CREATING A SOLAR CULTURE IN NICARAGUA VIA A UNIVERSITY-COMMUNITY KNOWLEDGE CYCLE

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ABSTRACT

Grupo Fenix has been working informally since 1996 as a collaboration between the Universidad Nacional de Ingeniería in Managua and the people in rural Nicaragua. This collaboration is now formalized as a "**CIPPER"**, Centro de Investigación, Promoción, y Producción con Energía Renovable (Center for Research, Promotion and Production of Renewable Energy) to facilitate a "knowledge cycle" between universities and rural communities. Successful examples of this process are the development of small photovoltaic module assembly workshops, workshops for improved solar box cookers, solar coffee roasters, solar dryers, two types of solar autoclaves[1], a prototype photovoltaic still[2] to make fresh water and electricity at the same time, biogas digesters and solar microdrip irrigation systems. The success of this work is based on two-way feedback of information between the university and the rural communities.

INTRODUCTION AND HISTORY

We know that results of our current energy consumption patterns will lead to a terrible end. Daily we face the images of the unfed millions, images that create a profound fear that becomes the basis for war. All the while, we live in a world that is filled with abundant natural resources.

With an awareness of this issue, in the year 1996 in Nicaragua, a group of students from the National Engineering University began working with the theme of renewable energy. Seeing the reality of their own communities, the students realized that with improved technological awareness these communities could take better advantage of the multiple resources available to them. Selecting the name "Grupo Fénix" they started experimenting with renewable energy technologies and taking advantage of diverse opportunities to acquire experience and knowledge. They installed solar pumps, solar drip irrigation systems, a mico-hydroelectric system, PV battery charging centers and hundreds of photovoltaic systems in rural communities. They built solar dryers, solar water heating systems, biogas digesters, dozens of solar ovens and hundreds of photovoltaic panels[3]. From their efforts they were able to create various entities based in renewable energy; an academic program within the university, a business, two NGOs and two rural production centers. The process also prepared young professionals who now work in fields related to renewable energy.

After working with a number of communities on many projects, the group came to further appreciate the importance of social aspects in the transfer of technology[4]. Technology alone does not bring about change. Changes are made by involving human beings. They realized that in order to advance the methodology of technology exchange (rather than simple one way

transfer) and create the ability to develop sustainable life styles, they needed to focus, for the time being, on improving and documenting the process with one community.

THE CREATION OF CIPPER

The organization that took shape to guide this process consists of the academic program and one rural production center and continued with the name Grupo Fénix. The refocused mission of Grupo Fénix is to contribute to the well-being of rural communities, creating an awareness of sustainable life styles through technical and cultural exchange, promotion and investigation in the field of renewable energy. The guiding principles are community participation, respect for the environment and human dignity.

Grupo Fénix is working to achieve its mission through the creation of a Center for Research, Promotion and Production of Renewable Energy, a CIPPER, to facilitate a knowledge cycle between universities and rural communities. Through a dynamic exchange of ideas, knowledge is brought from the university to the community where the ideas are applied and tested against the reality of daily life. The ideas and processes of the university are perfected in the community by "local scientists" in conjunction with university based researchers. Once the ideas and processes are improved, they return from the community to the university where they interact with other ideas to form new understandings. These new understandings return to the community once more to be tested and continue along the knowledge cycle. The function of the CIPPER is to develop, through the knowledge cycle, products and processes of renewable energy applications to the stage at which they can be reproduced by other institutions, organizations and communities.

EXAMPLES OF THE COLLABORATION

Both the informal collaboration and the formal CIPPER program have led to a number of successful developments. Among these are the following:

Photovoltaic Module Assembly Workshops: The Grupo Fenix now has two small "cottage industry" factories operating in Nicaragua to assemble photovoltaic (PV) modules from imported PV cells. The first was started in Managua in 1998 and is now a separate corporation called Suni Solar which not only manufactures modules of up to 75 watts in size but also manufactures and/or imports the balance of system components to install and maintain complete photovoltaic systems. While Suni Solar is still part of the overall Grupo Fenix it has its own management and completely independent finances.

The second PV module workshop was started in Sabana Grande in 1999 as part of a program funded by the Canadian government's CIDA program to rehabilitate landmine victims and give them a livelihood. This successful workshop is now an integral part of the CIPPER program and Marco Antonio, the landmine survivor in charge of the workshop has been developing new ways of encapsulating the PV modules to produce a more professional looking product while cutting the assembly time and costs [5] Figure 1. shows him working on small experimental modules to develop this process.

The Sabana Grande workshop has assembled and installed over 100 systems to date and now has a list of clients that include many private farmers and businessmen as well as rural health clinics, village centers and other community projects. Marco Antonio and Rodolfo from Suni Solar have traveled to Haiti to teach a rural organization how to set up their own cottage industry to assemble PV modules. Recently, as part of the two way feedback, they have been aided by

outside experts in the techniques of handling the new, ribbon growth PV cells and will be giving workshops in other developing countries to train others in these techniques.

Figure 1. Developing a new method of encapsulating PV cells to make modules.

Marco Antonio has also been training volunteer assistants from the US, Latin America and Europe in these assembly processes and making "seed" PV modules for these people to take to other countries to continue the process of spreading the cottage industry PV assembly. There are now small PV module assembly workshops in El Salvador and Mali (west Africa) and the organization of one underway in Honduras as a result of this work.

Professors and students from the University of New South Wales in Australia have also visited Sabana Grande and worked with the cottage factory there to develop quality control and module testing procedures to improve the quality of the locally produced PV modules.

Solar Cooker Development Based on training and designs from Girasoles, another local rural development group, Grupo Fenix started building and introducing solar box cookers into the rural community in 1999. These early cookers were expensive and complex to assemble so Fenix engineers and their rural partners started to develop new solar cooker designs that would be easier for the rural workshops to build as well as use as much locally available material as possible. The biggest job in introducing solar cookers to rural communities is the community development work necessary to get the rural women to really believe in the advantages of solar cookers and use them every day. The first woman's workshop center to build and promote the solar cookers was started in Unile in Northern Nicaragua in 2000. This workshop is now an

independent part of Grupo Fenix and has trained village women from both Nicaragua and Honduras in the techniques of building and using solar cookers. Figure 2 shows the Unile group assembling these cookers at their workshop.

Figure 2. Assembling a solar box cooker.

The second of these woman's solar workshops is now being built in Sabana Grande and is a major part of the CIPPER work. The two way feedback combining the knowledge of thermal physics and the quantum mechanics of black body radiation furnished by outside scientists with local practical experience has led to more efficient solar cookers that are less expensive to build and more convenient for the women to use[6]. All the problems with the encouragement of the everyday use of the cookers by the rural people have not yet been solved but it is hoped that the university-village collaboration will help address this concern. The feedback mechanism will build upon the system whereby the rural women "earn" their solar cookers by working in the woman's center, germinating tree seedlings and planting trees and other activities related to the creation of a solar culture. A Spanish-English bilingual handbook is available from Fenix on the construction and use of these solar cookers.

Solar Coffee Roasters One of the examples of the two way feed back is the development of ways to dry and roast coffee beans in the solar ovens[3] One older woman in Unile, Christina discovered how to do this in her solar oven and soon many of the women who had received solar cookers were emulating her techniques and experimenting on their own to develop ways of roasting maize and other grains as well as coffee to produce pinolillo (a pre-Columbian drink

made from roasted maize and cocoa beans) and other traditional drinks. Figure 3 shows Christina roasting coffee in her solar cooker.

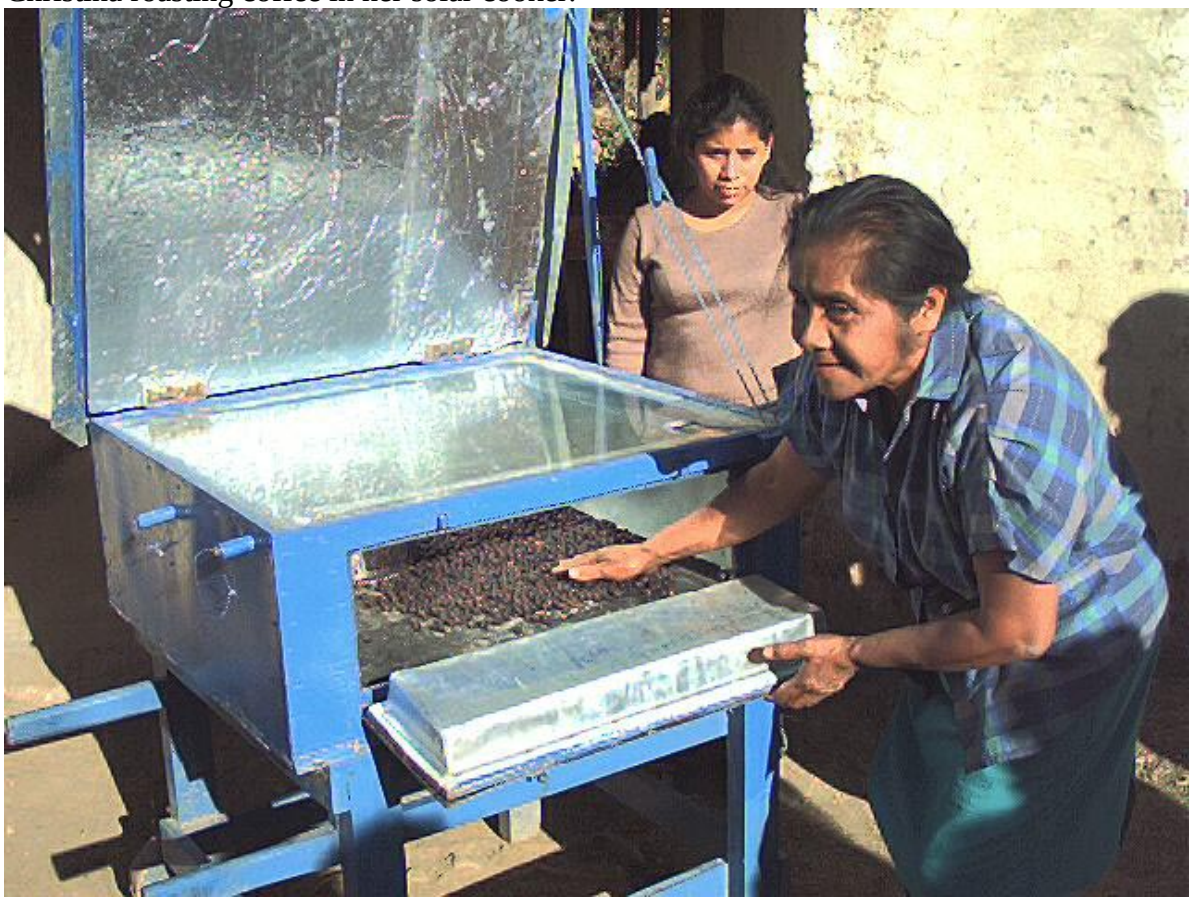

Figure 3. Roasting coffee in a solar box cooker

This process has now spread to other villages and an industrial sized solar coffee roasted has been designed and is being built at the CIPPER woman's workshop center in Totogalpa. The university feedback includes instrumenting the new solar coffee roaster to measure the temperatures during the roasting process and controlled experiments in different roasting techniques which will be carried out by the women with the help of outside scientists[7].

Solar Dryers There is a great need in rural areas for inexpensive and effective ways to preserve food and other commodities like medicinal herbs by drying them. Based on a design developed by the Appalachian Mountain College, Grupo Fenix has built two solar dryers that are now in operation in two communities near Unile and Totogalpa. Figure 4. shows one of these solar dryers being demonstrated at a rural development fair in northern Nicaragua. In addition, a number of other solar dryers of different designs have been built over the years by Fenix personnel and volunteers. These have worked with a varying degree of success and a collaborative research project is now underway to improve the solar dryer performance while making them easier and less expensive to make. The CIPPER has just finished two small solar dryers of an improved design, which an NGO had requested from the Totogalpa Solar Women's Group.

Figure 4. A solar dryer used for medicinal herbs.

The feedback from the operation of these dryers will lead to the construction of solar dryers of larger capacity and when a standard design is worked out (like was done with the solar box cookers) a bilingual English-Spanish handbook will be produced detailing the construction and use of the dryer.

Solar Microdrip Irrigation One of the major concerns in the developing world is supplying fresh water for drinking and also for agricultural use. In many parts of the world, the water table is dropping and hand operated wells are either drying up or the water level is getting too deep for easy extraction by primitive hand pumps or bucket systems. Most of these places are far from

the utility grid and diesel pumping systems are too expensive to install and operate. Grupo Fenix has a well developed solar microdrip irrigation program and has given numerous workshops in Latin America, Haiti and Mali, west Africa[8]. This again is a two way feedback collaboration between academic experts and rural people which has developed efficient solar water pumping systems using locally made PV modules and low pressure microdrip tubing to more efficiently use smaller wattage PV modules directly running efficient diaphragm pumps. Figure 5 shows such a system installed in Sabana Grande, which is being studied as part of the CIPPER program.

Figure 5. Installing a solar powered pump for a microdrip irrigation system.

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BIOGRAPHIES

RICHARD KOMP, Ph.D., the course advisor and instructor for the January sessions, is the author of PRACTICAL PHOTOVOLTAICS and has been working on solar cells since 1960. He has taught numerous courses and workshops on solar energy all over the world; is currently the president of the Maine Solar Energy association and has a small photovoltaic company, Sun Watt Cor. Richard also teaches graduate courses on Solar Energy at the UNI.

SUSAN KINNE, initiator of the solar cultural/course, has been on staff at the UNI for the past 15 years, first as a professor of electrical enegineering and currently is the director of the Fenix Program for Alternative Energy. Her first degerr was in German literature, then worked as a production engineer at Cincinnati Milicron, on their integrated circuit production line.

CODY REED is a graduate student in economic design and has been working as a volunteer intern with the Grupo Fenix for the past year. She helped design the CIPPER program and helped develop the unique structure.