local revolving loan funds have helped provide loans to 11 farmers in FUNDECOCA's project.

Government: FUDECOSUR involved government representatives in the training sessions.These individuals provided technical assistance, andsupport to the project. For example, one ministry helped FUDECOSUR gain entry to work with communities located within national parks.

LESSONS LEARNED

Environmental Management

This project links climate change mitigation and biodiversity protection through the promotion of biogas produced from animal waste. The protection of water sources was particularly important in this project; in fact, the project has resulted in the reduction of complaints by neighbors to the health department about water quality and foul odors. It would seem that the Health Department should have some interest in promoting a project like this.

Barrier Removal

Technical: This project has reduced technical barriers in the sense that community members – in FUDECOSUR's case, as many as 150 - have learned to build the biodigestors themselves, and have themselves spread this knowledge to other communities and even to other countries (Nicaragua and Panama).

Information/Awareness: As evidenced by interviews conducted with women and men who use biodigestors in these communities, community members are more aware of how environmental problems affect their livelihoods,and how using a biodigestor can improve the environment.The report did not examine whether or not other environmental issues were given more attention as a result of the biodigestors, which would be the true test of whether environmental awareness in general was actually increased.

Scaling Up

Through the SGP grant, FUDECOSUR had originally planned to install 80 biodigestors,in addition to the 30 they had already installed when they applied for funds. At the end of the grant period,FUDECOSUR's work had resulted in the installation of 93 biodigestors.Later interviews at the field level revealed that in this region, there were now about 200 farmers using biodigestors. Another interview suggested that about 300 were in use, but this included communities in Panama and Nicaragua

that had received training from Costa Rican FUDECOSUR beneficiaries. These figures illustrate that FUDECOSUR's work, particularly through capacity building, has resulted in the spread of biodigestors beyond those originally planned. FUNDECOCA's impact is also continuing beyond its grant period. At the end of its grant period in April 2000, 29 biodigestors had been installed, but as of October 2001 that number had grown to 40.

SOURCES CONSULTED

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Jorge Arturo Sáenz, "Biodigestores: Aportes a las condiciones ambientales y calidad de vida de la población campesina," October 2001, available online at:http://www.nu.or.cr/gef/ (July 10, 2003).

Eduardo Mata, National Coordinator, GEF Small Grants Programme Costa Rica. Email communication, October 2003.

"Sol de Vida:" Improving Women's Lives through Solar Cooking, Costa Rica

Themes

★ Renewable energy
✲ Innovative technology applications
❖ Institutional capacity development
❖ Awareness,culture and practices
✷ Gender equity and empowerment (MDG 3)

PROJECT DATA

Name: Sol de Vida:Improving Women's Lives through Solar Cooking
Implementing Organization: Fundación Sol de Vida (NGOs)
Location: Guanacaste, Costa Rica
SGP contribution: $53,000 total (3 grants: $20,000 in October 1994, $3,000 in April 2000, $30,000 in June 2000)
Start Date: Fundación Sol de Vida founded in 1994

ENERGY OVERVIEW

Energy Source: solar
Technology: passive solar cookers
Application: cooking, heating water
Sector: residential
Cost of each system: $100-$150 for materials, $300 total including instructors,transportation and follow-up
Energy provided: oven temperature of 150° C on average with good sun
Number Served: 130 households, 10 new community organizations founded

BACKGROUND

Much of the Guanacaste region of Costa Rica, a former cattle-ranching area,is dry and flat with a high degree of sunshine, and is subject to recurrent droughts. People depend primarily upon wood for cooking in the region, subjecting the remaining dry tropical forest areas to intense pressure. Some households also have electric or gas stoves. Many women spend most of their time attending to household chores, including cooking.

PROJECT DESCRIPTION

Overview

Operating in the Santa Cruz and Nicoya counties of the Guanacaste region, Fundación Sol de Vida takes a holistic approach to expanding the use of renewable energy. The project not only promotes the use of solar power for cooking, but also seeks to build women's capacity for other development activities through the process of constructing and using solar cookers.

Implementation

The project originated in 1989 when an American physics professor, William Lankford, visited Costa Rica and a number of women attended a workshop he gave on building solar cookers. After this, the women themselves established the Fundación Sol de Vida in 1994.

Demonstration of cooking with a solar stove at a community festival (Costa Rica).

There are three general areas of work, all of which have received SGP funding: workshops to build solar cookers, outreach activities through the yearly Fiesta del Sol, and educational and demonstration activities at the Casa del Sol.

Solar Cooker Workshops: Capacity-building is integrated into every aspect of the project's operation.Each community establishes its own independent organization, led by local women. There are five stages of project development: 1) assessing the feasibility of establishing a cooking project in a community by lending a woman a solar cooker for six months; 2) demonstrating solar cooking to generate interest in attending a workshop; 3) holding a construction workshop in which 10-15 women work together to build their own solar cookers, complemented by training sessions on organizational development, environmental issues, health, nutrition, human rights and self-esteem; 4) conducting follow-up and continued training on using and maintaining the cookers,combined with building trust by embarking upon complementary projects chosen by the newly-formed women's group, such as micro-enterprises,community gardens, and chicken and pig-raising cooperatives; and 5) establishing an independent organization in each community that can seek funding and support on its own to sustain the women's activities.The cost of the solar cookers and the workshop are shared by three parties: Sol de Vida, which organizes the training and finds trainers (often women who participated in previous training sessions; the women participants, who donate the labor and time to construct the cookers; and an outside donor, who covers the costs of materials for constructing the cookers.

Fiesta del Sol: These annual events have taken place every year

in February since 1991. Communities hold these festivals to promote solar technology, to educate communities about environmental issues,and to share the results of the other activities of the women's groups formed in connection with the construction of solar cookers.

Casa del Sol: This resource center offers educational services to school children and the general public. It displays several models of solar cookers, a solar water pump, a solar heater and a solar dryer, as well as photovoltaic panels for lighting.One Casa del Sol project involves building parabolic solar stoves, which reach a temperature of 400° C. Casa del Sol hopes one day to sell these internationally.

Technology

The solar cooker promoted by Sol de Vida has been refined over the years to meet the specific needs of Central American families, and continues to evolve in response to local conditions. Basically, it consists of a wooden box that is set inside another box, surrounded by insulation. It is covered by two panes of glass,through which sunlight passes to heat the cooker to an average inside temperature of 150° C (with good sun). Pots rest on a black metal plate inside the box, and aluminum foil reflectors help focus the sunlight on it. The cooker also contains a thermometer to monitor the temperature. The cookers can be built with $100-$150-worth of locally-obtainable materials.

Environmental Benefits

Global: 130 families have switched from wood,electricity or gas to solar cooking, thereby reducing greenhouse gas emissions. There is good sun availability in this region year-round, but on days when there is not enough sun, these families still rely on traditional cooking methods.

Local: Those who have switched to solar cooking have reduced their use of wood from local forests.

Local Livelihood Benefits

Health: Solar cookers do not produce smoke like wood-burning stoves. Women also receive training in health and nutrition during the 22-day construction workshop. Finally, food can be cooked with less fat when a solar cooker is used. For all of these reasons, this project should be improving health in the community, especially for women and children involved in cooking.

Education: Women benefit from educational components of the construction workshops. In addition, solar cooking takes less time, so women have more free time which they can use in educational and other activities.

Improved opportunities: According to several accounts, this project has "liberated" the women in this region, enabling them to engage in personal development in ways that were not possible before. This is both because of the training provided during the solar cooker construction workshops, and because of the additional time available for other activities since solar cooking is less time-consuming.A critical element that enables women to take advantage of the extra time is the fact that the project builds social as well as individual capacity by developing local groups and encouraging women to work together on other projects not related to cooking. For example, some of the groups now raise awareness about domestic violence, and are starting support groups to help women in this situation.

National Benefits

The project demonstrates ways in which solar cookers can be integrated into lifestyles in Costa Rica. Sol de Vida was awarded the "Premio Nacional de Energia" in 2000 by the Government of Costa Rica,and was mentioned in Costa Rica's State of the Nation report in 2000 as innovative projects in renewable energy. This suggests that demonstration benefits do exist nationwide, although no evidence has been found that the model has been taken up in other parts of the country.

Capacity Development

Sol de Vida's primary capacity-building activity is the construction of solar cookers. These workshops,combined with follow-up in the communities themselves, are specifically designed to build women's capacity to improve their own lives and that of their communities in ways that do not only relate to cooking. Not only do women learn individually about health, nutrition, self-esteem,human rights and more, but the workshops lay the groundwork for building trust between women and forming new women's organizations. This is capacity development in the truest sense:because of their experience in building solar cookers,these women are now more able to launch other activities to benefit their families and communities.

Beneficiaries

Women in the Santa Cruz region of Costa Rica are the primary beneficiaries, along with their families and communities. Secondarily, other communities benefit by attending the Fiesta del Sol or by visiting the Casa del Sol, and learning about solar technology, environmental issues and the livelihood improvements associated with solar cookers.

Partners

Women's community groups: the primary partners of Sol de Vida are the new women's groups established in ten communities (so far) via the construction of solar cookers. These women provided the labor for building the stoves, and now take leadership in creating new projects to benefit their communities. They are also involved in helping other communities start similar efforts, since participants are encouraged to become trainers themselves.

Government: The Department of Agricultural Development donated the land for the Casa del Sol.

International: Sol de Vida originally received the support of the Central American Solar Energy Project (CASEP),which provided training on building solar cookers at the University of Costa Rica. CASEP also seeks to spread the Sol de Vida model to other countries. Similar programs currently exist in Guatemala, Honduras and Nicaragua.

LESSONS LEARNED

Environmental Management

This project is an excellent illustration of how success can be achieved when a new form of energy use is integrated fully into the lifestyle of a community. Use of the solar cookers is sustained because women build the cookers themselves,investing time and energy. After construction, there is follow-up to ensure that the cookers are maintained properly, and to share recipes and cooking techniques.This too is a community-led activity, since the original construction workshop is designed to build cooperation between women from the same community, eventually leading to the establishment of a new, autonomous women's group.

Barrier Removal

Financial: Since women build the stoves themselves, only the costs of materials must be covered, plus small amounts for transportation and instructors for the workshops. Women who learn how to build these can then teach others to do the same, again at a low cost.

Technical: The Casa del Sol helps reduce technical barriers by creating locally-adapted models of solar-powered stoves,water pumps,water heaters and crop dryers.Educational programs at the Casa del Sol also help improve knowledge about these technologies,some of which can be reproduced locally.The fact that the Casa has designed a parabolic solar stove which they hope to export serves as evidence that barriers to solar energy technology are being reduced.

Institutional: This project is particularly strong in reducing institutional barriers, since whenever it works in a community it seeks to create a new institution - an autonomous women's group - which is educated and concerned about environmental issues and which has the capacity to undertake new projects on its own.So far, ten such community organizations have been created.

Gender: This is another particularly strong aspect of this project. Building women's ability to take actions on their own, particularly regarding the environment and livelihood issues, is a central goal of this program. The project is led almost completely by women. Its work illustrates how solar energy can be an instrument of development specific to women, opening up new opportunities for them and improving their standing in the community.

Scaling Up

Sol de Vida itself has concentrated its activities in the Guanacaste region of Costa Rica. Sol de Vida's goal is not simply to spread the use of solar cookers, but to enable women, armed with new skills and knowledge about the environment, health, human rights and other critical issues, to take on new activities of their own choosing. Sol de Vida's other efforts, the Casa del Sol and the Fiesta del Sol, seek more specifically to spread solar technology. However, throughout the work of Sol de Vida, human development is also critical. In fact, the two go hand-in-hand.For example, a Fiesta del Sol not only showcases the advantages of solar cookers, but also helps advertise the diverse activities of the women's groups formed through the solar cooker construction process,such as the sale of handicraft items or education about domestic violence.

Sol de Vida's model has been spread to other countries in Latin America by the Central American Solar Energy Project (CASEP).This U.S.-based nonprofit organization was founded by Professor William Lankford,who refined the model of a solar oven and conducted the first training in Costa Rica,from which Fundación Sol de Vida emerged. Several years later, a team of women from Costa Rica traveled to Honduras with support from CASEP to begin a project there. Today, the projects in Guatemala,Honduras and Nicaragua employ a model similar to that of Sol de Vida, which is in general promoted by CASEP.

The project does not promote a specific market mechanism to spread solar technology, either within Costa Rica or across Central America.Within Costa Rica, the spread of solar cookers is currently dependent upon Sol de Vida's ability to organize training workshops and to find donors to help cover the cost of materials. CASEP also relies on donors to spread the model to other Central American countries.

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Improving Domestic Refrigerator Efficiency by Conversion to Hydrocarbons,Dominican Republic

Themes

★ Energy efficiency
⁜ Linkages with other environmental goals
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Policy and legislation
✷ Poverty alleviation (MDG 1)

PROJECT DATA

Name: Conversion of Domestic Refrigerators from R-12 to hydrocarbons
Implementing Organization: Asociación Dominicana de Técnicos en Refrigeración y Acondicionamiento de Aire, ADOMTRA (NGO)
Location: urban areas, Dominican Republic
SGP contribution: $22,494 (June 2000), and $31,343 (December 2001)
Start Date: June 2000

ENERGY OVERVIEW

Energy Resource: fossil fuel-based electricity (reduced use)
Technology: natural, hydrocarbon refrigerant
Application: refrigeration, air conditioning in cars
Sector: domestic, commercial
Cost of equipment/installation: $880 for equipment, $60.00 per installation
Efficiency improvements: 30% improvement in refrigeration efficiency
Number Served: more than 2,500 refrigerators converted to HCs nationwide; 490 technicians trained directly in installation techniques

BACKGROUND

In the Dominican Republic, there are approximately 2.4 million domestic refrigerators, and about 7,200 refrigerator technicians.The domestic, commercial and industrial sectors consume approximately 269 tons of refrigerants. Ozone-harming and energy-inefficient refrigerants, such as CFC-12, also known as R-12, are gradually being phased out.The major substitutes for CFC-12, such as R-134a, do not harm the ozone layer but do act as greenhouse gases. However, another product manufactured in the United States called Enviro-Safe, is a natural hydrocarbon and is more energy-efficient for cooling than both R-12 and R-134a.

PROJECT DESCRIPTION

Overview

This project trains refrigerator technicians in energy-efficient refrigerator repair techniques,in particular through the replacement of CFCs with a natural hydrocarbon that provides more efficient refrigeration and does not act as a greenhouse gas. Since they are more efficient,less electricity is needed for refrigeration, and consumers save money.

Replacing CFC refrigerants with a more energy-efficient, natural hydrocarbon (Dominican Republic).

Implementation

The initial grant for this project concentrated on obtaining the refrigerant and the equipment, developing training materials, organizing national-level training for refrigerator technicians, and practicing the conversion of a refrigerator from R-12 to the more efficient, natural, hydrocarbon refrigerant. Obtaining the refrigerant, which must be imported from the United States, turned out to be difficult because of new customs restrictions.This delayed project implementation, but the problem was resolved and now local Dominican firms import the necessary refrigerant. So far, 142,000 6-ounce cans of refrigerant have been imported to the Dominican Republic since this effort began.This is equivalent to 169 tons of hydrocarbons, which can displace 509 tons of R-12 or 452 tons of R-134a.

The grantee, ADOMTRA, has established a revolving fund in order to help repair shops obtain the equipment they need for converting refrigerators. Some SGP grant money was set aside to provide capital for this fund.With this money, ADOMTRA purchased sets of tools and equipment needed for retrofitting refrigerators. Technicians and/or shops apply to receive equipment through the fund. If approved, they must pay 30% of the equipment's cost up front. The remaining amount must be repaid within a year.The repayments are used to purchase new equipment to distribute through the fund. If technicians receiving equipment fail to repay, the equipment is taken back and given to other technicians.

Although the project did not intend to target car air conditioners,as a result of this project approximately 35% of all technicians in this sector are now using the alternative refrigerant for this purpose as well.

The second SGP grant is targeted towards continued training of technicians and increased public outreach about the benefits of this natural refrigerant in terms of cost savings over time due to reduced energy use for refrigeration.

Technology

Enviro-Safe, the refrigerant used by this project, is a natural, hydrocarbon compound manufactured in the United States and endorsed by Greenpeace. It has no effect on the ozone layer because it degrades very quickly, and has much less impact as a greenhouse gas than other substitutes for Freon-based refrigerants. It is up to 32% more energy-efficient as a refrigerant, because it is a better conductor of heat. Since less energy is required to compress it, refrigerator compressors can last longer using this product.

Environmental Benefits

Global: This project reduces greenhouse gases in two ways. First, because Enviro-Safe is an energy-efficient refrigerant, refrigerators using it require less electricity, and fossil fuel emissions from electricity generation are reduced. Second, if it is released into the atmosphere, it is a much weaker greenhouse gas than either Freon-type refrigerants or their substitutes.This project has retrofitted over 2,500 refrigerators of 5,10,12 and 21 square feet capacity.

Local: According to product information, this natural refrigerant is non-toxic. Therefore, if spills occur the substance degrades naturally in less than one year.This is not the case for the synthetic refrigerants that it replaces.

Local Livelihood Benefits

Employment: The technicians who participate in the training sessions come from middle to low-income groups.The training provided through this project is required to obtain a technician's license to repair refrigerators.Thus,the project is enabling technicians to receive licenses and earn a living.The revolving fund also helps them access necessary materials and equipment.

Cost savings: Dominicans whose refrigerators are converted to this refrigerant save money on electricity because their refrigerators are more efficient.

Beneficiaries

Refrigerator technicians are the direct beneficiaries of the training provided by this project.190 have already been trained,and 300 additional technicians are currently being trained by the project. Secondary beneficiaries are refrigerator owners who can now save money on their electricity bills if they convert their refrigerators. In addition, car air conditioners are also being retrofitted with the new refrigerant.

Capacity Development

The main activity of this project involves building the capacity of refrigerator technicians to safely remove R-134a and other refrigerants,and to replace them with the Enviro-Safe.The project has not only trained about 500 technicians so far, but has also developed instruction manuals for the procedures. For consumers, the project developed warning labels for handling refrigerators, and information about the technical characteristics of the new refrigerant.

Partners

ADOMTRA, is a relatively well-organized association of refrigerator and air conditioner technicians. It was already providing training for technicians, and has added this to its training program. ADOMTRA has also partnered with INFOTEP, the Dominican Instituto Nacional de Formación Técnica y Profesional (National Institute of Technical and Professional Training).Many refrigerator technicians were already involved in this institute.The partnership helped raise awareness about the ADOMTRA training, and helped design training that included licensing for refrigerator technicians.

LESSONS LEARNED

Environmental Management

This project illustrates how efficiency savings can be achieved through improvements in home appliances, and also in automobiles.While it also replaces ozone-depleting refrigerants,this project is very much geared toward removing barriers to energy efficiency. However, to generate significant environmental benefits,the public must be educated about the benefits of the switch to the new refrigerant, and a sufficient number of technicians must be trained.

Barrier Removal

Technical: A major barrier to using the new refrigerant is a lack of technical capability in safely removing old refrigerants and installing this one.This project directly targets this technical barrier by providing training to technicians.The fact that the training is required for obtaining a license to repair refrigerators is significant and helpful in achieving the project's goals. A partnership with the national association in which refrigerator technicians are involved is also helpful in advertising the trainings as widely as possible.The project has also removed technical barriers for the use of this refrigerant in the automotive sector.

Information/Knowledge: The project introduced this hydrocarbon refrigerant to the Dominican Republic for the first time. Thus, an important element of the project has been to raise awareness about the benefits of switching to this refrigerant. These efforts, especially under the second SGP grant to the project, include producing stickers that advertise the environmental benefits and cost savings, and building connections with media to advertise the project. In particular, ADOMTRA now has a presence on Channel 5,called the "Natural World," where it discusses the ozone layer and climate change, and suggests

this as a way to take action.

Policy: The project encountered difficulties initially because of new customs regulations that were not allowing the hydrocarbon refrigerant to be imported. Overcoming this barrier took some time because ADOMTRA did not already have political connections or experience. Eventually, however, they were successful at importing the refrigerant, and since then other companies have begun to import the product.An ability to negotiate such policy issues is essential for energy projects, especially those that rely upon imported technology or products,like this one.

Financial: The project reduces financial barriers to implementing this technology by establishing a revolving fund through which workshops can obtain tools and equipment necessary to repair refrigerators and replace refrigerants. However, during the project the equipment costs have increased, which may have limited this project's ability to expand access to the equipment via the revolving fund.

Scaling Up

Given the large number of technicians, workshops, and refrigerators, there is the potential for scaling up this project. ADOMTRA appears to have reduced policy barriers to importing the product,and has successfully trained a number of technicians. Two barriers remain, and may require significant work and investment before they can be overcome: a lack of awareness about the product among consumers, and further financial barriers to purchasing the necessary equipment.The project is now implementing a wider outreach effort using stickers to advertise the environmental benefits of the alternative refrigerant.

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Replacing CFC refrigerants with a more energy-efficient,natural hydrocarbon (Dominican Republic).

Linking Micro Hydro Power and Forest Conservation, Dominican Republic

Themes

★ Renewable energy
✲ Innovative technology applications
✲ Linkages with other environmental goals
❖ Technical capacity development
❖ Policy and legislation
❖ Awareness,culture and practices
✷ Education (MDG 2)

PROJECT DATA

Name: Electrification of the El Limón Community
Implementing Organization: El Limón community (CBO)
Location: rural Dominican Republic
SGP Contribution: $27,500
Start Date: September 1997

ENERGY OVERVIEW

Energy Resource: water power
Technology: micro hydro
Application: lighting, information access, computer access
Sector: Residential, public spaces (related to education)
Size of micro-hydro system: 2.5kW
Households Served: 65 (350 people)

BACKGROUND

Many people in the rural areas of the Dominican Republic have no access to electricity.They use kerosene for lighting and costly batteries for other electricity needs.The extension of the electric grid is not expected to reach these communities for many years,especially since some of them are so dispersed and demand so little power that even mini-grids are not an economic solution. Without electricity, these communities are extremely isolated, with little opportunity for economic improvement.

In El Limón, located in the mountains 60 km west of Santo Domingo, kerosene was used for lighting,causing severe indoor air quality problems. Due to insufficient rainfall for agriculture, the town's main sources of income were raising goats and making charcoal.The nearby forest was being rapidly depleted as townspeople harvested it to produce charcoal.However, in the early 1990s a regional community development agency lent money and technical assistance to build an irrigation system. This system, which water from a stream 6 km away, required significant community investment and organization to build. Thus,the irrigation project not only enabled the town to grow its own crops, but also built their organizational skills for other projects.This high degree of community organization,as well as the existing irrigation infrastructure, made it possible for the community to go on to use water power to generate electricity.

Micro-hydropower project brings electricity and computer access to students (El Limón, Dominican Republic).

PROJECT DESCRIPTION

Overview

This project introduced an innovative micro hydropower system in El Limón,providing electricity for lighting homes and the local school. From the start, the project has been integrated into other development projects in the area. Because of this, and due to strong existing community organizations and intensive capacity development,the project has contributed to livelihoods in more ways than anticipated. It has also resulted in local environmental management activities; because of their dependence upon water for power, the community has initiated efforts to protect the forest within the local watershed.

Implementation

Jon Katz, a physicist at Cornell University, first suggested the idea of using the irrigation system to generate electricity during a 1996 visit to El Limón. He helped the community find funding for the project, including from SGP, Cornell University, and Rotary International, and designed the hydroelectric system. The community spent 18 months building it, each person giving one day per week to the project.The infrastructure was very challenging to build;the 135 concrete poles were particularly difficult to erect.These difficulties might have been insurmountable if El Limón's community were not already so strongly organized.

A hydroelectric committee was established,which collects electricity tariffs for maintenance and future repairs. Tariffs are approximately $2 per month, which is about what community members used to pay for kerosene. The committee required written promises to pay from each household before installing house wiring.Later on,the Inter-American Foundation donated money for laptop computers and video equipment, and Katz

designed a method of Internet access at the school that does not depend upon telephone lines, which are not available in El Limón (the system uses a digital radio, a repeater and a modem).

The project has made the community increasingly aware of the need to protect their water resources,and therefore the nearby forest.This is led them to reach out to other communities, educating them about how micro hydro power works, and actively discouraging degradation of the watershed. In fact, upon discovering an instance of illegal logging, the El Limón community contacted government officials, who then acted to stop this.

Technology

The micro hydro system in El Limón is a bit unusual in that power is generated and distributed at 240V alternating current, whereas normally in the Dominican Republic power is distributed at 120V.There are several reasons for the difference. First, 240V allowed the community to use a reasonably priced conductor, which has only 5% power loss.Second,since power can be generated at 240V, this avoids having to purchase a step-up transformer for the powerhouse. Third, 240V electrical devices are not widely available, which means it is unlikely that outsiders would attempt to steal power, which is a common problem in the Dominican Republic.

The turbine is located in a cement building in the forest above the town. After passing through the turbine, the water continues down to the community to be used for irrigation.Electricity is distributed via power lines suspended on 135 locally made cement poles.These poles,which weigh over 500 pounds each, were extremely difficult to make and to erect, and required a high degree of community collaboration.However, they proved their worth in 1998 when they withstood Hurricane George's 160km/hour winds.

To use the electricity, each household is equipped with a converter, a small transformer, a rectifier, and a filter capacitor to convert the voltage to 12V direct current. Breakers are also enclosed in the steel box with the converter, in addition to the manual breakers inside the homes to limit usage. This is important, because each of the 65 households connected to this system is limited to 35W so that the school and computer center can be allocated 200W. The household electrical allowance is enough for a few compact fluorescent light bulbs and a radio; a small black-and-white television can be used when the lights are turned off. Initially, community members were not happy with these limitations, but after realizing that three solar panels per household would be required to generate this amount of electricity 24 hours a day, there were no further objections. Only one wealthy household in El Limón has been able to afford even one solar panel.

Environmental Benefits

Global: 65 households no longer use kerosene and instead rely on hydroelectric power, thereby reducing greenhouse gas emissions.

Local: Since the hydroelectric system was built,the people of El Limón have begun to protect the local forest.The forest provides a filtering system for the area's sparse rainfall,and without it hydroelectric power would not be possible. For example, when a neighboring community began to cut down trees there, residents of El Limón alerted the government, which stopped the cutting. El Limón has also begun an educational and capacity development effort to help other local communities understand the benefits of the forest.

Livelihood Benefits

Health: According to members of the local women's association, the elimination of kerosene has reduced the incidence of asthma and colds, especially for the children.

Education: Electricity in the school has provided lighting and allowed for use of computers, with Internet access. Now, a Peace Corps volunteer teaches computer classes there. In addition, lighting in the homes helps children to study better. Prior to the project, very few children in Limón studied beyond the 7th grade.

Information access: The town is now connected to the Internet via the computers installed at the school. Twelve residents now have email addresses.

Capacity Development

This project has placed a heavy emphasis on capacity development. First, the project has helped the community build its capacity to manage its resources, and surrounding resources like the forest. SGP helped to organize workshops to train the community in accounting, project design and strategic planning, helping them to take charge of their own development. Evidence that the project has helped in this regard includes steps taken to protect the forest and finding new uses of electricity, such as for computer access. Second,El Limón now plays a role in helping other communities achieve similar successes. El Limón leaders travel to other communities giving presentations, and have produced a video about their own experience. They have given about 40 presentations, and are helping to carry out feasibility studies in these communities. Now, three other communities are developing similar projects.A new Rural Technology Center is under construction in El Limón, funded by the Inter-American Foundation,which will serve as a regional base for outreach and computer learning.The community has even developed its own website, which shares information about El Limón's various community projects, including the micro hydro project.

Partners

International: Jon Katz from Cornell University played a key role in initiating the project in El Limón.He also helped to leverage funds from the United States, including from EcoPartners, an initiative of Cornell University, and Rotary International. The Inter-American Foundation has also provided funding, both for the computers in the school and now for the Rural Technology Center.

National: SGP Dominican Republic has played a particularly active role in this project by organizing training and other activities to support the capacity development process in the com-

munity. Government authorities,when called upon by El Limón, did take action to stop forest destruction, but there is no information about any long-term partnership on this level.

Regional: El Limón has actively sought partnerships with other communities in the area,with a particular goal of helping those communities to understand the benefits of the forest and to encourage them to help protect it.

LESSONS LEARNED

Environmental Management

The El Limón project illustrates how the introduction of micro hydropower can translate into local as well as global environmental benefits.The steps toward forest and watershed protection are a direct result of the introduction of micro hydropower.

In addition,the project shows how energy projects can be integrated into existing infrastructure. The community had already built its irrigation system, and this project added a power distribution system to it.The project also tests an innovative electricity distribution system, at 240V alternating current with step-down transformers to 12V direct current at each household.One of the main challenges with this system is that transmitting power at this voltage requires very sturdy poles to avoid breakage. Communities less well-organized than El Limón might not be able to handle construction on their own.

The project also has found effective uses for the electricity at the times it is produced.Electricity produced by the water during the day is used at the school, where it powers computers and lighting. At night, the electricity is used for lighting homes. However, given the relatively low amounts of water available, there is not enough electricity to power refrigerators and other electric appliances, especially at night when the electricity is being used for lighting homes.

Barrier Removal

Awareness: The El Limón project has been extremely effective at reducing informational barriers to the implementation of energy projects. El Limón itself is very well organized, and through the project the community has gained a good understanding of micro hydro power systems. In addition, El Limón residents have been exceptionally good at sharing their experience with others. Community leaders have given 40 presentations and three communities are now undertaking projects. Part of the impetus for this effort is the need for the cooperation of other communities in protecting the forest and watershed.

Technical: The technical expertise necessary for the El Limón project came from a U.S.-based physicist with an exceptional dedication to the El Limón community. Great emphasis was placed on teaching community residents to construct many elements of the system themselves. El Limón is also sharing its experiences with other communities in the region. However, those involved with the project indicate that any project such as this will require extensive technical assistance from a skilled person who is consistently available throughout the construction period.

Financial: The project's infrastructure costs have been paid for by grants facilitated by the U.S.-based physicist involved in the project. This might seem odd for a village that has already demonstrated its ability to repay a $75,000 loan for the irrigation construction project. However, the project organizers felt that asking the community to pay for capital costs was unjustified in this case, particularly since the project design was very innovative, and loans might not have been available for this untested design. This seems to be a reasonable justification, especially since the project was challenging even for the well-organized El Limón community, and since residents have since become very involved in sharing their experience with other communities who may now be able to build similar systems.

Policy: It appears that some policy already existed to protect the local forest,since when a neighboring community was cutting down trees El Limón was able to ask the government to stop them.This illustrates an important role for communities in ensuring the implementation and enforcement of existing policies. If communities are aware of the need to protect an environmental resource, are aware of existing laws, and have sufficient motivation, they can play a key role in making sure that policies lead to real and positive environmental outcomes.

Scaling Up

This project has scaled up its efforts in two major ways, both related to capacity development. The project's impact in El Limón proper has been intensified due to the increased ability of the community to manage its resources and leverage others, as exemplified by the addition of computers and Internet access to the school and the efforts to protect the forest. Second,the project is scaling up in the sense of actively sharing its experiences with other communities would could undertake similar projects. So far, three are doing so, and out of the 26 communities that El Limón residents have assessed, 17 appear to have potential for micro hydro power.To develop its micro hydro system, El Limón relied upon significant outside assistance, facilitated by connections with Cornell University. This level of assistance may no longer be necessary, thanks to the on-the-ground experience that El Limón itself now possesses. Yet, financial assistance, or loan mechanisms, will have to be accessed for other communities to achieve similar results.

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Solar Rural Electrification via Micro-Enterprises, Dominican Republic

Themes

★ Renewable energy
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
❖ Institutional capacity development
✷ Poverty alleviation (MDG 1)
✷ Education (MDG 2)
✷ Health (MDGs 4-6)

PROJECT DATA

Name: Rural Electrification Based on Solar Energy in the Dominican Republic
Implementing Organization: Association for Solar Energy Development,ADESOL (NGO)
Location: rural areas, Dominican Republic
SGP contribution: $20,500 in 1994
Start Date: ADESOL founded in 1992; SGP grant in 1994

ENERGY OVERVIEW

Energy Resource: solar
Technology: individual PV systems, 20-50Wp
Application: indoor lighting, water pumping
Sector: residential,public facilities (related to health, education and water access)
Cost of each system: between $500 and $1000, depending upon size
Total power provided: 18 kW ADESOL, 150kW Solar Network (assuming average 30W on average per household)
Households Served: 600 via ADESOL and 5,000 through the Solar Network founded by ADESOL

BACKGROUND

Approximately 2 million people – between 300,000 and 400,000 households – in the rural areas of the Dominican Republic have no access to electricity. These people depend upon kerosene for lighting, which is of poor quality, and batteries for other electricity needs, which are costly. The extension of the electric grid is not expected to reach these communities for many years,especially since some of them are so dispersed and demand so little power that even mini-grids are not an economic solution. The lack of electricity means that these communities are extremely isolated, with little opportunity for economic improvement.

PROJECT DESCRIPTION

Overview

ADESOL seeks to remove financial and technical barriers to the spread of solar home systems in the rural areas of the Dominican Republic, thereby improving the quality of life and economic opportunities in these regions.ADESOL, along with its U.S.-based partner Enersol,has developed a model for promoting solar technology called the Solar Based Electrification Concept, or SO-BASEC. Based on the belief that those who benefit from solar electricity are its most important promoters, this model promotes decentralized small businesses and financing systems that enable rural people to learn about and to pay for their own solar panels.This guarantees them full ownership of, and responsibility for, their electricity use, and at the same time enables many more people to access the solar technology. ADESOL believes that it is better for end users to pay the full cost of the solar home systems because this will help ensure the development of a sustainable market for the technology. Subsidies,on the other hand,are based on finite funds and limit the number of people who can access the technology. They also artificially lower prices, which then cannot convey to investors and banks the true potential for profit in the market.

Solar photovoltaic panels installed on a school (Dominican Republic)

Implementation: ADESOL began its work by demonstrating rural residents' willingness to pay for the technology. Grant funds paid the up-front costs for a small number of homes to obtain solar panels,and these people, along with the rest of the village, formed a revolving fund to help others get the panels. After a deposit of approximately $115, residents could pay off the loan at about $6 per month,which was less than what they used to pay for batteries and kerosene. The revolving fund has financed more than 600 solar home systems in marginal rural communities in 18 of the 30 provinces of the country. At the same time, ADESOL trains rural residents as entrepreneurs who could run small businesses selling the solar home systems. These new small enterprises form the Solar Network, which is made up of 16 micro-enterprises. Finally, ADESOL supports community installations, including solar water pumps and lighting for schools,health centers, community centers and parks.

Environmental Benefits

Global: Through the Solar Network set up as a result of

ADESOL's efforts, over 5,000 homes have obtained solar home systems, and numerous other public facilities have been powered by solar energy. ADESOL estimates that over the lifetime of each 50W panel that replaces kerosene lighting, between three and six metric tons of carbon dioxide emissions are avoided.

Local: The local benefits depend upon the setting. In some cases, solar energy is replacing diesel-powered generators, which produce air quality problems as well as significant noise pollution.

Local Livelihood Benefits

Health: Kerosene use in the home creates respiratory and eye problems; these are avoided when solar lighting is used. These benefits are being realized by the people living in the over 5,000 households who have obtained solar home systems through the Solar Network. In some communities, health clinics have received solar lighting, which improves health care. In others, improved access to clean and reliable sources of water also results in improved sanitation and reduced health risks.

Poverty Alleviation:

- *Savings on energy costs:* While the cost of electricity from solar panels may be more expensive than many grid electricity rates, the panels are less expensive than current rural energy options; dry cell batteries, for example, may cost as much as US $30-60 per kWh, while solar panels cost between US $1-$3 per kWh. Thus, households can save money on energy use over time, enabling them to use this income for other purposes.
- *Opportunities for income generation:* The improved quality of lighting and power provided by solar panels enables their users to undertake more income-generating activities than before. For example, Mrs. Sanchez, who lives in Los Amaceyes in Monte Cristi, says that the new 35W panel allows her to carry out her home activities at night and frees up her days for selling juice to generate income, using power from the panel. The income from the juice-selling helps her pay off the loan for the solar system.
- *Employment* The solar energy micro-enterprises supported by ADESOL employ 60 people in running the businesses, assembling the control boxes and installing and repairing systems. Approximately 300 people depend upon the income derived from these activities.

Education: Children can now study at night much better than before. In addition, some schools have also received lighting.

Improved opportunities: Better income generating opportunities and increased access to information via television and radio results in a better quality of life in the rural areas of the Dominican Republic, thereby reducing pressures for urban migration.

National Benefits

The expansion of solar energy in the Dominican Republic reduces the country's dependence upon fossil fuels, which must be imported from abroad. Of course, solar panels must be imported, which also uses foreign exchange, but solar panels are less subject to price fluctuations than are fossil fuels. Additionally, the use of solar power in rural areas, where conventional grid-based power might involve large energy losses during line transport, helps the country use electricity more efficiently.

Capacity Development

ADESOL has focused significant energy on capacity building, mainly to stimulate the development of small electrification businesses. It offers courses covering technical issues as well as how to start and manage a micro-enterprise. In the past ten years, ADESOL has trained 222 Dominicans, as well as NGO representatives and Peace Corps volunteers, through 34 training courses. A new training center was recently built in Bella Vista, Sosua, which also acts as a demonstration site for new applications of renewable energy technology. For example, nearby are two potable water systems, one powered by solar energy and the other a hybrid of wind and solar.

Partners

International: Enersol, a U.S.-based nonprofit organization, was founded by Westinghouse engineer Richard Hansen to promote solar energy use in rural areas of the Dominican Republic. Enersol helped to found ADESOL, a Dominican NGO, in 1992, and now all of Enersol's work in the Dominican Republic is channeled through ADESOL. ADESOL benefits from its affiliation with Enersol because it gains access to international information and exposure. The two organizations work closely together to conduct training, test new financing schemes and promote solar energy organizations in other countries. For example, the two worked together to found ADESOL-Honduras in 1997.

National: PRONATURA, an environmental fund in the Dominican Republic, has supported ADESOL from the beginning. PRONATURA also coordinates the SGP, which has provided several grants for ADESOL's work. In addition, ADESOL works with the National Director of Parks to provide solar electricity in protected areas. It has also collaborated with numerous NGOs within the country, including the Dominican Social Churches Services and the Society for the Integral Development of Northeast, to put solar energy to use.

LESSONS LEARNED

Environmental Management

One of the most important lessons to draw from the ADESOL experience is that when users are responsible for the full cost of the technology providing their electricity, they are more aware of how this electricity is used. It provides a good incentive to use electricity efficiently and to properly maintain equipment.

Barrier Removal

Financial: ADESOL's main focus has been finding creative ways to help rural families afford solar home systems. Underlying all

of its approaches is the belief that users should pay the full cost of the systems so that markets can develop to reach the widest range of people who could benefit from the solar energy.

ADESOL has found revolving credit funds to be effective ways of maximizing the impact of its own limited financial resources. ADESOL extends loans to end users who, in turn, purchase solar home systems from one of the micro-enterprises in the Solar Network. The end user pays back the loan over no more than two years. The solar panel itself is used as collateral for the loan. While some solar panels have been removed from homes for lack of payment, the end users always started paying again and the panel was replaced. ADESOL's loan arrears rate is very low, at approximately 3%.

Another method ADESOL has employed to leverage funds is to take some funds from the revolving fund and place them in a U.S. bank account. This "Fondo Solar" now acts as collateral for ADESOL or another NGO to take out a loan from a local bank, and then extend loans to end users. While the bank required 100% collateral funds for ADESOL's first such loan, the next time it only required 80%. Thus, the bank began to assume partial risk in the loan.

ADESOL has demonstrated that, with effective financing mechanisms, rural Dominicans are willing to pay for solar-powered electricity. Several lessons have been learned along the way:

A decentralized network of solar home system micro-enterprises is able to reach more communities. Each micro-enterprise is independent and can make its own decisions about how to best reach its particular community. Yet at the same time, by being linked together through the Solar Network, the micro-enterprises gain access to the financing mechanisms managed by ADESOL. In addition, ADESOL maintains strict quality standards for solar home systems, and periodically audits bookkeeping to help avoid billing errors.

A fixed interest rate for loans helps protect funds from money devaluation. ADESOL uses a fixed rate of 30%, while for the past ten years Dominican pesos have lost about 14% of their value each year.

Clients must have a minimum level of income generation so that they can repay the loan. The micro-enterprise performs a client evaluation before a loan is made, and the client must demonstrate some earnings potential.

Payment schedules can be set according the type of income-generating activity available in a region. For example, a cattle raising district will have a monthly repayment scheme, while agricultural zones have payment schemes timed to correspond with the harvests.

Institutional: ADESOL has been very successful at building the institutional infrastructure necessary for solar energy to reach many regions of the Dominican Republic. Due to ADESOL's strong belief in a market-based approach, it chose to support the development of micro-enterprises. The SGP June 1998 report on rural electrification in the Dominican Republic notes that two other projects used funds to employ a person to manage sell, finance and install the solar panels. ADESOL believes that their operational costs are higher than they would be under a micro-enterprise scheme, and that micro-enterprises are able to promote and sell systems more quickly. On the other hand, another organization called ADEPE did use the micro-enterprise scheme and seems to have been very successful.

An important lesson to draw from ADESOL's experience with micro-enterprise development is the strong need for ADESOL to maintain a close relationship with the micro-enterprises to ensure quality standards and proper financial management. ADESOL's "Solar Network" is made up of 16 micro-enterprises, all of which have access to the ADESOL's revolving fund; they also must meet quality standards for their products and services, and their bookkeeping is periodically audited. ADESOL's role is key, because it enables the micro-enterprise to assure its customers of quality products and professional management.

Policy

ADESOL notes that high import taxes on solar panels are a significant barrier to their work, but it is not clear what, if any, efforts are underway to address this with the government.

Scaling Up

This micro-enterprise model for spreading solar energy use has been shown to be very adaptable for scaling up with a minimum of additional grant funding. As noted above, other organizations in the Dominican Republic have adopted the model successfully. A for-profit company, Soluz Dominicana, has begun selling solar home systems in the rural regions of the country, installing the systems and charging a $10-$20 per month fee for service. Part of ADESOL's goal was to demonstrate a willingness to pay in the rural regions, thereby stimulating market development, and in this respect ADESOL appears to have succeeded. The model has also spread internationally. ADESOL, along with its US-based partner Enersol, launched ADESOL-Honduras in 1997.

ADESOL believes that its ability to generate interest by private companies in servicing this region depended upon clearly demonstrating the rural population's willingness to pay for the solar technology. To do this, ADESOL avoided subsidies for the purchase of technology whenever possible. According to ADESOL, the drawbacks of subsidies are that they:

Limit the dissemination of the technology because subsidy funds are finite

Do not allow sufficient recuperation of funds to demonstrate the potential for profits to investors or banks

Create falsely low prices, which damages the ability of small to medium-sized businesses to gain clients

Mask the consumer's true willingness to pay for the technology.

ADESOL's experience suggests four necessary conditions in order to disseminate photovoltaic technology in rural areas for domestic use. They are that:

The proposed beneficiaries have sufficient knowledge and confidence in solar technology

The beneficiaries desire the technology, and are willing and able to pay for it

Commercial suppliers must exist in the local market, and be able to meet the demand for installations as well as for replacement parts

There must be an adequate number of trained technicians who can install and maintain the systems.

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Biogas from Sewage and Residual Waters in an Educational Institution, Ecuador

Themes

★ Renewable energy
✲ Innovative technology applications
✲ Linkages with other environmental goals
❖ Technical capacity development
✷ Education (MDG 2)

PROJECT DATA

Name: Sustainable Pilot Project for Biofertilizer and Biogas production derived from Sewage and Residual Waters
Implementing Organization: Fundación Ecuatoriana Santa Maria del Fiat (NGO)
Location: coastal Ecuador
SGP contribution: $24,115
Start Date: November 2000

ENERGY OVERVIEW

Energy Resource: biogas
Technology: biodigester
Application: cooking, waste management
Sector: educational institutions
Total capacity: 12 m^3 of sewage processed per day; 20 m^3 of waste water recycled per day
Number Served: 1200 people (1000 students, plus 200 in orphanage)

BACKGROUND

Santa Maria del Fiat is a large, educational complex located on the coast of Ecuador on the Chongon Colonche mountain range, in the buffer zone of the Machalilla National Park.This educational center, which includes a primary and a secondary school and university-level distance learning programs, hosts about 1000 students, 200 of which are boarding students.The school's orphanage houses another 190-220 children. The school did not have an adequate sewage system, and simply dumped biological waste and residual waste water off the cliff into the ocean,where it threatened marine biodiversity. In addition,nearby open spaces were used as dumping grounds,which caused bad odors and was beginning to contaminate the ground water and become a health hazard.The center was also making use of large amounts of water in this drought-prone region.

PROJECT DESCRIPTION

Overview

This project has successfully addressed the waste problems of this educational complex through the installation of biogas units, which have at the same time reduced energy costs for cooking,and produced fertilizer for use and for sale. In addition, a water reclamation system was installed to make use of the waste water, which is re-used in toilets and in watering plants.

Implementation

The project built a biodigester into which human and animal waste is deposited in order to produce biogas (methane), and fertilizer. During the school year, the waste of 500 people is required to operate the system effectively. During the summer, manure from surrounding farms and vegetable matter is used, and humidity and nitrogen levels are measured and adjusted as needed.The school's stoves were modified so that biogas could be used, and now the school uses 60% less butane gas for cooking. In addition, the school built a water reclamation system, which cleans soapy water for use in laundry facilities, toilets and plant watering.(Since biogas production requires a certain amount of water, more efficient use of existing water sources was necessary.) The biogas unit also produces a fertilizer, BIOL, which the school is selling, and also using in its own orchards.

There was strong community involvement in the planning and execution of this project. Representatives of "zonal committees" helped make decisions about the design of the project. During execution, students at the school participated in workshops to learn about biogas and alternative energy, and underwent training to enable them to make presentations about the use of biogas to the surrounding communities. Two biodigester units were built for demonstration purposes.

Technology

The biodigester unit built and operated by the school manufactures methane gas from human waste, manure and vegetable matter. The waste water reclamation system makes use of a fat trap and biological filter to make soapy water usable for toilets, laundry and watering plants.

Environmental Benefits

Global: The school has reduced its use of butane gas for cooking by 60% through the use of biogas, thereby reducing greenhouse gas emissions. In addition, marine biodiversity is protected,because biological waste and waste water is no longer being dumped over the cliff and into the ocean.Thus, this project addresses both the Framework Convention on Climate Change and the Convention on Biological Diversity.

Local: The more efficient use of water has resulted in several local environmental benefits. First, this is a drought-prone region, and is subject to climate variability due to the El Niño effect.The school is placing less pressure on water resources, and therefore is improving the region's ability to deal with droughts, and other effects of climate variability. Second, the school is planting and watering more trees,which improves the local habitat. Related to this, it is reported that the use of the fertilizer produced by the biodigester reduces problems with insects, thereby reducing the use of pesticides, and also slows the proliferation of weeds, which in turn reduces the use of herbicides.

Livelihood Benefits

Health: This project has very important health benefits. Since biological waste is now placed in the biodigester instead of

being dumped in the local area, the risk of disease is lowered, and the risk of contaminating the water supply is also reduced.

Education: The improvements in sanitation and the local environment, in addition to the savings in energy costs that accrue to the school, hopefully can result in an improved learning experience for the young people who attend the school.

Income generation: The school now needs to purchase 60% less butane gas,the price of which has been increasing.Secondly, the school now sells the fertilizer, called BIOL, and 45% of the sale revenues return to the school. Finally, the water reclamation system means the school needs to purchase less water. Apparently, the school has used at least some of these savings and additional revenues to pay someone to maintain and operate the biogas system.

Capacity Development

The school has used the project to build the capacity of young people attending the school in understanding alternative energy use. Using model biodigesters,11th and 12th grade students make presentations in the local community about how the biodigesters work, and in general about energy, waste and the environment.

Beneficiaries

The primary beneficiaries of the project are the 1000 students attending programs at the school, and the approximately 200 children in the orphanage. In addition, the surrounding communities have benefited via the educational efforts undertaken by the school.

Partners

The school has worked with the local community in establishing this project. During the summer, the school makes use of local manure and waste products to supplement the waste fed into the biodigester.

LESSONS LEARNED

Environmental Management

This project illustrates the very important role biogas can play in improving waste management as well as reducing greenhouse gas emissions.Since this system is implemented in a large school located on the coast in an ecologically sensitive area,the environmental benefits accruing from the biogas installation and the waste water reclamation system are quite significant. There may be good potential for implementing similar systems in large institutions to achieve similar effects.

Barrier Removal

Technical: This project is one of the few successful biogas projects in Ecuador. Therefore, it serves as an excellent demonstration of this technology. The simultaneous installation of a waste water reclamation system helps highlight this technology as well, which can be important because biogas production requires significant amounts of water.

Information/awareness: Since the project was implemented at a school, it has been particularly successful at raising awareness about the new technology. The school is strategically located, next to a religious sanctuary which attracts religious visitors and tourists.As a result,the school gets good exposure. School children have been involved in most aspects of the awareness-raising campaign, which has involved making and distributing 1000 posters and brochures and creating a video for distribution nationally and abroad. Media outreach is also planned, making use of these tools.As pointed out by the SGP coordinator in Ecuador, establishing a website would help greatly in disseminating lessons.

Scaling Up

The school has set a target to encourage the installation of at least two additional biodigesters in the community as a result of the outreach efforts and making use of their improved knowledge about the technology.

In addition, UNICEF has expressed interest in the project, and plans to study the technical aspects of both the biogas and waste water reclamation systems for possible implementation on a much larger scale in the city of Quito.

SOURCES CONSULTED

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