

**GUY/03/001: CAPACITY BUILDING AND DEMONSTRATION PROJECTS  
FOR ELECTRIFICATION OF  
HINTERLAND UNSERVED AREAS, UTILISING RENEWABLE ENERGY**

**The**

**WAUNA, OREALLA AND KATO PHOTOVOLTAIC AND WOODSTOVES  
PILOT PROJECTS**

**PROJECT EVALUATION**

**FINAL REPORT**

**Submitted To:  
The United Nations Development Programme (Guyana)**

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## **1.0. LIMITATIONS**

During the Evaluation of this project, the following minor limitations were encountered:-

- Limited ground time at some project sites due to transportation and weather issues.
- Equipment non-availability due to a delay in the arrival from overseas.
- Value-added processing equipment not being used temporarily

## **2.0. Acronyms and Terms**

GOG	- Government of Guyana
IAST	- Institute of Applied Science and Technology
NGO	- Non-Government Organisation
OFCWA	- Orealla Fruit-Cheese Woman's Association
OPM	- Office of the Prime Minister
PV	- Photovoltaic
RE	- Renewable Energy
UNDP	- United Nations Development Programme

### 3.0. EXECUTIVE SUMMARY

This project evaluation, concerns the capacity building and demonstration projects for the electrification of hinterland unserved areas, utilising renewable energy. This project was implemented by the OPM and funded by UNDP, during 2006 to 2008.

The objectives of this project were to:

- Increase knowledge and skills development for upstream policy and planning.
- Identify alternative funding mechanisms and opportunities for clean energy development.
- Providing technical assistance, institutional strengthening and capacity building, through the implementation of hinterland demonstration projects.

Information for this project evaluation was obtained from interviews with persons associated with the project, review of existing studies and site visits to Orealla, Wauna and Kato.

Renewable energies used and evaluated during the Project implementation were:

- a) Wind: Wind data was cancelled at Paramaktoi, but was found to be unsuitable for power production.
- b) Micro-hydro: A pre-feasibility study was done at Kato for a mini-hydro power plant that can provide irrigation water for fertile farmlands near to the village.
- c) Woodstoves: Persons from nine (9) hinterland communities had attended a workshop to develop capacity building in woodstove construction and use.
- d) Photovoltaics (PV): Two out of three PV systems were installed, namely at Wauna and Kato.

Following are the evaluation findings:-

- Kato's PV system worked well, but once, a minor-fault created a shutdown. The economic venture associated with the project was not fruitful.
- Orealla's PV system is still to be installed. This is due to a delay caused by a system design change.
- Wauna's PV system works well. There are some concerns with the management of the peanut processing facility, the battery house setting and the peanut value-adding equipment.
- Pre-feasibility study done at Kato on farm irrigation.
- Wind speed measurements at Paramaktoi proved unsuitable for power production.

- Purima PV system works well. The original inverter was unable to start the mill but that has been corrected. The income-earning activities have reduced.
- Woodstoves have been well accepted and used in eight (8) communities, while one (1) community's participant at the training workshop for woodstove construction and use, did not grasp everything that was taught and his sample stoves were remained unused.

Based on the evaluation findings, the following are being recommended:

- Project should be continued based on the outcome of the pilot phase.
- GNEA should be more involved and assist the OPM.
- Regional authorities should be more responsible and attentive with respect to the Project.
- Local ownership and responsibilities must be well defined and understood by the local end-users and the Regional Authorities.
- End-users should be involved in the decision making processes from the inception. This allows knowledge and experiences to be available for early inclusion in the Project Plan.
- End-users of woodstoves must be well trained before being made responsible for the utilisation of stove in the community.
- Establishment of field service capabilities by the provision of a RE powered multi-skilled training facility, which provides continuous training of technical, managerial and marketing skills. The training facility will also provide continuous consultancy services in technical, managerial and marketing to the hinterland community energy projects.
- Special funds for major maintenance must be available to the hinterland communities, under special conditions, for continuous operation of the Project.
- Equipment selected for use in the hinterland should be modern, efficient, field-proven, user friendly and easily repairable.
- All installations should be done by certified and experienced electrical contractors who will involve local residents in the installation.
- Trained electricians are to be close to the Project site.
- Special technical standards should be established and adhered to.

- The community should select the RE venture and a special team evaluate before approval.
- Establish a multi-skilled training centre to provide continuous training for skills development and to provide consultancy services for the project.

#### **4.0. Introduction**

Economic development and poverty reduction strategies which are being pursued by the Government of Guyana (GOG), requires efficient, available, reliable and affordable energy. This has caused the GOG to embark on an unserved areas electrification programme, which targeted coastal areas initially, then to the hinterland subsequently. Formulated by the GOG and approved by the UNDP in 2002, it was agreed that the UNDP's assistance to Guyana will be mainly the supporting of policies and programmes for the reduction of poverty in the country. From this, it was agreed that UNDP devotes its attention to (1) capacity development for poverty eradication and (2) environment stability among other things.

It was shown in the 1999 IDB Studies of New and Renewable energy in Guyana, that there is potential for off-grid electrical power generation utilizing renewable energy sources. The GOG is committed to the reduction of greenhouse gasses, and has avoided the use of fossil-based energy sources for electrification and economic development of the rural communities.

The OPM was the implementing agency for this project which has a cost of \$200,000. The pilot sites involved in the project are: Orealla, Kato, Wauna, Purima, Rupertee, Araputa, Marakaboi, kurukabaru, Paramakatoi, Kamarang/Warawatta, Jawalla, and Aranupata. The Renewable energy (RE) spectrum utilised in this project, involved wind, micro-hydro, PV and wood-stoves.

#### **4.1 Objective of Evaluation**

The objectives of this Report is to:

- Assess the effectiveness and efficiency of project implementation;
- Determine the results achieved;
- Ascertain the acceptance of the Project by its stakeholders;
- Determine the relevance of the project, as seen from the perspectives of its partners/potential partners;
- For each project, identify the areas of strength, competitive advantage and areas requiring improvement;
- Recommend any measures to enhance co-ordination with other major players in the field of renewable energy and sustainable development; and
- Provide recommendations for future phases, given the continued relevance of the project to the UNDP/CPAP and the expressed needs of existing and potential partners

## 4.2 Methodology

Project and Performance information was obtained through access to:

- Project reports and articles;
- Site visits; and
- The use of an Administered Questionnaire to interview selected users, farmers, officials of the UNDP, the OPM, the Regional Administration and the Ministry of Amerindian Affairs.

The information collected was analysed and the technical and managerial issues were identified and presented (See questionnaires in Annex).

## 5.0. PROJECT CONCEPT AND DESIGN SUMMARY

The provision of efficient, reliable and affordable energy is necessary for economic development and poverty alleviation strategies. This process is being pursued by the GOG through the UNDP funded Unserved Areas Electrification Programme for Hinterland Communities Utilising Renewable Energies.

The project aimed at identifying NGO ventures where alternative energy can be utilised. The ventures must be sustainable and generate funds which required for its upkeep.

Through consultations between the OPM, UNDP, the Regional Authorities and the end-users, decisions were made based on the viability of the venture and the availability of a suitable renewable energy resource. Final ownership of the project would be the regional authorities through a MOU that would be between the OPM and the regional authorities. The end-user will pay fees to the village council for the equipment's use. The project recognised that training for development was an essential ingredient for the success of the many activities involved, and suitable training programmes were conceptualised for these different requirements such as farming, manufacturing, processing, marketing and equipment operation. Enquiry of potential markets for value – added products were also done as a strategy in the project design.

Much labour intensive activities create low production and is time consuming. With the addition of power driven equipment, increased production rates was seen as a means of increasing profits and improving the economy of the community. Also, the production of value-added products was expected to have the same economic benefits.

Utilisation of high efficient equipment, e.g, the rocket woodstove, was perceived as being a safer method of cooking (reduced smoke inhalation), and reduced wood consumption for equal cooking loads, relative to the common 'fire-side'. As such, these units were included in the project because of the foreseen benefits.

The project engaged in having pre-feasibility studies to obtain data and have advanced knowledge of all ventures that were intended to be examined.

All of the activities concerning the implementation of this phase were coordinated by the OPM.

Training and capacity building was fore planned, and was a part of the project implementation process. The different disciplines that were involved in the project were identified. Mythological tools used, involved participatory decision making, socio-economic analysis, workshops, and feasibility studies by consultants on behalf of the project. The capacity building exercises for the end-users emphasised on theoretical and practical studies which were reinforced by the booklets.

## **6.0. PROJECT PROCESSES, RESULTS AND IMPACTS**

Many management methods were utilised to deal with the different situations which existed during the project plan and implementation. These processes produced varying levels of success.

Having the OPM as the implementing agency, consultations on every aspect of the project were done with all persons and organisations that were involved. This arrangement enhanced the understanding of the objectives involved, and helped to identify suitable RE ventures which were economically viable or provided social upliftment of the community, within the framework of the rural development plan.

Before final decisions were made, field-tests were done and results recorded for analysis, pre-feasibility studies and mini-market surveys were undertaken where applicable, while skills training for capacity development was identified as being a priority.

The outcome of the intended activities showed that maximum success was only hampered in a few instances.

The RE systems were greatly successful in the communities. A lack of specific technical knowledge and a misunderstanding by a participant caused the 100% availability of the RE systems to be reduced slightly.

Economic ventures that are attached to these RE systems have not been fruitful. Part of this was due to a misconception that residents could have afforded the required financial investment, and another situation developed where the consumers were not stationary, but moved as their work demanded.

The selection of critical processing equipment is very important, especially for the hinterland. Field-proven conditions were confirmed from overseas, but the value-added

products were not forth-coming at a particular site because local operating set points have not yet been established. Raw material suppliers have been left without a ready market due to low prices for non-value added products there. The project has improved the social life in all of the communities mainly by creating conditions for safer and efficient cooking and by providing the mechanism for higher learning.

Delays in the project implementation created slight disappointments within the management of the associated venture. But the positive effects brought about by the project, has changed the lives significantly in most instances where skill levels have been advanced and some daily tasks now have less human efforts

## **7.0. Challenges and Constraints of Project Implementation**

The major challenges and constraints which were encountered during the Project Implementation were:

- Project decision-makers used unreliable or insufficient market survey data, which affected the generation of funds from the applicable ventures.
- Equipment should be correctly sized to accommodate loads.
- Equipment should be available before being selected for use, because replacement by substitutes, require design changes and an extension of time for site installation.
- Equipment selection depends partly on the capability as indicated by the manufacturer or supplier. The Project has experienced that this dependency could be out-of-sync with actual requirements, which affected the economic ventures.
- RE site downtime was lengthened because the training did not cover in-depth technical aspects.
- End-users being trained extensively, but somehow, have not grasped all of the essential information.
- Regional Authority (from one district) was not showing much interest.

## **8.0. Acceptance by Stakeholder**

Stakeholders recognise the Project as:

- ✓ A means that provided renewable and sustainable energy in the hinterland, which has no pollution.
- ✓ A means to generate income in the hinterland
- ✓ A means to have a healthier lifestyle in hinterland
- ✓ A means to reduce the human effort in laborious tasks in the hinterland
- ✓ A means to be more time efficient in the hinterland
- ✓ A means of improving skill levels development
- ✓ A means of creating an RE implementation information base
- ✓ A means of learning equipment performance in the field
- ✓ A means of collecting data on potential RE sites.
- ✓ A means to improve educational facilities in the hinterland

## **9.0. Relevance of Project as seen by Partners / Potential Partners**

The aims and objectives of this project, from the partners view, were to plan and implement RE ventures that will satisfy certain technical, social and environmental conditions.

The partners welcomed the interest expressed by the potential users of the RE ventures. The users' interest encouraged the continuous implementation of the project by the partners, which has these qualities:

- ✓ Reduction in pollution
- ✓ Reduce the cost of production
- ✓ Raise living standards
- ✓ Increase the level and availability of skills in the community by specialised training programmes
- ✓ Expend the local economy
- ✓ Increase local production
- ✓ Increase local employment and reduce migration
- ✓ Saving of time and human labour

The provision of continuous electrical lights by the project has created great satisfaction of the partners, when some end-users achieved academic excellence and the display educational videos.

The rural electrification RE project has had a very visible and positive impact on the communities involved, which satisfied the objectives.

Because of the many benefits to the communities, the project has helped to fulfil the overall development goals set out by the Partners.

## **10.0. Good Practices, Lessons Learned And Shortcomings**

During the data gathering activities for this evaluation exercise, it was noticed that there were areas of strength and competitive advantages, together with areas that needed improvement. This Report provides the UNDP and the GOG with feedback information which is essential for assessing similar RE projects, particularly if there is to be a Phase II.

### **10.1. Good Practices**

This project has enjoyed many success in the various applications of RE, because of the fact that both the technical, environmental and social aspects were investigated before implementation.

Different types of RE were utilised, and this multi-energy exposure and experience has provided a larger reference-base, which has different types of technologies.

Most of the ventures implemented have a linkage for potential generation of funds to sustain the operations.

Educational growth in many disciplines now exists in hinterland communities, because skill development training was a priority during implementation.

Indigenous agricultural products and materials were coupled to RE systems, and all of these enterprises were non-dependent on external sources for raw materials.

The reliability of energy production was thoroughly investigated before being recommended and implemented. This action prevented wind power from being utilised as the RE provider at Paramakatoi, where the wind speed was found to be inconsistent.

Practical involvement through the management of the project has strengthened institutional capacity of the project staff and partners. This is absolutely needed for future decision making.

### **10.2. Lessons Learnt**

During the implementation of this project, the useful lessons learnt are as follows:

A community-based project should be managed by the community, while an entrepreneur-controlled project should have the responsibilities clearly understood by all involved. Equipment selection must be precise and suitable for the function it is expected to perform. Extensive marketing studies should be undertaken to determine the viability and sustainability of the RE business ventures intended.

Harnessing of resources available in hinterland communities for community development, is greatly improved by the provision of training, material inputs and reliable power. Training programmes must ensure that participants understand exactly what is being taught, so that they will be promoting the technology correctly on their return home. Electrical skills must be available at the project sites or in the vicinity, to avoid stoppages.

Project installation with prolong delays tends to create slight dissatisfaction among end-users.

### **10.3. Shortcomings**

The Project encountered a few shortcomings, and are follows:

- A participant from a training workshop apparently returned to his community without the complete understanding of what is required technically. This resulted in five (5) woodstoves intended for use, being put in storage and awaiting components that were available in the community.
- Lack of competent electricians on project site to effect repairs.
- At this time, one specific piece of equipment, the peanut roaster, is not performing as was expected.
- Income generation was not properly investigated.

### **11.0. Proposed Framework for Phase 2 of Project**

During the evaluation of the pilot project, a desire for its expansion was always expressed.

In the designing of the proposed second phase of the project, much attention should be given to the following areas of each project venture:

- Management
  - ✓ Record keeping
  - ✓ Financial management
  - ✓ Organisational structure
  - ✓ Production control
  - ✓ Training
  - ✓ Marketing
  - ✓ Decision-making
  - ✓ Availability of consultancy services

- World economic conditions
  - ✓ Recessions
  - ✓ Unfair competition
  - ✓ Difficulties of market access due to protectionism

The proposed framework for the expansion of the project are:

- Keep the project expansion in accordance with the basic requirements of the existing hinterland electrification programme, using RE.
- The GNEA should become more involved and assist the OPM with implementation.
- The regional administrations must be fully involved in the project preparation, and be made to understand and accept their responsibilities.
- The communities should identify their business venture or their social upliftment activities, which require RE.
- The OPM should integrate and coordinate the activities of all of the other Partners, for the sourcing of the necessary resources.
- A multi-talented team should investigate the identified ventures, do feasibility studies and write project reports. From this, the most viable ventures should be selected for funding.
- Equipment for the project should be simple, efficient, easy to maintain, durable and be modern.
- Basic important spares should come as part of the project.
- The mix of equipment for the project should be a minimum, so as to reduce the variety and quantity of spares that are to be bought.
- Establishment of a special training facility will provide all necessary training that is required for the success of the project. It should provide the following:
  - ✓ Management skills training
  - ✓ Motivational development
  - ✓ Technical skills training
  - ✓ Feasibility studies skills training
  - ✓ Project preparation skills training
  - ✓ Managerial and technical consultancy services to improve their productivity efficiently and profitably.
  - ✓ Trade assistance, where marketing services would provide research and information on market channels
  - ✓ Quality control, which supports field-trips by local and foreign experts who will render consultancy services through workshops; looking at product dissemination; product design improvements; and render assistance and

extensive information dissemination on modern agricultural and other technologies.

- ✓ Continuous maintenance programmes for users.
- ✓ Conservancy and easy access to financial resources for phase 2 can be provided through the International Donor Community.

## **12.0. Recommendations**

Based on the evaluation of the RE Pilot Project, the success should encourage further expansion of the RE powered systems in hinterland communities.

The recommendations are based on an assessment of the factors observed, and take account of those that were most prevalent in successful systems and notably absent in those that were unsuccessful.

### **12.1. Technical Recommendations**

The following Technical standards should be established:

- Provision of all battery house safety gear;
- Provision of information to the users on battery disposal systems;
- Safe and proper battery house construction;
- Sealed batteries should be used to reduce maintenance;
- A layer of wood is required below the metal roofing material of the battery house to reduce corrosion if wet batteries are used;
- Batteries must have enough room around them to ensure easy and safe servicing;
- Provision of suitable tools;
- Installation of safety and warning signs;
- Labelling of equipment controls;
- Record keeping for tools, equipment failure, equipment replacement, etc;
- Select field-proven components, or have trial-runs on special equipment before sending them to the hinterland, allowing quality systems to be obtained in all applications;
- Latest model equipment with better performance and durability to be selected;
- Provide user-oriented components for easy user interface and the avoidance of operational errors;
- Woodstoves supplied to the hinterland without outer casings and suitable insulation must have special instructions accompanying them; and
- Only certified and licensed electrical contractors should install electrical RE systems.

### **12.2. Institutional Recommendations**

The success of PV powered systems in the hinterland requires that there should be strong institutional support, to ensure that the users receive on-going training and other essentials, for the operation and maintenance of the RE system and the power using/processing equipment.

Because the technology is relatively new, the minimal experience required for servicing in these hinterland communities is often not available. This results in an otherwise reliable RE system and load–equipment being perceived as being unreliable.

The recommended improvements in Institutional support are:

- ✓ Before a project is decided on, it is important that the income-earning activities, identified for the use of the power from the RE systems, is accepted and supported by the communities
- ✓ Users of the RE systems should be educated about the operating principles and the technical limitations and requirements for the successful operation of such systems. Otherwise, unrealistic expectations could result in avoidable damage to the systems.
- ✓ Establish field service capability by introducing more detailed technical and managerial skills, among the hinterland residents.
- ✓ Do not depend on the local income earned from these RE powered systems alone. Some budgetary provision should be made available for the purchase of operating spares and supplies.
- ✓ Successful RE systems need continuous effective training for both users and repair personnel.
- ✓ Training should take account of the rapid turnover of personnel, assigned by the hinterland communities, to operate these systems. Continuous training is a necessity for the success of these projects.
- ✓ An essential factor for successful system implementation is ensuring that local ownership and responsibility is well defined and understood among all of the local end-users and the Regional Authorities.
- ✓ Early involvement of the end-users in the decision-making process will allow communities to use their local knowledge and experience, and have enough time to plan for successful RE system implementation and management, as well as determining the viability of any associated economic ventures.
- ✓ Selected projects should enable income to be earned by as many persons as possible within local communities, using locally available resources.
- ✓ Projects must be compatible with local culture and customs,
- ✓ Establish a training centre for development of skills required by the hinterland communities, equipped with RE powered systems.

### **12.3. Recommendations for Local Project Management**

The Project has proven that RE can provide a reliable power supply, when necessary for the installation of developmental amenities in such communities.

It is intended that those RE systems, which have been installed, would eventually be handed over for local ownership and management.

The following, are the recommendations for local project management:

- ✓ Confirm the institutional arrangements, obligations and responsibilities of the owners/operators, within the benefiting communities. These activities should be clearly defined, accepted and understood by all parties.
- ✓ A proper market/user evaluation should be undertaken to determine the sustainability of the economic ventures identified to earn the income needed for the successful on-going maintenance and operation of the PV powered enterprise.
- ✓ Locals should be involved in the physical installation of all of the project's equipment, to obtain hands-on experience.
- ✓ Locals should be in the forefront for the selection of the economic ventures that are being coupled to the RE project.
- ✓ Ensure continuous training at all levels
- ✓ Establish good communications between the users and the Regional Authority/OPM for advice and updates.
- ✓ Establish a monitoring system to identify problems with the Project and provide immediate solutions.

#### **14.0. Conclusions**

Most significant RE projects in developing countries are funded by long-term loans under favourable terms. These loans are generally provided by development agencies that are established to promote progress in remote parts of the world.

RE systems have shown to be a valuable tool for promoting progress in the under developed hinterland areas of Guyana. Small RE systems with higher capital costs, than fuel-powered systems, is the option decided upon for renewable energy, due to the effects of global warming.

A substantial amount of information now exists to address most uncertainties of a RE system, but the equipment that uses the RE power must be well selected to increase reliability.

The information obtained from this evaluation, which is summarised in this report, should stimulate the use of RE systems, in situations where their application is the best choice technologically, financially and institutionally.

## **ANNEXES**

### **I. Terms Of Reference**

### **II. Documents Consulted**

### **III. Persons Interviewed During Evaluation**

### **IV. Weekly Cash Balances Of Orealla Fruit Cheese Factory**

## **I Terms of Reference**

The Terms of Reference for the Evaluation of the three Pilot PV Systems and woodstoves Projects are as follows:

- 1) 'Assess the effectiveness and efficiency of project implementation'
- 2) 'Review the results achieved by individual activities under the project, focusing on process, results and impacts'.
- 3) 'Identify constraints and challenges faced with regards to:
  - Project implantation
  - Results achieved up to the time of the evaluation
  - Total acceptance of the Project by its stakeholders; and acceptance of the relevance of the project as seen from the perspectives of its partners / potential partners'.
- 4) 'Identify the Projects' areas of strength and competitive advantage and those that need improvement'.
- 5) 'Recommend any measures to enhance coordination with other major players in the field of renewable energy and sustainable development.
- 6) Provide recommendations on the future direction(s) given the continued relevance of the project to the UNDP CPAP and the expressed needs of existing and potential partners.

## **II Documents Consulted**

Overview: Woodstoves (ws), an alternative to Fossil Fuel in Remote Areas

Office of the Prime Minister; Past Project Evaluation Report; Capacity Building and Demonstration Projects for the electrification of Hinterland Unserved Areas utilising Renewable Energy Atlas Project No. 12817/GUY/03/001;2006

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H. Williams, Office of the Prime Minister; Report on the Installation of the PV System for the Peanut Roasting Project at Region 1.

Office of the Prime Minister; Training for Peanut Farmers in Region 1.

Utilising Renewable Energy Sources to enhance Economic Development – A GOG / UNDP Initiative; 2006

H. Williams and T. O’Brian; Report on Survey done to Assess the Feasibility of Producing Value Added Products in Regional Utilising Renewable Energy.

D. Eskenazi, D. Kerner, L. Slominski; Evaluation of International Photovoltaic Projects. September 1986.

T. Philippi; International Market Assessment of Stand-Alone Photovoltaic Power Systems for Cottage Industry Applications; November, 1981.

### **III. Persons Interviewed During Evaluation**

Refer to Excel Document Project Results/ Annex 3

#### **IV. Weekly Cash Balances Of Orealla Fruit Cheese Factory**

Refer to Excel Document Project Results/ Annex 4

### **Factory Production (cont'd)**

Total production / wk

= 15 baskets / batch X 6 batches X 5 dys / wk

= 450 baskets / wk

Sales at \$200 / basket X 450 baskets / wk

= \$90,000 / wk

Weekly Sales, WS = \$90,000

Weekly Expenditure, WE = \$54,435

Weekly Profit = WS – WE

= \$90,000 - \$54,435

= \$35,565