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LESOTHO RENEWABLE ENERGY TECHNOLOGY PROJECT

FIRST YEAR ANNUAL REPORT

May 31, 1982

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PREFACE

The Lesotho Renewable Energy Technology Project (project number 632-0306) was approved by AID in August, 1979. Associates in Rural Development, Inc. (ARD) was selected and contracted by AID/Washington in February, 1981 to provide the technical assistance component of the project. In late March, 1981, the project's chief of party, Mr. Jay Stryker, arrived in Lesotho with the project manager, ARD president Dr. George Burrill, to begin ARD's efforts under the contact. Dr. Judith Gay, the field supervisor, and Mr. Gary Klein, the laboratory supervisor, were already in Lesotho, and joined ARD and the project in mid-April, 1981.

The project is scheduled for a three-year life under AID funding, which includes ARD technical assistance. This report is the first of ARD's annual reports and covers the project's operation from May, 1981 to May 31, 1982.

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Section I

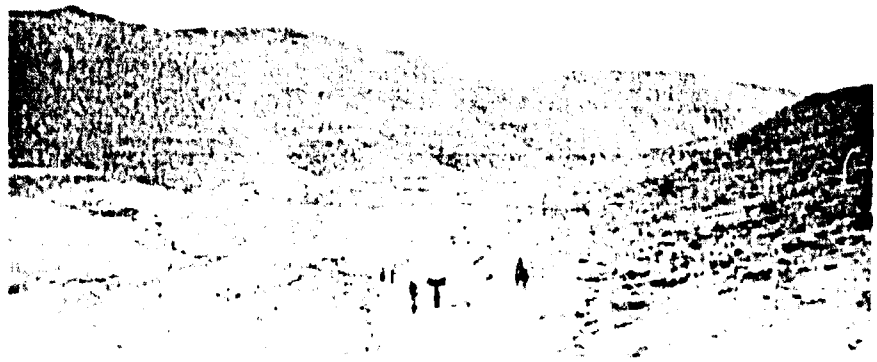
SUMMARY

The Lesotho Renewable Energy Technology (RET) Project addresses the problems Lesotho faces in meeting rising energy demand and prices. Although all aspects of Lesotho's economy are affected by energy problems, the project emphasizes the predominant rural/agricultural sector of the economy. In turn, within the rural sector, there has been an initial selection of certain priority areas. As the rural poor are most desperately in need of adequate energy sources for:

- cooking,
- water heating,
- heating buildings, and
- extending the growing season and food processing,

these areas have received priority attention.

A summary of the project's design, as refined and put forth in log-frame format at the beginning of project implementation, may be found in Appendix A. Although the main focus of the project is on rural areas, and building the capability of both public and private sectors to address energy issues and problems in those areas, it is also intended to meet increased energy demand in urban areas and ultimately conserve costly energy imports. However, the project's present key goal remains to help the rural poor meet their energy needs by providing technologies which are socially, technologically and economically acceptable.



Women in the barren mountain districts of Lesotho coming home with bundles of fuel for cooking, heating water and space heating. They go almost every day to collect heavy bundles of small shrubs or cow dung from distant mountain slopes.

A Peace Corps volunteer on the project staff demonstrating to village children that there are new solutions to old problems, such as baking bread in a solar oven.

The introduction of new energy systems and technologies requires extensive social fieldwork to avoid the outcome of some development projects, where new ideas or technologies are abandoned after the project ends. To this end, ARD has been working closely with Basotho counterparts, and the RET project has Basotho involvement in all aspects of planning, technology selection, economic analysis and dissemination activities. Of great importance is that the RET project is a "pilot project," which stresses the selection and refinement of energy systems that are likely to be adopted by local people. The project is also "institution-building" in that it is preparing a trained cadre of Basotho within the Ministry of Cooperatives and Rural Development's Appropriate Technology Section (ATS).

Despite long delays by the Government of Lesotho (GOL) in providing adequate laboratory space and full staffing, the project is well along in achieving planned targets and developing successful strategies. Project accomplishments during the first year include initiating the village energy survey, establishing a "Technology Implementation, Monitoring and Evaluation System" (TIMES), construction and purchase of numerous energy devices for comparison testing, construction of demonstration devices and prototypes, conducting numerous workshops and demonstrations, providing training for both ATS staff and personnel from other ministries and organizations, establishment of offices and workshops in two locations, and recruitment and staffing of ATS positions.

Section II

A REVIEW OF THE YEAR'S ACTIVITIES

A. Introduction and Project Background

The RET project paper was written in 1979, requests for proposals went out in 1980, and Associates in Rural Development, Inc. was awarded the contract in February, 1981. The ARD team, which arrived in March and April, consisted of the team leader, field supervisor and laboratory supervisor. The U. S. Peace Corps (PC) initially provided two volunteers and the Danish Volunteer Service (DVS) one. The RET project is part of the Ministry of Cooperatives and Rural Development's (MINRUDEV) technical division, which has several sections, including an Appropriate Technology Section (ATS), Village Water Supply, Communal Gardens, etc. The ATS was to be staffed full-time by eight Basotho who would be counterparts to ARD and Peace Corps personnel. A small workshop had been set up by the ministry in 1978 to house ATS activities, and upon project start-up in April, 1981, one full-time ATS staff member was present.

The RET-ATS was to have a major center in the capital city Maseru which included an office and laboratory/workshop. Three regional centers were to be set up, two in the mountainous district centers of Mokhotlong and Quacha's Nek, and one in the lowlands district of Mohale's Hoek. Each was to have a PC volunteer (PCV) and a Basotho counterpart.

In May and June, 1981, the RET team visited each regional

site to make contact with GOL personnel, explore the needs for renewable energy technologies (RETs) and evaluate logistical problems at each site. The team decided to start regional activities in the Mokhotlong district first, on the basis of the district's relatively greater need for RETs compared to the other districts and the initial logistical support offered by a remote rural clinic at Malefiloane, 20 kilometers southwest of the town of Mokhotlong. Two additional PCVs completed training in July, received some additional training in RETs and were assigned to the Mokhotlong district.

In the project paper, some support was to be provided by the Ministry of Agriculture's Farmer Training Centers (FTCs), which was crucial in the project design for shop and training facilities. In Mokhotlong, however, the FTC was initially unable to provide space for an RET center, which resulted in a shift of focus away from the district center to the rural clinic at Malefiloane. During the first year, activities at Malefiloane included the construction of a workshop and a small passive solar house (which will also serve as an office), staff recruitment and training, construction of prototype RETs and energy survey work in surrounding villages.

In addition to establishing the laboratory and workshops and staffing the project, substantial progress was made in all other project input and output categories. Below is a detailed discussion of the first year of project activities. For organizational purposes, it is divided into three sections:

- the RET project as a pilot project,
- institution-building activities, and
- technology design, development and demonstrations.

B. <u>The RET Project as a Pilot Project</u>

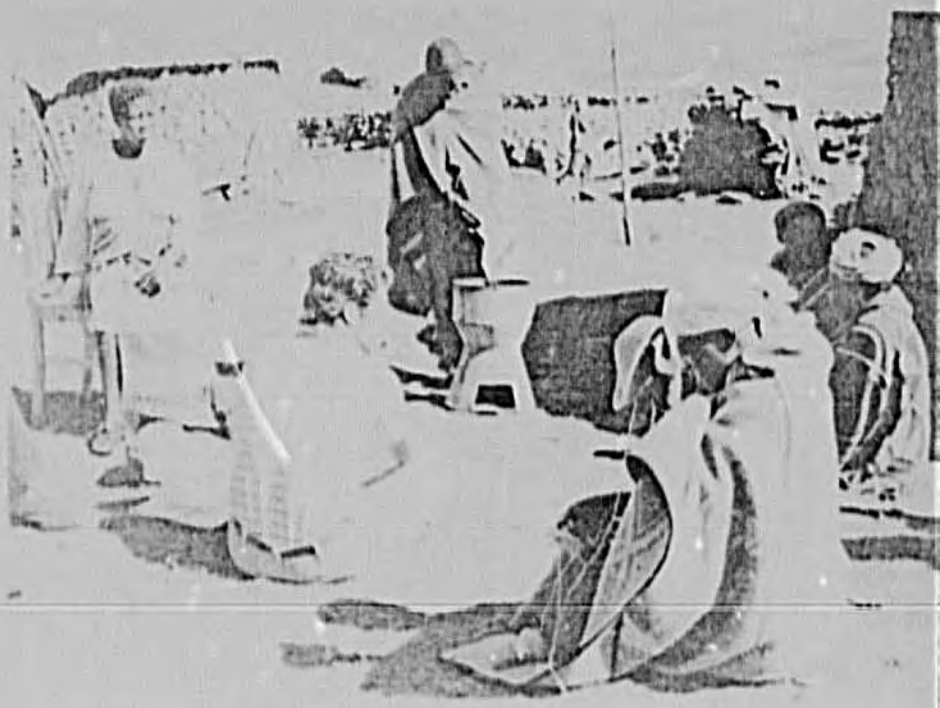
The RET project was designed as a pilot project, and ARD has been implementing it with that fact in mind. In order to be successful, the project must constantly evaluate technology development and implementation strategies to determine what has been learned. Hopefully, what is learned will be translated during the project's life into highly useful and socially acceptable technologies with sound production and dissemination strategies, and indications from the first year lead ARD to believe this goal is being achieved.

To implement this project, ARD originally proposed, and has been using, a learning laboratory approach. A few words on this subject are necessary to provide adequate background for a discussion of the project's implementation and sequencing schedule.

There are two basic reasons why the learning lab approach was chosen. First, although the project is utilizing basically proven technologies, it still needs to adapt RETs to local conditions, which entails continual problem-solving. Second, ongoing work needs to be carried out on appropriate production, transfer and dissemination strategies.

ARD believes that RET projects should develop technologies and interventions that will not require large amounts of

PROTOTYPE DEVELOPMENT: FIELD AND LABORATORY APPROACHES



Members of a village development committee discuss a prototype metal brazier which they have tried out in their homes. Their evaluation and suggested modifications provide essential feedback for ongoing design and testing processes.

The walls of a Lorena/Morena earthen stove are being softened and trimmed--thinner walls make more radiant heat available for the space heating so needed in the cold climate of Lesotho's mountain areas. Such laboratory work has been an essential part of first-year activities to modify proven technologies to suit local conditions

continuing government support. To this end, the project has focused on generating adequate information so that quantifiable estimates can be made of technologies' costs and benefits. In turn, this information should aid the selection of technologies that can eventually be adopted with little or no government support. Further, a major aspect of a pilot project, and the learning laboratory model, is determining what the project can teach us about the feasibility of project technologies and how to make the project's component strategies work even better.

The first year was a process of adjusting and determining the most fruitful direction for the project. Adaptations in project design occurred as an integral part of the approach and are discussed below in appropriate sections of this report. The learning laboratory model calls for data to be collected in technical, social/cultural, economic and financial, and process categories. The latter is particularly important to the technology and intervention strategy development orientation of the learning lab approach. Process data allow for identification of key problems during the project and a consequent analysis of those problems. It also allows for a determination of whether the physical and/or technological needs being addressed by the project are needs that people want met and if the project is meeting them in a manner people expected.

Another vital component of the pilot nature of the RET project is that the project is intended to be "needs-driven."

That is, technology intervention and development are to respond to the real and felt needs of people in the rural areas. ARD's administrative approach to implementing the project, taking into account all of the above issues, has been to emphasize a needs-driven energy survey and planning process. This has been further supported by the development of a full project information system (see page II-20).

C. Implementation Schedule

In April, 1981, at the beginning of project implementation, the project staff reviewed specific tasks for year one. The figure on the next page (Figure II-1) shows these tasks and the sequence of when these activities occurred during the first year.

For a more general overview of project milestones, the timeline given in the project paper is helpful. This project implementation timeline underwent some modifications due to delays in GOL staffing, acquiring workshop space and a reassessment of the nature of village energy technicians (VETs). A comparison of the project paper timeline and the actual chronology of events is shown in Figure II-2.

A project evaluation (PES) was conducted in January, 1982 by AID. It pointed out the unusually long time lapse between the signing of the project agreement and contract award. This delay caused problems with Peace Corps, such that the four volunteers assigned to the RET project on schedule (October, 1980) were reduced by attrition to only two available in April,

Figure II-1

PROJECT IMPLEMENTATION SCHEDULE FOR FIRST YEAR

Activity	5/81	6/81	7/81	8/81	9/81	10/81	11/81	12/81	1/82	2/82	3/82	4/82	5/82
project staff orientation	X → X												
preliminary site visits (first site selection, 6/1)	X →	→ → X											
language study	X → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → X
data collection and survey design		X →	→ → →	→ X									
training of data collectors (MORD, PCVs, ARD staff)				X →	→ → →	→ X							
interview and select MORD staff					X → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → →	→ → X
data collection--first area						X →	→ → →	→ → X					
data analysis							X →	→ → →	X				
set up RET lab (if space is available & supplies arrive)								X → →	→ → →	→ → →	→ → X		
project monitoring info. system established								X → →	→ → X				
MORD and PCV orientation and technical training program				X → X				X → →	→ → →	→ → →	→ → →	→ → →	→ → X
solar house design								X → →	→ → X				
first regional training center established--Malefiloane												X → →	→ → X
cooking device design									X → →	→ → →	→ → X		
village implementation process											X → →	→ → →	→ → X
initial analysis of research and development technologies								X → →	→ → →	→ → X			
training workshop--Maseru												X → →	→ → X

Figure II-2

PROJECT IMPLEMENTATION CHRONOLOGY

Activity	TIMELINE MONTHS Project Paper	Actual
Sign RET Project Agreement	D	D
AID/W Release Request for Proposal	D + 2	D + 8
Support Services Prime Contract Award; Project Begins	D + 6 C*	D + 18 C*
Contractor Start-Up Period -- Staffing	C + 2	C + 1
Project Staff Orientation/Planning, U. S./Lesotho	C + 4	C + 2
Program Organization and Procurement	C + 4	C + 3
Staff Training -- Language	C + 6	C + 3
Staff Training -- Evaluation Process	C + 7	C + 3
Staff Training -- Technologies	C + 7	C + 3
Village Meetings, Presentations and Survey Begin	C + 7	C + 4
Village Energy Technicians (VETs) Trainees Selection	C + 7	redesigned
Train Appropriate Technology (A. T.) Unit	C + 7	redesigned
Train First Group of VET Trainees at RET Rural District No. 1 (Mokhotlong Farmers' Training Center)	C + 8	C + 13
Set Up RET Research Laboratory in Maseru	C + 8	redesigned
Begin Construction of Village Demonstration Units (continue throughout program)	C + 11	C + 13
Begin R&D Unit Pilot Project	C + 14	C + 9
Solar House Construction	not applicable	C + 13

*The lapse of 18 months between the signing of the project agreement and the award of the contract obscured the comparison of the timeline put forth in the project paper and the RET project's actual chronology presented in this figure. Thus, the starting point for both timelines was reset to C when the contract was awarded and the project begun.

1981. The evaluation strongly recommended that the project be scaled down from three districts to one (Mokhotlong) and the number of VETs be reduced from 140 (per the project paper log frame) to 100. Along with the latter reduction, it was recommended that the VET concept be reevaluated and existing entrepreneurs or their employees be included in VET selection. ARD is in full agreement with these recommendations and has been proceeding with project implementation along these lines.

Project Implementation and Design Considerations

As already mentioned, the project paper, as written in 1979, made several assumptions which did not materialize due to conditions in force two years later when the project actually began. The ATS was to have a full-time staff of eight Basotho--three engineers, two technical officers and three technical assistants. A workshop was to be available for RET project use. The project was to be both a pilot effort and do institution-building. Heavy reliance was placed on the FTCs in district centers to provide classroom and dormitory space along with some land and outbuildings for conducting practical demonstrations. The primary mode of dissemination was to be VETs--local entrepreneurs who would receive technical training or villagers who expressed interest in receiving both basic business and technical skills. MINRUDEV staff were to conduct most of the VET training after an initial set-up period under RET staff guidance, and each VET was to be given a tool kit at the end of the training period.

In summary, there were three key areas in which project design problems arose:

- late staffing of the project,
- availability of FTC support, and
- the VET concept and training.

At this point, a further discussion of the VET concept is in order; the other two problem areas are discussed further in other sections of this report.

The realities of both rural and urban situations suggest that the approach to identifying, training and supporting VETs may have to be modified. According to the project paper, technology dissemination was to occur primarily through the VETs, who were to be selected by local villages. However, initial work in the rural areas indicated that considerable technical and business training, as well as market development, will be necessary before individuals with no prior experience can hope to make a living at such work. Furthermore, the skills required for producing RETs are so varied (masonry, plastering, woodworking, metalworking, welding, glass fitting, building, etc.) that no one person can be expected to master them all.

In urban and peri-urban areas, there are Basotho (many of them women), who already have some business skills and are eager to branch out into new work. Yet, most VET candidates are seeking regular employment with the project (in keeping with the common understanding that a "technician" is salaried),

rather than training for the enterprise approach which the project paper envisions. Attempting to produce and market totally new technologies in competition with the products of industrial South Africa is a risk which many individuals fear to take.

Because of the ideas, expectations, attitudes and actual buying patterns which South African marketing has created in Lesotho, the RET project may have to use a similar commercial approach to advertising products and services. It may also have to work through existing institutional links and extension services which can provide dependable requests for VET products and/or services in the early stages. The project is working in concert with credit unions, cooperatives and existing small businesses to provide back-up support for the VET program. It may also adopt diverse training and support strategies, according to the particular type of RET produced--thus, training mud stove specialists in villages, sheet metal stove workers in production centers, solar building contractors in growing towns, etc.--rather than expecting to create a cadre of all-purpose VETs. All these factors led to a reassessment of the VET concept during the first year.

One final point in project design concerns the dual role of the project as both a pilot effort and in institution-building. ARD is attempting to meet this challenge through our technology selection process and the professional advancement of ATS staff, who are learning skills using the process and

technologies selected under the pilot plan. Even if the RET project does not continue with these specific technologies, the ATS staff will have the skills and knowledge to carry on an energy-conscious development program. ARD believes this is the best approach to institution-building within a pilot project.

D. Institution-Building

The focus on institution-building and providing a base from which to develop, produce and disseminate RETs has occupied a majority of the project's time and effort. Most of the components of institution-building have been touched upon already. They consist of staffing and staff training, office and workshop establishment, acquisition of commodities for the laboratory and educational/media efforts, development of a project information system and data base including the energy survey, establishing a library and media development. Each component is discussed in turn below.

Staffing

Staffing of the project requires 18 people to work as a multidisciplinary, multinational team consisting of three expatriates hired by the contractor (ARD) from the United States, eight Lesotho nationals provided by the GOL, four Peace Corps and one Danish volunteers, and two Lesotho nationals hired by ARD to provide administrative and logistical support. Since the project emphasizes household technologies and the participation of women in development, recruitment of women team members had a high priority. This is shown in the

following table.

Personnel Allocations

Position	Location	Personnel
Project Coordinator	Maseru	expatriate, M, ARD
Solar Engineer (Head of ATS)	Maseru	Mosotho, M
Laboratory Supervisor	Maseru	expatriate, M, ARD
Field Supervisor	Mokhotlong	expatriate, F, ARD
Assistant Solar Engineer	Maseru	Mosotho, M*
Assistant Solar Engineer	Mokhotlong	Mosotho, M*
Senior Technical Officer	Maseru	Mosotho, M
Senior Technical Officer	Mokhotlong	Mosotho, F
R&D Laboratory Coordinator	Maseru	expatriate, PCV#
Rural Center Coordinators (4)	Mokhotlong	expat, M, PCV, DVS
Technical Assistants (2)	Mokhotlong	Mosotho, F*
Technical Assistant	Maseru	Mosotho, F+
Administrative Assistant	Maseru	Mosotho, F, ARD
Stock and Supply Manager	Maseru	Mosotho, F, ARD*

*Individuals identified and under recruitment.
+Individual transferred to ATS.
#Incumbent resigned from project; replacement requested.

As mentioned, recruitment of additional Basotho staff for the ATS was hampered by a GOL freeze on hiring for budgetary reasons. However, in January, 1982, two additional staff members were hired, an assistant solar engineer and a senior technical officer. Also, one technical assistant was transferred into the ATS by the ministry. Recruitment continued, and at the end of the first year, candidates for

all unfilled positions had been identified.

Consultants provided expertise in several areas--bio-gas systems, fuel-efficient cook stoves, energy-efficient building design, technology assessment, and greenhouses and food dryers. The direct results of these consultancies were a set of fuel-efficient stove designs suitable for the fuels and cooking conditions of Lesotho, designs for solar-heated buildings, and a set of small greenhouses and food dryers. Inter-ministry collaboration resulted in the RET project working with and supplementing ongoing programs in nutrition, agriculture and energy.

The project paper lists 20 person-months of short-term hire for consultants. By the end of the first year, five person-months of consultant time had been expended.

Consultant Services

Consultant	Person-Months	Services Rendered
Dr. J. Nolfi	0.25	bio-gas feasibility
Dr. G. Murrill	1.00	technology selection process and project information system
Mr. I. Evans	2.00	fuel-efficient stoves
Mr. R. Alward	1.00	solar design in greenhouses and hot water systems
Mr. B. Hamilton	0.75	energy conservation in buildings

All of the consultants assisted with staff training, but the greatest amount of training was carried out by the ARD team--Mr. Stryker, Dr. Gay and Mr. Klein.

ATS staff underwent training as soon as they finished

their initial orientation with the ministry. Ms. Khoboko, a home economics educator, was assigned to work with Dr. Gay. She learned about the design of surveys, wrote sample questionnaires, conducted initial tests of surveys, analyzed data and prepared reports. Subsequently, she participated with Dr. Gay in training enumerators, conducting the village energy survey, computerized data analysis and report writing; she contributed immeasurably by following up on topics which were not originally in the survey. This lead to new insights into fuel and cooking problems, and resulted in a better understanding of local people's perceptions of these problems. She also received training in the actual construction, testing and demonstration of earthen stoves, paolas, grow-holes and food dryers, using basic sheet metal, carpentry and masonry techniques.

Mr. Kanetsi was assigned to work with Mr. Klein in the engineering and construction of RETs, which included many site visits, working in the ATS workshop, testing and evaluating RETs. Using an engineering design approach in collaboration with a stove consultant, several ideas emerged for earthen stoves alone, which were incorporated into the stove development program. Mr. Kanetsi also participated in the architectural analysis of energy-saving designs for Lesotho, which form the basis for a follow-on architectural program. This training involved the use of programmable calculator routines for solar energy and of BASIC, a computer language,

STAFF TRAINING

An ARD consultant provides staff training in earthen stove design and construction techniques.

Preparing the sand and clay "Lorena" mixture.

Shaping a first prototype stove to handle typical Lesotho cooking pots.

with the data loggers used for monitoring buildings.

Both Ms. Khoboko and Mr. Kanetsi received training in operational aspects of ATS and the RET project from Mr. Stryker. This involved the protocol and procedures necessary for project implementation, logistic and support functions needed for surveys, RET design and dissemination, and writing short- and long-term plans. Public relations and educational materials preparation were stressed.

The administrative assistant and the candidate for stock and supply manager were also given training. This involved the introduction of energy concepts, technologies and literature, and training in library, office and financial management procedures, including bookkeeping and calculator use.

Office and Workshop

Although the ministry provided initial office and workshop space in the technical division complex, it was soon found that the one-room office was too small, and both the office and original workshop space were needed by the village water supply project, another AID-supported project. A suite of rooms was subsequently provided near the ministry headquarters. The workshop, which was established in 1978 for building prototype RETs, was also too small for the full-time staff of five expected to use it, and some alternate sites were considered. At least three changes of plan occurred, as ministry priorities shifted. Finally, a site five kilometers from Maseru in the Khubetsoana development area was made available, and at the end

WORKSHOP

In the original MINRUDEV workshop, which will be moved to the Khubetsoana site, a Mosotho artisan guides a Peace Corps staff member in sheet metal stove construction.

At the Khubetsoana site, the project's chief solar engineer oversees the start of work on the first building--a small shed in which cook stove tests can be conducted, and prototypes, fuel and utensils stored.

of the first year, construction had started on a new workshop and office complex. The site is on a half-hectare plot, adjoining a major road, with good access to public transportation and utilities. Moving the workshop, and eventually offices, to the new site has involved delays beyond the management control of the project. However, site preparations, security fencing, foundation layouts and construction of a building for stove testing were completed by the end of the first year.

The other office and workshop complex is located in Malefiloane village, in the Mokhotlong district. During the latter half of the first year, a workshop was constructed on the Malefiloane clinic grounds that utilizes solar orientation and solar gain. Also, a small solar-heated, well-insulated building, to serve as an office, library, classroom and overnight accommodations for visitors, was under construction by the end of the first year. Both structures demonstrate the concepts of insulation and solar heating in a remote rural area that has one of Lesotho's windiest and coldest microclimates.

Commodities Acquisition

ARD's contract calls for the acquisition of both laboratory and media equipment for the Maseru workshop and office. Assessment, during the initial months, of needs in these project areas brought ARD to the conclusion that both should be addressed early so that the project would have the proper equipment at the appropriate times. To date, 44 percent

of project funds have been expended for equipment in these two areas. The majority of the larger items have been obtained, and the remainder will be acquired on an "as-needed" basis. There have been no problems with delivery of materials to Lesotho nor in the proper application of that equipment toward project goals.

Project Information System and Data Base

To keep track of technology development, from the laboratory through village use, a set of four specialized information systems was established. They are:

- the project chronological and administrative file, which forms an historical record and also reflects logistic concerns,
- specific technical data resulting from laboratory tests and initial field trials,
- village-level survey data, as collected and reported by the field supervisor, and
- the Technology Implementation, Monitoring and Evaluation System (TIMES).

The TIMES data base allows for rapid filing and retrieval of information and specific issues under the following headings:

- technical--development and laboratory testing,
- social/economic--acceptance and feasibility, and
- extension/dissemination--village-level implementation.

Information will be collected from village development committees, individual technology users, MINRUDEV staff contacts at all levels, other persons from cooperating ministries and organizations, and ATS and RET staff members.

The importance of the survey process to technology selection and development has already been discussed, and the development and execution of the survey was a major focus of the project during the first year. In mid-1981, a small survey of fuel use and cooking practices was conducted in order to provide prior assistance for the work of ARD stove consultant, Ianto Evans, who was in the field during January and February, 1982. This survey was also used to verify and delineate the cooking fuel problem in Lesotho.

On the basis of this preliminary work, the survey component of the project focused on the rural areas of Mokhotlong. Several months were devoted to collecting background data on the social, economic and institutional structures of the district, and helping field staff obtain information on the specific villages in which they were located. In this way, a foundation was laid for subsequent cooperation between RET staff, villagers and local institutitons in technology selection, design, field-testing and dissemination.

The main part of this effort, a major village energy survey, was designed and carried out initially in four environmentally distinct villages in the Malefiloane area and two on the main Mokhotlong road. A schedule of interviews and observations was designed, translated and pretested, and three enumerators from the Malefiloane area were trained. A week was spent by the enumerators and two RET staff members in each of

the six villages. This provided time to establish close contact with villagers, introduce and explain the project, and observe as well as conduct interviews concerning energy and other rural development problems.

The village energy survey in these six villages is part of an ongoing data collection process which provides:

- a basis for energy-related needs and social feasibility assessments in technology selection,
- specific information to guide research and design work on priority technologies, and
- detailed data on local institutions, resources, skills and opinions to guide the project in subsequent work in these and similar villages.

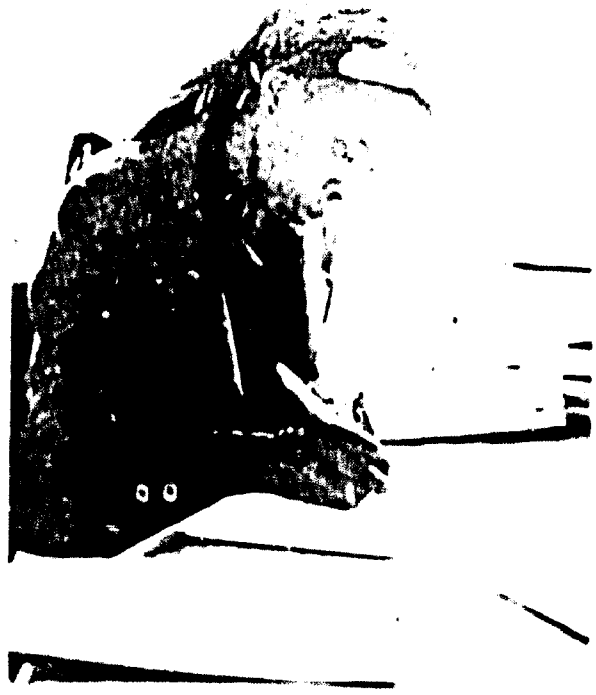
As of the end of year one, data assembly for analysis was being carried out.

Library and Media Development

The project has started a library on RET subjects (including general energy and technical information), which includes books, pamphlets, assorted technical periodicals and professional journals, motion pictures and slides. It has certainly met a need for specialized information in Maseru for many individuals and groups outside ATS and project staff. A library cataloging and loan system was established, and will be maintained by the project's stock and supply manager.

Since much of the public dissemination will be via newspapers and fliers, a media file was established, which is both a collection of other appropriate technology organizations' information and a chronological record of the

An office staff member cataloging and arranging books in the project's RET reference library--a resource available to the entire development community in Lesotho.



Periods of office work, translating and documentation alternate with fieldwork for project staff members.

project's publications.

A major hurdle in technological dissemination is readable, correct translations. A word-for-word translation often loses its meaning when taken literally, such that phrases and concepts need to be expressed in idiomatic language. Problems revealed by English to Sesotho and Sesotho to English "back translations," sounded a cautionary note and provided guidance for those trying to convey technical ideas. Illustrations can also be misunderstood. The project's continuing media development component is working on easily comprehended graphic displays and photography.

A project contribution at the national policy level was participation in the formation of the National Council for Science and Technology, which will be the main body for establishing priorities for technology dissemination.

Summary

Growing ministry support for the project indicates development of a strong institutional base. This support can be measured in real financial terms. The project paper called for a $77,000 level of support over the three-year contract period, but for the GOL fiscal year 1982/1983 alone, GOL support is budgeted at $118,000, of which $51,000 is for workshop and office construction.

E. Technology Design, Development and Demonstration

Despite the lack of completed laboratory space and facilities, the project moved ahead with the development and

adaptation for conditions in Lesotho of numerous technologies identified in the project design and by project staff. The preliminary survey carried out on the cooking and fuel problem in mid-1981, as well as observations, interviews and Basotho staff knowledge, confirmed initial thinking that cooking, water heating, space heating and extending the food growing season were top-priority energy-related needs. While the full village energy survey was being designed and executed, field and laboratory work proceeded with the most likely candidate technologies for meeting these priority needs. Background work and initial feasibility analyses were also carried out for some of the suggested research and development technologies. Since some of these, such as photovoltaics, are mainly to be applied in institutional settings, initial institutional linkages for these RETs were established by project staff. The following sections provide a technology-by-technology overview of project activities during the first year.

Fuel-Efficient Stoves

Preliminary survey results indicate that almost every woman is aware that fuel supplies are becoming more costly and/or less available. However, in rural areas, women respond by spending more time in gathering fuel at greater distances from their villages. In peri-urban areas, the price of fuel keeps rising, and occasionally, it is unavailable. In the Mokhotlong center, the fast-burning shrub "sehalahala" (Chrysocoma) is sold by women who may have head-loaded it for 10 kilometers or

truck owners who have harvested it from mountainsides 50 kilometers from town. Firewood, coal and paraffin are expensive imports and are typically used by the wealthy, shops and government offices. The other major fuel is animal dung (lisu), which is typically collected from animal enclosures by digging it out and drying it on the tops of kraal walls. Villagers without animals or kraals must collect dung from fields or pathways, or negotiate with cattle owners for this fuel, usually in exchange for labor. Shortages of cooking fuel result in impoverishment of local people when they buy fuel or spend long hours to collect it and diminished meal quality as people begin to cook "lazy" meals to conserve fuel.

To an outside observer, fuel-efficient stoves with chimneys would appear to be a most welcome innovation that would receive widespread acclaim. However, cooking requires multi-fuel, multipurpose units, a fact which must be acknowledged by stove designers. An open fire in the center of the traditional, round, thatched house, a "rondavel," serves a multitude of functions--cooking, water heating, space heating and lighting. Any competing design must provide or make adequate substitutions for all these needs. Disadvantages of the traditional open fire include a spark and burn hazard evidenced by many children with burn scars, a smoke hazard that shows up in eye and respiratory problems in older persons, and the minor problem of ash disposal.

- The Paola

To obtain the benefits of the traditional open fire with portability, the indigenous solution is the "paola" (pail)--a metal bucket or pail with small holes punched in the sides to allow combustion air to enter. The typical paola is about 30 centimeters in diameter and 30 centimeters high. It is used to burn sehalahala, a fast-burning resinous shrub that acts as an igniter, and lisu. As lisu is first ignited, it emits copious quantities of acrid smoke, so the typical paola fire is started outside the house. Once a glowing bed of coals is established (lisu approximates peat in its heat content and burning characteristics), the paola is brought into the house. Cooking is done with pots placed on or within the paola, and after the meal, people sit around it, sharing and enjoying the light and warmth of the dying embers. In the morning, the ashes in the paola are carried outside.

The RET project worked with several designs for improved paolas during the first year. One was developed in 1978 by the ATS, using thick-walled pipe and a welded grate construction. Although long-lasting, it was deemed too heavy for use by most women. Another design, initiated by the Thaba-Tseka Rural Technology Unit (RTU), has roughly an hourglass shape which directs the smoke stream at the base of the cooking pot. The RET project investigated this idea, and it does produce a fuel savings of about 50 percent when heating foods quickly. However, it loses this efficiency in the long, slow simmering

PAOLAS AND EARTHEN STOVES

The head of the Women's Bureau in Lesotho and other visitors at a World Food Day demonstration compare and discuss the relative merits of several different types of metal braziers (paolas).

A staff member shows a group of visitors "what's cooking" during a testing and demonstration session at the project's research and development workshop in Maseru.

or repeated boiling of many recipes. Also, it does not radiate enough heat to satisfy those sitting around it. Modifications in the paola's geometry and holes in its sides are being tried by the project.

Other modifications to the paola, in terms of its material (e.g., clay, stone), size and internal smoke stream pattern, are being reviewed by the project. At the same time, a hybrid idea is being pursued, whereby the paola is attached by means of a smoke diverter or funnel to an earthen stove. This could result in the quick heating and cooking features desired by many, along with the thermal efficiency of an earthen stove. Another modification involves fitting a chimney system and water-jacketed stovepipe to the paola. Both of these ideas will be fully explored during the project's second year.

- Earthen Stoves

Stoves constructed of sand and clay mixes of the "Lorena" type were tested extensively at the Maseru and Malefiloane workshops. Since similar mixes are used in traditional building construction, the materials are familiar and acceptable to local people. However, the thick-walled Lorena stove from Guatemala is designed to burn wood and crop residues, and provide slow simmering. Although the Lorena retains heat in its mass after several hours of cooking during the day, the design concept does not easily translate to the situation in Lesotho. First, the fuels used, sehalahala and lisu, require different firebox sizes and smoke chamber

designs. Second, cooking is done early in the morning or after sundown, such that heat stored in the stove's mass is not needed while people are away from the house during the day, and at night, when people want to sit around a fire. These factors lead to a number of design changes in the Lorena to better meet Lesotho's needs. In fact, the project changed the name slightly to "Morena," which means chief in Sesotho. By modifying the combustion chambers, making the walls thinner so that heat is radiated from the stove more rapidly, and adjusting the top surface height to a comfortable level for local women, the Morena is beginning to offer some potential for Lesotho. Extensive field trials will follow.

- Retained Heat Cookers

The retained heat cooker, also known as a hay-box, is a proven technology for which initial dissemination is beginning. It consists of a pair of cloth bags filled with an insulating material which fit around a cooking pot after it is removed from a heat source. When used in conjunction with an improved paola, rice, cornmeal ("papa"), grains, beans, other vegetables and meat stews can be prepared with very little fuel. This type of device can also be used with paraffin stoves to reduce the amount of fuel consumed. Versions with straw, styrofoam beads, feathers, paper and used cloth as the insulating material have been made and tested. The principal barrier to its acceptance is the desire of many cooks to stir food continuously. The RET project has considered approaches such

DEMONSTRATION FOR THE KITCHEN STAFF OF THE PALACE OF THE KING

Retained heat cooker -- Women look with amazement to discover that rice really did cook when placed in a cardboard box surrounded by an insulated pillow for 40 minutes--the same amount of time it took to bring the water to a boil on the stove.

Solar oven -- The project's home economist and palace staff members discuss the principles and potential of solar energy as they watch a cake baking in a solar oven.

as "new recipes" which do not require stirring or even peeking under the lid.

- Solar Ovens

Solar ovens of various styles were tried by the project and found to meet with initial interest in them as curiosities, but only moderate acceptance in use. This is, of course, quite predictable because much of the cooking is done in the early morning or at dusk. The concentrating-focus (parabolic) type was not found to be very useful as it can only cook small amounts of food at one time, the mirror requires frequent adjustment to the sun angle, and the focused light on the pot is irritatingly bright. Further, cooking ceases when a cloud blocks the direct sunlight.

The semi-focused type of oven holds much greater promise. It consists of an insulated box (the oven proper) with a glass door and a set of reflecting panels outside. Even on partly cloudy days with periods of intermittent direct sunshine, temperatures above boiling are produced. Bread, cake, stews, whole grains, legumes and other foods that do not require stirring can be prepared with relative ease. Project research also showed that preservation of fruit and vegetables in bottles can be done very simply in a solar oven, eliminating the need for fuel to boil large kettles of water. The cost of about $60 is too high for the poorest of villagers, but it may be attractive to those with more disposable income.

- Institutional Cooking Devices

Each of the devices already discussed has potential for institutions such as schools, hospitals and restaurants. The school lunch program is the first area where improved paolas, Morena stoves and solar cookers (which work well in the typically clear morning skies of Lesotho) were introduced. Since most schools require students to collect some fuel on their morning trip or during a morning recess, young scholars will enjoy an immediate, direct benefit from increases in fuel efficiency, and destruction of limited local biomass will be reduced if such cooking devices are utilized.

- Metal Stoves

Stoves made of sheet metal or combinations such as cast iron with brick (used in Swaziland) may hold promise for Lesotho. Only the most cursory examination of these possibilities was made during the first year, but they will be explored further in the second. In the same vein, increasing the efficiency of commercially available stoves, by using flame shields, small ovens which fit over burners, etc., was identified as having potential.

Water-Heating Technologies

Another major area of project work was in water heating. At present, most water for cooking or washing is heated over paraffin stoves, lisu fires in paolas or open fires.

- Combustion Heaters

Two devices were tested for suitability in heating water

using combustion. The improved paola was found very suitable. The other was the Morena stove where a separate water container, typically a used food aid oil tin, was placed in the smoke stream. Village acceptance of these methods appears favorable and compatible with the need for one to three liters of boiling water.

- Solar Heaters

Few small-scale, low-cost solar water heaters are on the market in Lesotho. Most of the units available are in the $350-and-up price range and provide hot water of about 55°C at the tap. Such units may be found on a few urban houses and hospitals, shops and schools, where they often work as preheaters for a conventional, electrically heated, "geyser" unit. Project field trips to numerous solar water heater installations revealed that many were inoperative due to corrosion or cracking of materials, improper installation and/or sediment buildup blocking internal flow. For example, one unit was quickly "repaired" by simply straightening a severely bent hose connection. The project has been providing information to contractors, architects and home builders on commercially available units, and guidance on proper sizing, installation and maintenance. The project has demonstrated a portable, seven-liter, solar water heater, made at the Thaba-Tseka RTU, but many people indicated that they would rather use a solar oven to cook and heat water, rather than purchase two solar appliances.

Energy-Efficient Buildings

The third major area of project activity during the first year was in architectural improvements for existing buildings and new construction.

- Solar House

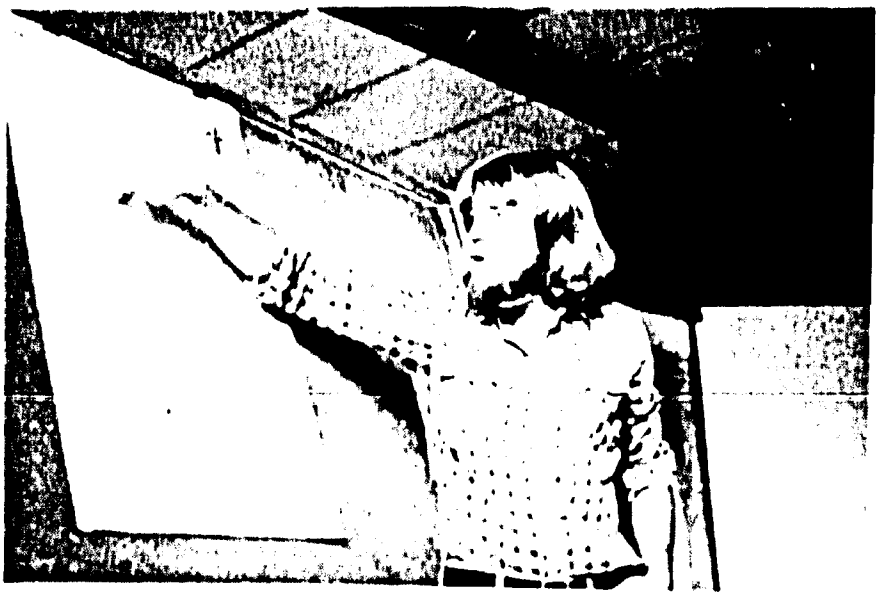
In the project paper, the project coordinator was to live in a house designed and built by the project using project funds, which would illustrate energy efficiency concepts. After discussion and an assessment of the best strategy for demonstrating solar building techniques, this was changed in implementation to constructing a set of small energy-efficient buildings, typical of the kind constructed in Lesotho.

Also, a small office building, with a plan similar to a house, was designed for the Malefiloane workshop site. This building utilizes passive solar heating in one of Lesotho's coldest climates. By the end of the project's first year, the foundation with an insulated concrete slab and the beginning of the walls with an insulated core were under construction. This building will be monitored with automatic recording equipment to measure its thermal performance. Plans were also made for work early in the second year by an architectural consultant who would develop plans for low-, middle- and upper-income solar homes.

- Retrofit

Project staff met with a number of building owners who desired improvement in existing building thermal efficiency.

PASSIVE SOLAR SEMINAR



Energy-efficient buildings, solar retrofit and insulating strategies are introduced by ARD consultants at a seminar for architects and contractors who are responsible for most of the building design in Lesotho.

As fuel prices continue to rise, many persons want to add insulation, reduce air infiltration and so forth to avoid higher heating costs. With the help of consultants, Mr. Alward and Mr. Hamilton, in January and February, 1982, the project was able to provide advice on both procedures and suitable materials for such retrofits.

- Energy Efficiency in Buildings

The project established criteria for energy efficiency in buildings, including methods for determining the proper solar orientation on a site, roof and window shading parameters, window sizing, descriptions of thermal performance of floors and walls, criteria for ceiling and roof insulation, ventilation and air infiltration measurements and criteria, and thermal mass analysis. These criteria were drawn up in conjunction with a variety of institutions and architects/builders in Lesotho, and were presented to local architects and builders at a workshop conducted by Mr. Alward and Mr. Hamilton on February 4, 1982. Evidence of the interest and importance of this work to Lesotho, and the potential impact of these project activities, is that twice as many people attended the workshop as were expected.

Food Production/Preservation

The fourth major area of project activity was in greenhouses, grow-holes and food dryers.

- Greenhouses and Grow-Holes

Since extending the growing season is important in the

SOLAR WATER HEATERS AND FOOD DRYERS

A project staff member investigates existing installations of simple commercial solar water heaters to determine the relative effectiveness of available systems and indigenous installation approaches (as in this ground-level, gravity-feed system), and identify maintenance problems.

The project's home economist and engineer explain the design and operation of a metal and fiberglass food dryer with removable screen tray. User education is as important as technology design in assuring RET acceptance.

mountains of Lesotho, the RET project conducted a training program for nutritionists and agricultural extension agents on this topic. The program was an actual hands-on building experience, leaving the FTC in Mokhotlong with demonstration grow-holes and greenhouses. Many local people were familiar with the idea of growing seedlings for spring planting, and now they have seen firsthand how to build units with common tools and materials that can provide crops throughout the winter, as well as more dependable, early seedlings. Grow-holes can greatly raise nutritional standards in Lesotho, and the spread of this concept has strong potential. For example, the local hospital immediately expressed an interest in constructing a larger greenhouse for its own food supplies.

- Food Dryers

Prototype food dryers had been constructed by the ATS prior to project start-up. These units were found to work very well for a few foods, but some inexperienced users produced under-dried foods, while others had hard or half-cooked products. Project review of this problem indicated that the dryers required redesign and additional research with various foods, plus operator education. The project dried various vegetables and fruits as part of its demonstrations, which aroused much interest and resulted in requests to purchase dryers. The project also conducted a training session nutrition extension workers in Mokhotlong, part of which involved the construction of a food dryer. This was received

favorably, since part of the 1982 crop was lost due to early frosts and the lack of reliable food preservation techniques. Development work with food dryers is continuing.

Research and Development/Institutional Technologies

As planned in the project paper, the "research and development" program was to have included a number of technologies.

- Bio-Gas Feasibility

In the project paper, a bio-gas demonstration system was to be developed and placed on a feedlot, although the feedlots in Lesotho have very few cattle and a government abattoir is not yet operative. However, interest was shown by some local farmers and the national pig breeding farm, and an initial feasibility study was conducted by the project. The results of this study indicated that the cool to cold climate with its large daily temperature swings and the relative lack of water in the quantities needed would make the operation of a bio-gas system in Lesotho difficult and costly for either feedlots or smaller individually owned systems. Further, there is not a great need for bio-gas energy at the institutional sites visited, which are already on the electrical grid or have bottled gas available. Other donors have expressed interest in bio-gas or are developing units, and the project is acting as an information source for them, but has decided not to build a demonstration unit at present.

- Hydroelectricity

A second "research and development" activity is hydroelectricity at the "micro" scale, which is targeted as a second-year activity. However, preliminary work was done in the first year in collecting hydrological data, examining potential sites, which involves both the water potential and number of possible electricity users, and establishing institutional links with ministries and organizations which would eventually install and operate these units. A team from the National Rural Electric Cooperative Association (NRECA) is scheduled to perform detailed site evaluation and feasibility studies in the first phase. Then, with the RET team, they will conduct a second phase for training local personnel in the actual installation and operation of the equipment. The RET project has several enthusiastic and willing trainee candidates from both the government and private sector.

- Photovoltaics

The RET project technology selection process placed photovoltaics fairly low on the action list because photovoltaics for irrigation and water pumping would play a minor role in the highlands of Lesotho because most water is supplied by mountain springs. Photovoltaics for trickle charging of batteries for radio communication are well-known in Lesotho, and the project has helped rural clinics regarding state-of-the-art systems by providing up-to-date technical information and contact with suppliers. To the same end, the

project has provided information to the vaccine cold chain program. The concept of photovoltaic power has spread to private individuals, and at least two houses in Maseru are installing photovoltaic panels for a 12-volt refrigerator and a 12-volt lighting system.

Technology Demonstration

The project received numerous requests for information on RETs, and demonstrations and training programs to be conducted by the RET staff. (Please see the list of demonstrations given in Appendix B.) Visits by home economics groups, teachers, newspaper reporters and interested individuals to the workshop site occurred throughout the first year. Preparations for each visit or demonstration were invaluable training for the project staff. The actual demonstrations afforded opportunities to introduce new ideas and technologies, and obtain opinions of various RET devices, thus involving many Basotho in the technology selection and development process. For example, timed water boiling contests were often set up between teams using old and new types of paolas with identical amounts of traditional fuels. Such participation assured active involvement in the search for new fuel-conserving strategies, as well as stimulating informal conversation from which important questions and ideas could flow. Baking with a solar oven and cooking in retained heat cookers also formed regular parts of such demonstrations.

Although great interest was usually expressed in these new

devices, the higher initial cost was sometimes seen as problem. In addition, the comparison with commercial stoves using fossil fuels (for those who can afford them) and the status attached to ownership of imported goods are important factors which the RET staff must recognize in their promotional efforts. However, the project does have numerous orders for specific RETs already. It now remains to develop the most suitable designs, and then provide VET training and support for artisans who can fill those orders.

Section III

FUTURE DIRECTIONS

Several directions have been set for the RET project on the basis of findings from the first year's research, technology development, survey and dissemination efforts. In developing these directions and technologies, the project has used energy-related needs that have been identified as guiding criteria. Four basic areas have been designated as high priority.

First, and foremost, cooking technologies will be emphasized. Since there are multiple technologies which address the energy-in-cooking problem, each will be examined for social, technical and economic acceptability. Because of Lesotho's interdependence with the Republic of South Africa, many commercial utensils, stoves and fuels are available. These will be closely examined to determine if improvements in their design or use can be made. One example is the modification of cooking pots by the use of insulating covers and jackets. Another is the use of small flame shields to help direct heat to the pot. Still another is the alteration of recipes, especially when long boiling times are required. The development of earthen and metal stoves, particularly in terms of multiple fuels and uses, will proceed.

Second, water heating, by means of "waste heat" from combustion and solar energy, will continue to be a focus. Efforts will be made to increase public awareness of solar

FUTURE DIRECTIONS -- DEMONSTRATION AND EXTENSION

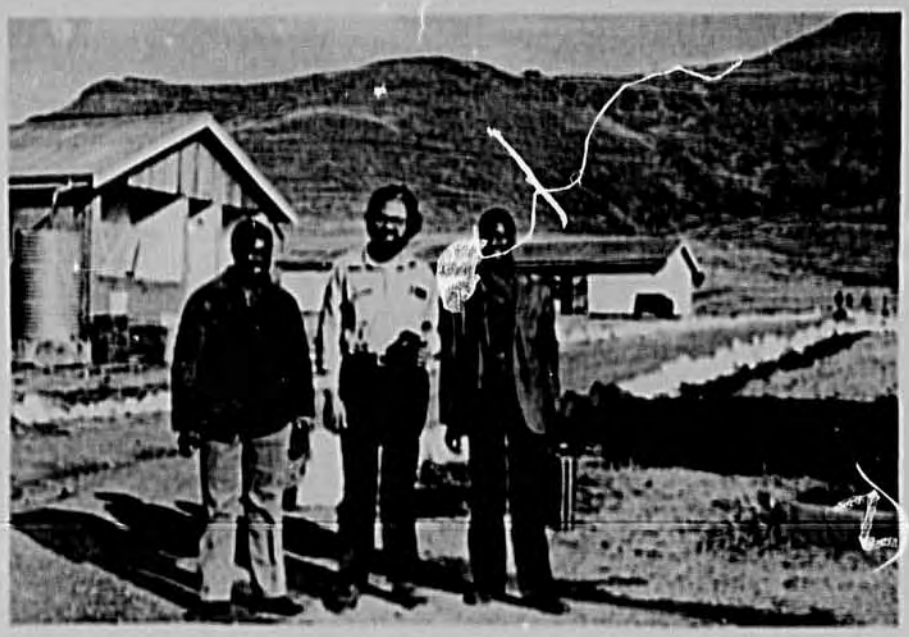
Above, the project on the move--setting up materials for a demonstration.

Below, meetings with nutrition classes, church groups and other volunteer women's associations provide ideal opportunities to discuss ways in which new technologies and cooking methods can be used to conserve energy. Modification of cooking methods may prove as important as elaborate technologies in a total national program for domestic energy conservation.

potential for both preheating and direct heating of water. Because of Lesotho's favorable solar potential, many new buildings could incorporate solar water heating and existing structures could be retrofitted. Of central importance is public acceptance of the idea of large quantities (e.g., more than two liters) of hot water available at the tap as a direct improvement in the quality of life.

Third, the development and dissemination effort to make buildings more energy efficient will continue. Urban and peri-urban buildings are large consumers of electricity, gas, coal and paraffin for space heating. Insulation, reduction in air infiltration, thermal storage and solar gain techniques all contribute to increasing a building's thermal efficiency. In the second year, efforts will be made to increase public awareness of these techniques both for new construction and retrofitting existing buildings. Building materials, especially insulation, will be evaluated in terms of the cost-effectiveness of commercially available and locally produced items. Because of the widespread availability of imported building materials (metal- or wood-framed windows, doors, corrugated steel roofs, etc. are found in houses in the most remote hamlets) and public acceptance of commercial items, these will receive more project attention than thatch, which is in short supply and not considered "modern" by house builders. The RET project will be disseminating sets of plans for houses, shops, clinics, etc., which utilize solar orientation, solar

FUTURE DIRECTIONS -- INTER-MINISTRY COOPERATION



The director of the Mokhotlong Farmers' Training Center (Ministry of Agriculture) and the senior community development officer of MINRUDEV meet with the project's team leader. Here, they discuss plans for training workshops to introduce RET to extension workers from both ministries. The Mokhotlong FTC (seen in the background) is available for training courses, while the RET project provides staff, tools, materials and prototypes for such cooperative training programs.

Ultimately, the people of Lesotho are talking and working together to understand the nature of their energy problems and devise solutions appropriate to local needs, drawing upon resources and ideas from worldwide RET developments.

gain, good insulation and so on, through commercial and government distribution channels, as utilizing existing channels should speed this dissemination effort.

Fourth, providing energy for growing and drying food will be another major project thrust. The interest and enthusiasm shown in the first year for small greenhouses, grow-holes and food dryers will be built upon as part of VET training and dissemination efforts in the second year.

In the area of research and development technologies, two main components have been targeted for the second year. First, small-scale hydroelectricity will be pursued through the demonstration stage. A two-part effort will be made--the first stage will be establishment of a site and the second, actual installation and training of personnel. While the number of micro-hydro sites in Lesotho is limited, this technology still has a role to play in providing electricity for rural sites far from the national electricity grid.

Second, although the use of photovoltaics for radio communication and lighting is already established in Lesotho, the RET project will continue to provide current information on available systems. Because of the limited need for water pumping in the mountains (most water supplies are gravity fed due to the terrain), the role of photovoltaics for water pumping appears to be small. However, the use of photovoltaics and storage batteries for small electric motors in village applications warrants further study. The potential such

systems will be compared with pedal power, limited animal traction and small heat engines using the technology selection process.

Activities in the area of dissemination and extension will increase during the second year. Major components will be the production of numerous brochures, booklets, pamphlets, sets of plans, short instruction manuals, slide shows, radio talks and taped interviews, films, posters and plays. This will require training the ATS staff in media preparation. Proven technologies are already being introduced by word of mouth and demonstrations through schools, government extension workers and voluntary associations, but a proper media campaign will enhance these efforts enormously. This will mesh with the VETs' promotion of their technologies, creating additional opportunities for income generation.

VET training will mesh with these efforts. Persons who are selected as VET trainees will go through an initial orientation for a particular technology, in the form of demonstrations, posters, slide shows and examination of construction plans. Then, they will try actual construction under the direct guidance of an ATS or RET instructor. Finally, they will construct and use a unit entirely on their own; this step is very important, not only to build confidence, but also to underscore problems in the training program so that on-the-spot corrections can be made.

Training will occur in both the laboratory and village.

Training in the regional center or laboratory will be required for technologies which have several assembly steps or demand skills that are best taught in a controlled environment. Typically, this would include solar ovens, retained heat cookers and solar water heaters. Training in the village is more challenging and would be restricted to simpler, non-portable technologies which require fewer tools and materials, such as earthen stoves, grow-holes and food dryers.

Increased information-sharing with other energy-related projects and programs is anticipated. Since the RET project's scope of work is necessarily limited, some other technologies will be tried by other organizations. A few examples are large-scale bio-gas systems, industrial solar ponds, and oil-seed production and other bio-fuels for diesel engines.

Institution-building and staff training are interrelated, ongoing processes. As it grows, ATS staff handle more of the day-to-day operation of the project. The ultimate goal is, of course, to have a gradual phase-out of the RET team during the project's third year and for ATS to be a fully operational institution at the end of that year. Thus, training involves a great deal of daily operations and logistic support, along with technology development. Internal training for the ATS (i.e., Basotho training Basotho) is crucial, such that senior ATS staff are being provided with training skills to help junior staff. Emphasis is placed on professional advancement, and participation in relevant courses in Lesotho or regional

conferences is encouraged.

Institutional awareness of RETs and energy problems by MINRUDEV and other ministries is most important, and the ATS is developing awareness among these organizations about the potential of RETs. Presently, energy conservation, solar and nonsolar technologies are slowly being recognized. Since the ATS deals with appropriate technology in general, it will emphasize more than just energy-related technologies. The ultimate goal is for ATS to be a national resource for problem-solving concerning RETs and appropriate technology. Building a high level of awareness of these areas and ATS' role will help permit achievement of this goal.

At the national policy level, the project will work closely with the Ministry of Water, Energy and Mines on electricity and fuel planning and policy. Also, project participation in the National Council for Science and Technology will help shape the choices for technology selection in the immediate future. To further bolster national linkages with other developing countries, the project and ATS staff will be participating in programs to increase regional technical exchanges.

Appendix A

MO 824

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date February, 1984

Date of this Summary May, 1981

Project Title Lesotho Renewable Energy Technology Project

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	**Program Goal:** The broader objective to which this project contributes: To meet growing energy demand and to conserve fuels, especially for rural and lower income groups, and improve the quality of their lives through increased availability and efficiency of energy.	**Measures of Goal Achievement:** For the target populations: 1) decreased per capita use of biomass fuels, 2) increased per capita use of other renewable energy sources, and 3) decreased growth of imported energy.	Surveys. Government statistics.	**Concerning long term value of program/project:** 1. Traditional and conventional energy sources will become increasingly scarce and costly. 2. People are actively interested in increasing their standard of living. 3. Money saved in the process of adopting renewable energy sources and conservation strategies will not be used to purchase more imported energy supplies.
If Outputs, Then Purpose	**Project Purpose:** On a pilot basis, to develop, demonstrate, and disseminate feasible renewable energy technologies and strategies, and conservation technologies and strategies, and to develop an institutional basis for implementing the above.	**Conditions that will indicate purpose has been achieved: End of project status.** 1. A set of proven renewable energy and conservation technologies and strategies. 2. Operating MORD renewable technology unit. 3. Operating cadre of VETs.	Project evaluation process. External evaluation. Project records: surveys, orders for RETs, test results of RETs. Demonstration of RETs.	**Affecting purpose-to-goal link:** 1. Cooperation of GOL. 2. Target population acceptance of relevant innovations. 3. VETs will implement their skills in target areas.
If Inputs, Then Outputs	**Outputs:** 1. Research and development laboratory installed. 2. Regional training centers established. 3. Training materials produced. 4. Personnel trained. 5. Demonstration buildings designed and constructed. 6. RET & conservation strategies introduced. 7. Energy-related data collected & analyzed. 8. Experimental technologies evaluated. 9. Library & ref. materials established. 10. Village-level implementation process.	**Magnitude of Outputs necessary and sufficient to achieve purpose.** One (1) R. and D. laboratory. Two (2) or more regional training centers. Pamphlets, brochures, films, slides. Eight (8) MORD staff, at least 103 VETs. Three (3) or more buildings. At least four (4) different types. One (1) data base. Two (2) or more. Books, files, reports, pamphlets.	Project reports and files. External evaluation. Inspection.	**Affecting output-to-purpose link:** 1. Space and materials are made available on a timely basis. 2. Qualified candidates are available for training.
	Inputs, Activities, and Types of Resources: AID-technical assistance commodities local training construction support PEACE CORPS GOL-regional training center facilities; office & lab. space; warehouse land & space; housing for PCVs; furniture; staff; secretarial and translation service regional MORD staff support	**Level of Effort/Expenditure for each activity:** 1 long-term (physical sci., sociologist, lab sup.) 2 long-term local hire; 20 person-mos. short-term. Vehicles, horses, mules, tack & stables, media equip. & supplies, lab & sci. equip., R&D equip., energy-saving construction material, shop equip. Travel, per diem, lodging, supplies, equipment. Design expertise and materials -- $64,000. Vehicle operations and maintenance -- $65,000. 4 volunteers for life of project; 4 motorcycles. At least two locations. Eight MORD staff. As needed from existing MORD staff.	Project records.	**Affecting input-to-output link:** Continuity of GOL, USAID, and U. S. Peace Corps support.

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Washington, D.C.

Appendix B

DEMONSTRATIONS -- 1981/1982

Maseru District

Peace Corps	August 22, 1981
F. N. C. O.	September 16-27, 1981
Food Preservation Unit	September 24, 1981
Lesotho Women's Club	October 13, 1981
Food Preservation Unit	October 16, 1981
Lesotho Agricultural College	October 20, 1981
L. T. I. -- Carpentry	October 20, 1981
T. T. I. -- Electronics Laboratory	October 21, 1981
L. T. I. -- T. T. S.	October 23, 1981
Agricultural District Office	October 28, 1981
I. V. S.	November 8, 1981
Lesotho Homemakers Association	November 18, 1981
Nutrition Home Economics Unit	November 27, 1981
Anglican Centre	December 1, 1981
Peace Corps	December 21, 1981
Boiteko Women's Association	January 15, 1982
Palace Kitchen Staff	February 22, 1982
Agricultural Research	February 23, 1982

Mokhotlong District

Matenong Village	October 6, 1981
Farmers Training Center	March 22-26, 1982

Butha-Buthe District

Dorcas Welfare	October 14, 1981

Leribe District

I. E. M. S. -- Mahobong	April 29, 1982

Mafeteng District

Mafeteng Hospital

Appendix C

PERSONNEL ROSTER THROUGH MARCH, 1981

Associates in Rural Development, Inc.

J. Stryker, project coordinator
J. Gay, field supervisor
G. Klein, laboratory supervisor
M. Maqanda, administrative assistant
stock and supply manager recruitment postponed

Ministry of Cooperatives and Rural Development

R. Mota, senior engineer, technical division

Appropriate Technology Section
B. Kanetsi, solar engineer
Messrs. Chaka and Lepolesa*, assistant solar engineers
E. Khabisi, senior technical officer
M. Khoboko, senior technical officer
Z. Lenono, technical assistant+
Adontsi and Matele*, technical assistants

Volunteers

U. S. Peace Corps
N. Hine, laboratory coordinator (resigned)
D. McLean, regional center coordinator
D. Palasits, regional center coordinator
M. Savino, regional center coordinator

Danish Volunteer Service
J. Hoffman, regional center coordinator

USAID Mission to Lesotho

F. Correl, director
S. Norton, general development officer (through Dec. 1981)
D. Bernius, general development officer (from Jan. 1982)

Project Affiliates

M. Piee, Mokhotlong district community development officer
P. Mattoo, development officer, BEDCO
D. Magers, credit union development officer, mgmt. advisor

*individuals under recruitment
+individuals to be transferred April 1, 1982