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SMALL-SCALE ENERGY TECHNOLOGY PROJECTS IN THE PACIFIC TERRITORIES: A CASE STUDY REVIEW

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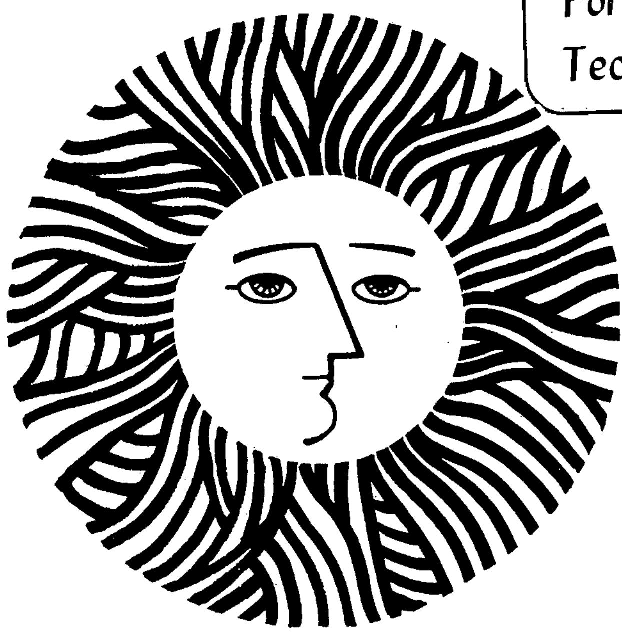

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DISCLAIMER

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ABSTRACT

For federally sponsored small-scale energy projects a critical issue is transferring the technology from the project to the people who might find such a technology beneficial. During 1978, 1979, and 1980 the Department of Energy has funded 28 small-scale energy projects in the Pacific Territories through the Appropriate Energy Technology Grants Program. Average grant size is about $12,000. The projects attempt to be appropriate for developing Pacific island communities by using local labor and materials, using renewable resources, incorporating simple technologies, and being culturally sensitive. Most of the projects are completed now and are at the technology transfer stage.

During the last three years the authors have traveled throughout the Pacific monitoring the projects, offering technical assistance, and encouraging successful completion of the work. In the course of these travels we have noticed that there is a commonality between successful projects where the technologies are more easily transferred and the work is replicated locally. Based on our observations, we have established criteria for defining a successful project and have identified common project elements which support these criteria. We have prepared five case studies which illustrate these elements and define features which contribute or hinder technology transfer. Case studies include a typhoon-proof greenhouse on Guam, wood stoves and small solar devices on Yap, various devices built at a youth educational facility on Ponape, an unusual solar hot water system on Majuro, and a solar fish drying facility on an outer Truk island. Conclusions from these studies are extrapolated to all 28 projects. By using these extrapolations as criteria for project evaluation we have noticed a continuing increase in the quality of the projects.

This paper presents the case studies and discusses the criteria and common elements for successful projects and technology transfer. Lessons learned from these simple projects can be used in facilitating technology transfer of other, perhaps more complicated, technologies.

INTRODUCTION

In the spring of 1977, the Building and Community Systems Division of the Energy Research and Development Administration (now the Department of Energy - DOE) instructed its San Francisco Operations Office (SAN) to establish a pilot program for encouraging appropriate energy technology projects within Federal Region IX. This Region includes Arizona, California, Hawaii, Nevada, and the Pacific Territories - the Pacific Territories include American Samoa, the Commonwealth of the Mariana Islands, Guam, the Federated States of Micronesia, and the Independent States of Belau and the Marshall Islands. (The Federated and Independent States of Micronesia are also referred to as the Trust Territory of the Pacific - see Table 1 for a summary of the political and geographical features of the Pacific Territories.)

SAN announced the Appropriate Energy Technology Program (AET Program) in the fall of 1977, asking small businesses, individuals, nonprofit agencies, and Indian tribes to apply for grants for designing, constructing, and/or demonstrating small-scale energy technologies. These technologies were to conserve fossil fuel or use renewable energy resources, and were also to have community- or village-level social benefits. The program was popular; SAN received 1,100 applications requesting $21.3 million, an overwhelming response considering only $1.25 million was available.

For awarding grants, SAN used a review process that transferred much of the decision-making responsibilities to the states. Social, economic, technical, and innovative merits were equally stressed as selection criteria. After three separate reviews involving state and university groups and committees, SAN awarded 108 grants. The average grant was for $12,000: the largest, for $43,000; and the smallest, for $500.

The grants covered a complete spectrum of small-scale energy technologies, including solar active and passive systems, wind machines, biomass conversion systems, energy conservation devices, recycling methods, aquaculture and agriculture systems, hydroelectric devices, geothermal systems, and hybrid systems.

In the spring of 1979, DOE transferred the program administration to the new Office of Small Scale Technologies within the Building and Community Systems Division of the Conservation and Solar Applications Program. This Office expanded the AET Program into all ten federal regions and offered funding cycles during the spring of 1979 and 1980. Using essentially the same review procedures as the pilot program, DOE awarded about 600 grants in each of these two years. Additional annual cycles will be offered in the coming years depending on new DOE budgets.

The San Francisco regional office now administers the program for Federal Region IX. This office has organized a system for monitoring the 28 Pacific Territory projects. This task includes offering technical advice and assistance, assessing the direct and indirect energy impacts, looking for projects with commercial possiblities, and encouraging the applicants to complete the projects on time. During the last three years Dr. Case has made five trips to the Pacific Territories to monitor the projects. Mr. Actouka was the Energy Planner for the Trust Territory and helped with the monitoring and promotion of the projects.

CASE I

FISHDRI (Romanum Island, Truk District, Eastern Caroline Islands)

A. Background

The Trust Territory of the Pacific Islands includes about 2,000 islands scattered across 8 million square kilometers of Pacific Ocean between the equator and 22° N latitude and from 130° to 172° E longitude (See Figure 1). After World War II these islands were placed under the protectorate of the U.S. by a United Nations mandate. For administrative purposes the Trust Territory was divided into six districts, now under the jurisdiction of the U.S. Department of the Interior: the Northern Mariana Islands, Palau, Yap, Truk, Ponape, and the Marshall Islands. According to the mandate, the U.S. was to encourage these Districts to become independent, and each District was to decide its own political fate by the early 1980s.

During 1969 Micronesian and United States representatives started preliminary negotiations concerning the political status of the Districts. In 1972 the Northern Mariana Islands negotiated separately for Commonwealth status with the U.S., and in 1978 they ratified a constitution creating the Commonwealth of the Mariana Islands (CMI). During that same year the rest of the Trust Territory Districts voted on a constitution to establish the Federated States of Micronesia. Yap, Truk, Ponape, and Kosrae (Kosrae was part of the Ponape District until 1977 when it became a separate District) ratified this constitution and became the four states of the Federated States of Micronesia (FSM). Palau and the Marshall Islands rejected the constitution and ratified separate constitutions in 1979 and 1980 establishing the Independent States of Belau (Palau) and the Marshall Islands. There are now four constitutional governments within the Trust Territory (the CMI, FSM, and the two Independent States), however the Trust Agreement which created the original entity has not been terminated. During the last few months of the Carter Administration the FSM and the Independent States were discussing a Compact of Free Association with the U.S. which would give the U.S. defense access to these island areas in return for 15 years of financial and other assistance. The Carter Administration gave preliminary approval to the Compact, but the Reagan Administration is reviewing the agreement before granting final approval.

The Truk District or island group consists of about 90 islands. Fifty of these islands are on a great encircling reef that encloses a lagoon with a radius of 48 kilometers. Within this lagoon are a number of high islands, including the District Center, Moen. Truk is the most populated of the Districts with a population of about 35,000 (1978) (Ref. 1, p.427). There is a steady population migration to Moen, but many of the people still live in small villages scattered throughout the lagoon and outer islands.

These people are isolated from Moen. There are no commercial air flights or telephone links, and travel by small boat is dangerous and expensive. Because of this isolation, the villagers have retained much of their original culture. However, they are slowly being exposed to new technical advances. Increasing populations place stresses on day-to-day subsistence living, and now there are critical energy demands, primarily for refrigeration and communication systems and for better health facilities. Villagers need communication systems for both storm warnings and emergency aid requests after storms strike. Medical facilities require water hotter than the 80° F ambient temperature. Small diesel generating units are expensive to operate and difficult to repair, and fuel supplies are uncertain. Much of the living is still on a day-to-day basis. The islands have no cash economies - fishing and a very little farming are the main occupations. The islands are turning from this way of life and a few are searching for ways to start economies through small local businesses.

B. <u>Project Description</u>

Romanum Island is typical of the outer islands. It is about 5 square kilometers in size and has a population of around 200. The island is approximately 30 kilometers across the Truk Lagoon from Moen. There are no local businesses or cash economy. The people mainly fish and then scrape together whatever cash they can or trade the fish during infrequent trips to Moen for boat fuel or supplies. Because of their proximity to Moen and the contact with the people there, the people of Romanum are changing from their traditional ways of living.

In 1978 the Romanum chief, along with a Peace Corps volunteer, applied for a grant to build some solar dryers for drying fish by-products. These by-products would then be ground up as chicken feed for their chickens. There is no electricity or refrigeration system on the island. Therefore fish left over at the end of the day are usually thrown out. Chicken feed is becoming expensive and requires a trip to Moen to purchase it. This project would thus solve the problem of excess fish and expensive chicken feed. In addition, they planned to start an island cooperative business and sell the chicken feed to neighboring islands. They also planned to experiment with a number of different dryers, find the best type for the location, and then encourage others to build similar systems.

DOE awarded the cooperative a grant for $12,000 to build and experiment with a number of dryers and to purchase equipment for the grinder. Work was to start in summer 1978 and finish a year later. This appeared to have all the ingredients for a successful project: the start of a local business, training of local people to build solar devices, solving an energy problem using renewable resources, and so on.

C. Project Results

After two and one-half years DOE terminated the grant. No work had been done and the money had been spent on other things. (According to the grant provisions, the grantee receives 60 percent of the money before the work starts.) There was about a half-year delay between the time the application was submitted and the grant was awarded. During this time the Peace Corps volunteer left and was replaced by another volunteer who was not familiar with the project nor technically equipped to do this type of work. The original volunteer was the only one on the island who spoke English and the only one familiar with solar dryers. He wrote the application and, with the chief's approval, submitted the application under the chief's name. The check for the project came directly to the chief.

In the Truk District and other Trust Territory Districts, U.S. agencies have a history of giving monetary aid of various types without too much discretion or sensitivity. Money is given out according to U.S. standards without much awareness of how this money might affect Micronesian cultural and social structures. Often agencies do not follow up on the results of their expenditures - to the Micronesians the money then appears as handouts.

This was the case with the grant for Romanum. The chief received a check for $7,200 and, based on past experiences, took a broad definition of the project and what the money could be used for. Again, based on experience, he was sure no one would come to Romanum to check the progress of a small grant (agencies do not monitor larger grants in more accessible Moen). However, DOE monitors all the AET grants in Federal Region IX, and so the authors traveled to Truk in late fall 1978. The chief received a letter saying that a visit would be made in a few weeks. He felt that he should have some piece of equipment to show, but he could not build solar dryers. Therefore, he used the money to buy materials and engines for some new fishing boats. During our visit we explained to the chief through an interpreter that he must complete the project. The chief and the new Peace Corps volunteer assured us that the work would be done.

Romanum is a difficult place to visit not only from the Mainland but also from the Trust Territory headquarters in Saipan. No one in Moen had the authority or the knowledge to help. It was difficult to correspond with the chief when only the Peace Corps volunteer wrote English. Another visit was made the following year. However this trip and subsequent correspondence were largely ineffective. The authors tried to locate equipment needed to carry out the project, but because of the distances between Romanum, Saipan, and San Francisco results were slow and discouraging.

No work was done on the project and it has been difficult to determine the reasons. The chief probably had good intentions, but he was technically not capable of building the dryers. It is difficult for islanders to work within the grant structure, which includes reporting requirements and time schedules. The Peace Corps volunteer had good intentions too, but there were severe disagreements between him and the chief. Caught in the middle of local island politics, his help was refused by the chief. Each of the principals has a different reason why the project failed. Nevertheless, the money has not been returned - it has been spent on fishing equipment. The cost for DOE to get the money back would be more than the grant award, so they have decided to terminate the grant without further action.

D. Analysis of Results

The chief and the original Peace Corps volunteer had a good idea and purpose. This is the type of project sorely needed on these small islands, and they intended to do the work properly. The project failed in a physical and technical sense, and Romanum does not have a small business. There is no device producing energy or improving island life. But DOE learned some lessons and gained some experiences that have proved quite valuable in awarding and monitoring grants.

First, for a project to have any chance for success the person who thought of the idea and submitted the application must be responsible for the project through its entirety. When there is a change in people responsible for a project, the project has problems. The original impetus is lost, technical skills are different, the purpose of the project changes, and so on. These are small, simple projects designed to be completed in a short period of time. There must be continuity and this continuity is lost when leadership changes.

Second, Peace Corps volunteers usually have a term of two years. They are often well qualified to provide techincal skills and leadership, particularly with the appropriate technology training they receive now. However, the two-year term does not seem long enough for them to conceive of and then complete a project. It takes a half-year or so before they learn the problems and think of solutions. By the time they have written the application and awards have been made, at least another half-year has passed. It takes a few more months to receive 60 percent of the money. This hardly leaves much time even to start the project. There are exceptions to this, but usually the leadership must come from a local person with the technical knowledge and managing skills necessary to complete the project.

Third, the community must play a strong role in the project. Villagers should be aware of what is being done and have the interest to help. Ideally they should be required to provide some material or volunteer labor. They must have an interest in the results.

Fourth, funding agencies must be sensitive to the cultural and social ramifications of the grants. The Romanum grant was probably too large for the project. Project wages were much higher than wages in Truk. A grant such as this can do much to disrupt a culture not familiar with a cash economy and the ways of U.S. funding agencies.

Fifth, funding agencies must realize that the entire concept of awarding money and then requiring someone to follow a schedule and submit written reports is strange to a culture not based on writing and management. The U.S. funding structure is established for the Mainland and while the requirements may be reasonable in that context, they are often difficult for Micronesians to meet. The whole concept of a project is a difficult one for a society not used to building mechanical or technical devices. Even the concept of each step building on the previous step and work progressing in an organized pattern must be learned on these outer islands.

Sixth, all projects must be monitored, preferably by a responsible and knowledgeable person in the area. This is not easy for Micronesia as there are only two or three Micronesian engineers, and travel is difficult and expensive. Still, some type of contact must be maintained and it must be more often than once a year. It seems that the more remote the project, the more important this contact. Sensitivity must be used in striking a balance between local ways of working and doing business and funding agency requirements for working on grants.

E. Conclusions

By DOE standards losing $7,200 is a small loss, but this loss follows a history of money poorly spent in the Trust Territory. Money is hard to come by for these small grants and so DOE must make it clear, in a fashion sensitive to Micronesian culture, that results are expected. DOE must also use sensitivity in selecting grants to award and in predicting both energy-producing consequences and cultural effects. The project itself is only the direct and often minor consequence of the grant. The indirect effects, positive and negative, are far reaching in these fragile social and economic environments.

In this case, the money will not be returned, but the lessons may have been learned cheaply. Mistakes made on this grant have not been made again. Luckily, the long-range effects of this grant on Romanum will be few. They have two new fishing boats, which are expensive to fuel but which have also helped establish a fishing industry. This industry may eventually be more worthwhile than the chicken feed business. They are now realizing how expensive these boats are to run and there is interest in returning to their old native sailing canoes and boats - another worthwhile indirect effect.

CASE II

YAP INSTITUTE OF NATURAL SCIENCE APPROPRIATE TECHNOLOGY PROJECT (Yap District, Western Caroline Islands)

A. Background

The Yap District consists of nine inhabited atolls, two single islands, and four normally uninhabited islands and atolls. These islands and atolls are in the Western Caroline Islands between the equator and 11° N latitude and from 136° to 148° E longitude (Ref. 1, p.442). Yap probably has retained more of its natural culture and traditions than the other districts. Portions of Yap Island, nearby Maap, and the outer islands are relatively untouched by modern technologies. People still live the daily subsistence life, with farming and fishing the major occupations. Most of the small villages have no electricity. An occasional diesel generator provides electricity for small refrigerators for health supplies and radios for communication.

Yap is one of the least populated of the Districts with a population of about 8,500 (1978). Population trends fall into the familiar Trust Territory pattern. Populations are increasing, and as people become exposed to new technologies they migrate to Colonia, the District Center, on the island of Yap. Colonia seems to be handling the growth better than some of the other District Centers, but they still have severe problems of health and sanitation, unemployment (see Table 2 for Pacific Territory unemployment data), housing, and reliable supplies of fuel. (During most of 1979, electricity from the oil-fired plant - 3.1 MW peak capacity - on Yap was available from 9:00 p.m. to 5:00 a.m. for the hospital only. See Table 3 for peak electricity generating capacity for the Pacific Territories.)

One feature that impressed the authors during a visit in fall 1980 was that the Yapese seemed to be very aware of their culture and traditions and are trying harder to maintain them than most of the other Districts. Perhaps this is because Yap is isolated and has not been as affected yet by affiliation with the U.S. Nevertheless, advances are slow, and the political leaders seem to be considering as much as possible the social ramifications of each advance. At present, parts of Yap, Maap, and the outer islands offer some of the most beautiful vistas and unspoiled villages found in the South Pacific: untouched beaches with outlying coral reefs and a crashing surf, villages of artfully made thatched huts, friendly people, and an easygoing day-to-day existance. Amid these traditional ways, the new television facilities on Yap, broadcasting Mainland programs, seem very much out of place. Slow, deliberate changes may be difficult to maintain.

B. Project Description

As people migrate to Colonia they adopt the modern trappings of automobiles, electrical or kerosene appliances, standard western housing, and so on. Many of the traditional ways are put aside. On the other hand, traditional ways that are still used on lesser developed parts of the District may be inefficient, unhealthy, and burdonsome. Many of the communities still lack refrigeration for health supplies and communication systems. Local economies depending on copra are finding the traditional way of drying copra with coconut husk fires unsatisfactory. (Copra is coconut meat. It is dried and pressed to yield coconut oil for cooking and other uses.) Despite considerable wind, solar, and biomass resources, there are very few alternative energy devices. The reasons are the usual ones: lack of trained personnel, harsh environment, unreliability of such devices, and difficulty in obtaining repair parts.

In such a setting, the Yap Institute of Natural Science has been trying to promote appropriate technology devices for the last few years. The Institute is a family affair, run by a couple (he is a native of Yap and she is from Guam) and housed in a conglomeration of buildings, buses, and shacks on their property. They are energetic, technically quite skillful, and concerned with traditional ways and seem to have a good sense of how to go about a project. For these reasons they are well thought of locally, and the Institute has been quite successful.

Along with some volunteers and some part-time paid help, they have been experimenting and promoting alternative energy devices. Operating on an extremely low budget, they have managed to send a young woman to the University of the South Pacific in Fiji. She has returned and is now working at the Institute. They publish a variety of pamphlets, including the Yap Almanac Calendar. In addition, they are constructing a well-built, energy-efficient house combining traditional and western architecture.

In 1979 they applied for a grant from DOE to build and demonstrate a variety of alternative energy devices. DOE awarded them a grant with a term of two years to build a solar oven that could be used to dry copra and food, a passive solar ventilator for cooling homes, and a variation of a Lorena cooking stove.

The solar oven is an ingenious device in which the heat is controlled by varying the amount of air flow. This oven at low temperatures dries copra or food. (Traditional methods take four days in a smoke house over an open fire, use large amounts of coconut husks, and contaminate the copra with smoke.) They are monitoring this oven now and are comparing the results with other ovens and dryers they have built.

The passive solar ventilator creates a natural circulation of air by warming air with a solar collector on the roof. Cool air is drawn into the building through low vents in the walls.

The final device probably has the greatest potential. Throughout the Trust Territory much domestic cooking is still done over open fires using wood and coconut husks. Some families are now using kerosene or electric stoves, and this is proving to be expensive. The Lorena stove would be the logical solution to the problem as it is proving to be elsewhere in developing countries. Such a stove is easily constructed from a mixture of clay, sand, and water and uses efficient channeling of the heat to reduce fuel consumption (Ref. 4). Unfortunately, on Yap and other Pacific islands the sand is usually coral, which does not withstand the heat very well. Salt-laden sand does not work well either, and water for washing the sand is often in short supply. The Institute is experimenting with materials and designs that still use the same heat channeling principles as the Lorena stove. Its most successful design uses a series of cast concrete slabs stacked on top of each other, forming a single cooking unit. The first stove cracked after a bit, but now they are trying different mixtures of concrete with more success.

C. Project Results

The workers at the Institute have finished the current projects and are testing them. Within the next few months they will have written a series of brochures describing how these devices can be built. A number of communities will be building variations of their copra dryer. There also seems to be a good deal of local interest in the wood stove. With this small grant the Institute has become more established on Yap and is beginning to acquire a reputation throughout the western Pacific.

D. Analysis of Results

The Institute seems to be successful with their work for a number of reasons. First, they have a strong role in the life of Colonia. The work they do goes beyond experimenting with energy devices. They are sensitive to the problems of Yap, including conflicts between traditional ways and technical advances. They are working with and educating the Yapese and are performing various community services.

More elegant small-scale energy devices can be found, but the Institute demonstrates their systems in a fashion compatible with Micronesian temperament. Too often the U.S. has used a hard-sell campaign with new ideas for the Pacific. Since World War II, Micronesians have seen their way of life completely changed by U.S. institutions. These changes were rapid and were inflicted upon them in ways that did not consider the Micronesian interests. Changes in the Pacific should occur at an appropriate pace that compliments their traditions. The Institute demonstrates their projects in a manner that appears to work, albeit slowly.

Their method is simple: If an idea works, improves the quality of life, and is acceptable culturally, people will try it. Ideas do not need to be sold - people will try good ideas of their own accord. The device must work and must work reliably over a period of time. Too many alternative energy devices are unreliable in the Pacific island environment. Once they break down they are difficult to repair and parts are hard to find. U.S. manufacturers have a spotty record for servicing their products in the Pacific. A broken energy system does great harm in areas where people are now attracted to energy-consuming appliances. The Institute's devices work, seem to be reliable, and can be repaired with local materials.

An important part of the Institute's work is educational. Volunteers of all ages work on the projects. The publications are a community effort, and the community takes pride in the Yap Almanac Calendar (which promotes appropriate technologies). The Institute pays a few employees' wages - the young woman from the University of the South Pacific is a part-time employee.

Finally, the projects were well thought out, and the grant was the right size to do the work properly. The wages paid were compatible with local wages. The projects were not complicated and could be completed in a reasonable time. They were realistic about the problems they might encounter and had prepared a realistic time schedule. In general, the Institute seems to be a good model of how other similar institutions should operate in the Pacific.

E. Conclusions

If Pacific island societies are to use less energy and are to find substitutes for petroleum products, the effort must start with local institutions. Most of the islands do not have a Yap Institute of Natural Science, but when one appears, island governments and federal agencies should offer encouragement. This is perhaps the most important element of this grant. The Institute received acknowledgement and encouragement for their work. With the publicity that attended this grant and with the success of the project, their work will become easier.

The Institute will also play a key role in establishing a network of people working on appropriate energy devices throughout the Pacific. Such a network, which plays an important role in other countries, is just starting in the Pacific. A network serves to transfer ideas, promote successes, prevent failures from reoccurring, apply peer pressure to other people receiving grants, and so on. Travel and communication problems in the Pacific hinder development of such networks, but already other institutions are appearing on the other islands.

CASE III

TYPHOON-PROOF GREENHOUSE (Merizo, Guam)

A. Background

Guam is the largest (541 square kilometers) and southern most of the seventeen islands in the Mariana Island chain. Its location is $13^{o}26'$ N latitude and $144^{o}43'$ E longitude. Bordered by the Pacific Ocean on the east and the Philippine Sea on the west, Guam is 2,170 kilometers south of Tokyo and 5,300 kilometers west of Honolulu. The U.S. acquired Guam as a possession in 1899 during the Spanish-American War and in 1950 made Guam an unincorporated territory with local legislative authority. The climate is generally tropical - hot and humid. Rainfall is heavy (about 200 cm/year), and often there is a heavy cloud cover (Ref. 1, p.197).

Guam is the most westernized of the U.S. Pacific territories or possessions. It has been an important U.S. military base since World War II, and the military is the largest employer and economic unit on the island. In addition, Guam is a transportation and merchandising center for goods being shipped elsewhere in the Pacific and has a rapidly expanding tourist business from Japan. Guam's population is about 102,000 (1975) of which approximately 92,000 live in urban areas. Because of the military a sizeable percentage of the population is from the U.S. Mainland. The original natives of Guam, the Chamorros, currently constitute a decreasing portion of the population.

Agana, the capital and principal city, has a population of about 50,000 and is similar to fast-growing U.S. towns of the same size. Unusual features of Guam and Agana include beautiful beaches and rural areas, treacherous roads made of coral that becomes very slippery when wet, no mass transit system (resulting in large traffic jams and a waste of fuel), typhoons that do devistating damage almost annually, and the remnants of heavy World War II action.

Energy production on Guam is entirely from imported petroleum products, mostly from the Philippines. Two oil-fired plants produce the island's electricity. Primary end users include the transportation and military sectors. Because of Guam's vulnerability to fuel shortages, the Guam Energy Office (GEO) has been trying during the last few years to develop other alternative sources. There has been strong local political support for developing Guam's ocean thermal energy resource, perhaps one of the best in the Pacific. This new energy source is also seen as a source for economic development. The GEO is spending a smaller portion of its time working on other alternatives. Some of GEO's efforts include making energy audits, encouraging industrial and domestic conservation, assessing the solar, wind, and biomass resources, and promoting small energy demonstration projects.

Until recently little effort has been given to small decentralized systems or to alternative energy production in the outlying rural areas. These areas include small fishing and farming villages similar to settlements in other developing countries with low incomes and standards of living, subsistence farms, low mechanization, and expensive (if any) energy. There are very few energy-producing devices using renewable resources and simple technologies. Materials are hard to come by and there usually is no local expertise. The environment is harsh and includes typhoons and a highly corrosive atmosphere.

B. Project Description

Until recently, the person who worked on this project lived in the rural village of Merizo, an old fishing and farming community located on the southern end of the island and about an hour's drive from Agana. This is one of the most fertile areas of the island. Unfortunately, because of its exposure the area is highly vulnerable to typhoons and seems to be heavily damaged almost annually.

The project worker lived on one of these small farms. He has worked at a variety of jobs on Guam and elsewhere and was one of the original staff of the GEO a few years ago. His background has given him an interest in alternative energy production, particularly small systems for outlying Pacific islands. Three years ago he was interested in trying to solve the problems of heavy storm damage to farmers' crops and the low level of productivity.

In 1978 he applied for a grant from DOE, but was unsuccessful because of the large number of applications and the small amount of money available. He applied again in 1979 and this time he received a grant for $3,000 to build and demonstrate a typhoon-proof greenhouse that would use French intensive gardening methods. He hoped this greenhouse, which would be built entirely from local materials, would be easily replicated by other farmers in the area. Construction was to include a wooden and metal pipe frame built on an existing 15' x 30' concrete foundation, raised beds for French intensive gardening, screening to keep the pests away, and storm shutters. He planned to start work in the fall 1979 and complete work in a few months. Other farmers in the area were to help him and supposedly were quite interested in the results.

C. Project Results

One of the authors visited the site twice, once during fall 1979 and again in fall 1980. At those times no work had been done even though the construction was simple and the project could be completed in a few weeks. The work was finally done in late fall 1980 after considerable pressure from the GEO and DOE. Information from GEO says that the construction is fair at best and does not seem to meet the storm-proof requirements. The applicant, who has now moved from the island, apparently lost interest in the project. A new tenant on the farm will try to improve the greenhouse. There is no local interest and the final result is probably one of discouraging others from trying similar projects.

D. Analysis of Results

A project such as this in a remote location depends entirely on the individual for success. The applicant is a sincere person who is concerned with the quality of life problems of rural Pacific settlements. He has traveled widely and seems to have experience working with energy systems in a number of places. He is eloquent and present his ideas well. The greenhouse idea was a good one, filling a local need, and his budget and work schedule were reasonable. There was every intention on his part to complete this project successfully and to work with others promoting it.

In the early stages of the AET Program, grants were usually awarded throughout the Pacific Territories without input from the local energy offices. Many of the energy offices were just becoming organized and the personnel were unknown to DOE. Also, because of the low administrative budget, it was difficult to maintain contact with these offices or provide them with funds to do their own grant monitoring. The GEO, with its capable staff, should have had a more active role in awarding this grant. Based on the applicant's past work, they probably would not have recommended him for an award.

Also, it is important that these rural projects be monitored continually or regularly. The federal government has a history of awarding grants to Pacific communities on U.S. terms and with U.S. standards and then not caring about the results. DOE planned to monitor this project, but distance from Guam was a problem and the annual visits probably were not effective. During these visits promises were made and then quickly forgotten. Correspondence from the Mainland was not effective either. When the GEO intervened, it had its own problems. The applicant has had a continual disagreement with the GEO since his employment ended a few years ago. During their frequent visits he became increaingly nasty and felt he was responsible only to DOE. The GEO should have been responsible for monitoring this grant from the beginning.

The work meets all the criteria for a bad project. Grant money was probably spent on other things besides new materials. There is no local interest in the work. When an ultimatium was given to the applicant last fall, he finished the project but the quality was not good. Oddly, throughout the project term the applicant insisted that the project met his standards for fine work and was a worthwhile endeavor.

E. Conclusions

There are a number of lessons to be learned from this project. First, good ideas are easier to come by than the individuals to carry them out. Local energy offices or institutions familiar with the local people proposing the work should be involved with the grant award process. Second, projects at these remote locations should be monitored continually, preferably by people in the area. Monitoring provides technical advice and shows the grantee that the sponsoring agency is interested in the outcome. Allowances should be made for work in tropical conditions and for local differences in approaching a job, but the agency should hold the grantees accountable for their work and for adhering to reasonable work schedules. Third, projects should have local support and interest. This is true both for replication of the project and also to encourage and help the applicant.

CASE IV

ARAMAS KAPW, ALTERNATIVE/APPROPRIATE ENERGY DEMONSTRATION SITE (Ponape, Eastern Caroline Islands)

A. Background

The island of Ponape is the government seat for the Federated States of Micronesia. Government buildings will be either in the present District Center of Kolonia or in a new town proposed for the center of the island. Ponape is a high island located in the Eastern Carolines between the equator and 11° N latitude and 154° and 162° E longitude. The island has been the District Center location for the Ponape District, which includes this high island, the 25 surrounding islands (most of which are volcanic), and eight coral atolls. The District has a population of about 21,000 (1978), and Kolonia, the only town of any size at present, has a population of about 7,500 (Ref. 1, p.443).

Ponape is one of the most beautiful of the Micronesian islands. Its rainfall, approaching 1000 cm/year in the center of the island, is one of the highest in the world and gives the island lush vegetation and spectacular streams and rivers coming from the mountains. The population is concentrated in Kolonia, but there are small rural settlements where people farm and fish. Kolonia has the charm and flavor of an old U.S. western town. There is a scattering of small stores and government buildings, a small junior college, and a few businesses. These businesses include the Ponape pepper processing operation and a new establishment making water catchment tanks.

Ponape's problems are the same as those of the other Districts although in some cases perhaps not as acute. There is a shortage of sanitation and housing facilities, and the dirt roads are awful. There is a new power plant (about 2.4 MW), but it is proving difficult to maintain and expensive to operate. There is a complete reliance on imported petroleum and an increasing use of electricity. There is very little local economy and unemployment is high. U.S. development priorities have contributed to changes in the social structure and traditional ways of the Ponapeans.

Ponape has some excellent leadership though, and as the capitol, it is in a position to solve its problems more easily than the other Districts. Ponape also has an excellent natural hydroelectric resource with the streams and rivers - some of them already have prewar Japanese dams.

B. Project Description

Opposite Kolonia on the lagoon is a small peninsula of land called Nett Point. At the end of Nett Point, commanding a beautiful view of Kolonia, the bay, and the surrounding islands, is a renovated warehouse that is the headquarters for Aramas Kapw (Changed Person), a delinquency prevention Outward Bound type of school. The school was established a few years ago to provide educational and confidence building programs for young adults from all of Micronesia. The warehouse contains sleeping, cooking, and educational facilities. A few teachers present programs lasting from a few days to a few weeks, patterned after the U.S. Outward Bound programs. They also offer programs for adults from Ponape and training for Peace Corps volunteers.

The staff is exceptionally capable, comprising a combination of people from the Mainland and from Micronesia. All of them have had extensive experience working with young adults. A Ponapean who is in charge of the educational programs has had a fine history of teaching in the Trust Territory and has a good way with the school's participants. Funding for the school is low but adequate, coming from a variety of Trust Territory sources. The young adults return to their islands and homes, thereby providing the school with an excellent opportunity to pass on ideas to large numbers of people.

In winter 1980, Aramas Kapw applied for a grant for $26,000 to build a variety of renewable energy devices. The school planned to instruct the young adults on how to build and maintain these devices; in turn they would pass these skills on to others upon return to their homes. The project was well thought out and they had done substantial research on the available energy resources and the types of systems they should build. In spring 1980, DOE awarded Aramas Kapw $20,000, which was later revised to $26,000, to build or install and demonstrate:

- A Savonious rotor wind machine for producing about 200 watts of electricity;
- A 2-3 kW commercial wind machine to produce electricity for the school as the school is not connected to the main power system;
- A 115 watt solar photovoltaic array as a backup source for the wind machines;
- A solar water heating system and water catchment system;
- Various types of solar crop dryers and fish dryers;
- Small solar water distilling units.

They also planned to collect operational data and publish a report.

C. Project Results

After receiving the grant the Aramas Kapw staff said they would make this the best small-scale energy project in Micronesia. They may have done so, as the project is progressing as planned and seems to be very effective. The water catchment system and the Savonious rotor were built during the 1980 summer program. The catchment system collects water from the warehouse roof and stores the water in two 250-gallon tanks (manufactured by the new water catchment tank business). This is the source of fresh water for Aramas Kapw. They will build the solar system during another educational program. The Savonious rotor is operating but they have not hooked it up yet because the proper size electrical wiring is not available locally. The Savonious rotor was also built during the summer program.

They have not yet installed the commercial wind machine. Because of increasing equipment costs they have ordered a 1.5-kW Aeropower wind turbine instead of the original 2-3 kW machine. During spring 1981, a group of students will erect a commercial 60' Rohn free-standing tower for the machine during a three-week course on alternative energy. They have received all the equipment (which is no small accomplishment for this part of the Pacific) and they have installed the control panels for the machine and the battery array. Community leaders from two nearby atolls chose the participants for this program.

The school has also received and installed the ARCO solar photovoltaic array. The system has not been connected to the batteries yet - wiring is the problem. During the spring program the participants will build solar stills and dryers and stoves and ovens, some of which they will take back to their atolls. In addition, they are learning what types of data are necessary for siting these systems and how to collect or estimate these data. The staff has taught them the theory of these devices, how to build them, and how to maintain them.

D. Analysis of Results

This type of facility is a natural for demonstrating small-scale technologies. The Outward Bound principles of training for young adults have been well established on the Mainland for some time. Aramas Kapw runs on the same principles, with certain changes for Pacific life. The school is well organised and the staff has a history of successful work with youth. There is a good combination of Micronesian talent, expertise, and a commitment to make this school a success. To help with the technical aspects of the projects, they have hired a young wind expert from the Mainland to work with them for a few months. This has worked out very well. His work has been excellent. They are installing all the systems properly and both students and staff are receiving an education.

Others in remote areas of the Pacific have had problems ordering and receiving energy equipment from Mainland manufacturers. Orders often go unanswered, prices increase, shipments are delayed, or the right equipment is not sent. In their grant, Aramas Kapw asked for money to send their technical expert to the Mainland to select and order the equipment. This is expensive, but on the other hand, this is one of the few projects the authors have visited where the proper equipment was received on time.

The project seems to have the right combination of commercial and home-built systems. The more complicated wind machines must be purchased from the Mainland. Still, commercial wind machines have not had a good history in the Pacific. High winds, corrosive atmosphere, vandalism, and lack of repair parts are a problem. Many of the islands have good wind regimes and it is worthwhile trying various commercial machines to see if these machines do have a future in the Pacific. Working with commercial machines is also a good way to teach Micronesian youth the principles of small-scale energy devices in general. Micronesians do not have the technical heritage or background of U.S. youth. These things must be learned and, therefore, it is important for them to be exposed to machines that work, and to learn how to keep them working. (Lack of proper maintenance is a problem throughout the Pacific.)

The home-built systems are simple enough so that they can be built with local supplies. Maintenance should not be a problem even on the outer islands.

Aramas Kapw has also selected the right type of technologies to demonstrate. There is a great interest, particularly on the outer islands, in photovoltaic systems. (There are already a number of photovoltaic powered communication systems on the outer islands. The number is increasing, and the effort is strongly supported by the local governments.) The simple crop and fish dryers are also needed, and the use of efficient wood-burning stoves is just starting to spread.

The most successful element of this grant is the demonstration and educational factor. A project with working systems is most useful if people are being taught the techniques of building and maintaining these systems. An interesting contrast is that in addition to learning about energy systems at the school, the students are also relearning traditional crafts and skills such as making sail-powered fishing boats. These are the true appropriate technologies Micronesians depended on just a few years ago for their livelihood.

E. Conclusions

This is an excellent project. It approaches the crux of the problem with technical systems in the remote areas of the Pacific - these are people not used to such devices and without the technical background or heritage to adopt them quickly. For the last forty years the U.S. has been giving the Micronesians systems they do not have the training to maintain. Reading plans or instructions, or using preventive maintenance are new concepts. These concepts are now being taught in local schools, but they have not been practiced on a large scale. Aramas Kapw is giving their participants a complete education, starting with the basics of working with mechanical and electrical equipment. Every successful Pacific project must have this very basic educational element.

Once again, project leadership has proven critical. Every part of the project was well thought out, including elements that have caused problems elsewhere, such as purchasing equipment. The school has a commitment to educating young adults and to preserving the cultural ways of the Micronesians. This commitment is evident by the school's success.

CASE V

SOLAR HOT WATER SYSTEM FOR THE TROPICS (Majuro, Marshall Islands)

A. Background

The Marshall Islands are a double chain of coral atolls east of the Eastern Caroline Islands and north of the Gilbert Islands. Their location is from 5^{o} to 15^{o} N latitude and from 162^{o} to 173^{o} E longitude. The Marshall Islands include 34 low coral islands and 870 reefs, with a total land area of about 117 square kilometers. Majuro, the District Center, is a coral atoll some 50 kilometers in length and less than 1 kilometer in width. The population is about 27,000 (1978) (Ref. 1, p.445).

Like so many of the other Pacific islands, the Marshall Islands are very important to the U.S. for strategic military reasons. The new political agreement being negotiated (Compact of Free Association) between the Marshalls and the U.S. will give the U.S. military use of the islands in turn for various types of monetary aid. Majuro has no military bases but does serve as the transportation and merchandising center for the Marshalls. The population consists of a combination of people from the U.S. Mainland, Marshallese native to the area, and natives from surrounding areas who have migrated to the center.

With a growing population Majuro has a number of problems. It is a low island - the highest point is only a few meters - and in fall 1979, an unusually high tide innundated most of the island, destroying much of the housing. Tents were shipped from the U.S. and about 5,000 people are still living in tent cities. Fresh water is also a critical problem. Water is collected in rain catchment systems. The new airfield is engineered and built with a slight cant so that water runs off to a central collecting area. There are also a few shallow lense wells but pumping from these wells is tricky due to potential sea water intrusions. During a visit to Majuro in fall 1980, city water was available only from 5:00 to 7:00 p.m.

In addition to water, housing, and sanitary conditions, energy production is a problem. People both on Majuro and the outer islands are changing from a subsistence form of living and are becoming more energy dependent. A new, more efficient, oil-fired plant is being built and there is some interest now in developing systems to use the local renewable energy resources, which are considerable. Small systems using solar active components, photovoltaics, and wind machines are being built both on Majuro and on outlying islands.

B. Project Description

Problems usual to the Pacific in developing small energy systems are found on the Marshalls. There is a lack of local expertise to build systems; once systems are built they are not maintained properly; systems are not engineered for the tropical environment; there is a lack of repair parts; and there is inadequate information about available systems. The applicant for this project is an architect from the Mainland residing for a few years on Majuro. This person, who is familiar with solar systems, felt that a successful demonstration of a domestic solar water system would encourage others to try similar systems. DOE awarded the applicant a grant for $4,620 to design, build, demonstrate, and test a solar system from fall 1978 to fall 1979. The original collector was to use copper tubing imbedded in a heat-absorbing material such as asphalt. The collector was to be 4' x 8' and circulation was to be through thermosiphoning. The water storage system was to be part of an ingenious water catchment system that the applicant had installed on his own home. The applicant planned to test this system, demonstrate it to others, and write a detailed report with the results.

C. Project Results

The largest piece of glass available on Majuro was 3' x 3' so the collector was built to that size. The copper tubing was shaped in a coil configuration. Although this configuration was efficient for heating the water, it prevented natural water circulation. An engineer helped the applicant redesign the copper tubing into an inverted conical shape with a mirrored pyramid in the center. The collector now lies flat but water rises and circulates through the conical configuration. The applicant also found that the closely spaced tubing makes additional absorption material unnecessary.

The applicant's job took him away from Majuro on and off for a year or so, so final construction was delayed. In late fall 1979, the system was operating and the applicant was just collecting data when four days of unusually high tides innundated Majuro. The applicant's home was in the area of heavy destruction and the house, collector system, and workshop were heavily damaged.

DOE, quite reasonably, expected that this would be the end of the project, so they were pleased when they received a detailed report a few months later describing how the system had been rebuilt and was operating again. The system has been operating now for over a year as a preheater to an electrical hot water system, but the monitoring data show that it could function effectively as a primary heat source. The applicant has included these data and a detailed description in a final report that DOE will be publishing (Ref.7).

D. Analysis of Results

The features leading to this project's success are the applicant's commitment to a successful project, his perseverance, and his knowledge and ability to solve engineering problems. We have found that many of the applicants seem to lose interest in their projects during the project term, particularly if they encounter unusual barriers. In this case the entire project was destroyed, but the applicant had the interest to rebuild the system and continue with the tests.

Finding local help for engineering problems is extremely difficult throughout the Pacific. Here the applicant, who already had a background in renewable energy systems, was fortunate to have an engineer available who could help him redesign the collector. Running into engineering barriers such as these has proved a difficult barrier to circumvent for many of Pacific projects. Another weakness seems to be collecting the proper data once the system is operating. The applicant has been collecting useful data for a year or so. Finally, and most important, the system works and lasts. These are the absolutely essential ingredients for a renewable energy project in developing countries. Too often a renewable energy device works for a short period and then fails, with no one to repair it. There the system stays, not operating, discouraging others from trying similar ideas.

This project meets most requirements for a successful project. It works and has been working for a while. It demonstrates renewable resources, is environmentally sound, has no cultural drawbacks, etc. Hot water uses only a small amount of the energy on Majuro but a solar heating system such as this is an effective way to demonstrate to others the principles of alternative energy devices. The only help provided was from a professional engineer. It would have been useful and educational if other people, not highly trained technically, had been trained to develp such a system.

Second, the project is difficult for others to replicate. Chances for replication in remote areas such as this are slim - particularly on outlying islands whre expertise is even more limited. Also, the system is quite complicated, perhaps giving others the idea that such a system needs to be highly engineered. Finally, the applicant was able to repair this system, but would others?

E. Conclusions

With this project a clever and presevering individual has overcome engineering and environmental barriers to build a working solar hot water system in an area that has few working systems. He was fortunate to have engineering help - such a barrier on another island might have been the end of the project. He also had the interest to rebuild the system after it had been destroyed.

The purpose of these grants is to encourage the development of small-scale energy systems. To be effective, these projects must offer benefits beyond a system that is of use to just one family or group. Here an elegant system has been designed, built, and tested. It is operating efficiently and will probably continue to do so. The chances of replication are small, however, and there was no training of local people who could certainly benefit from this kind of knowledge. The system is situated in a private home, and although the home is centrally located, the system's demonstration value is probably limited. At this time in the Pacific, though, any operating small energy-producing system should be considered a success, and for this reason alone the project is worthwhile. Finally, this is an unusual system that perhaps should be investigated in more detail in Honolulu or the Mainland.

ADDITIONAL DATA

We have used conclusions drawn from these five cases to create a list of elements which contribute to a successful project. Tables 4, 5, and 6 show these elements and match them with specific projects for 1978, 1979, and 1980. Tables 7, 8, and 9 give summary details for each project, and Tables 10, 11, and 12 present data concerning the Pacific Territory projects as a group (technology type, recipient type, average grant size, etc.).

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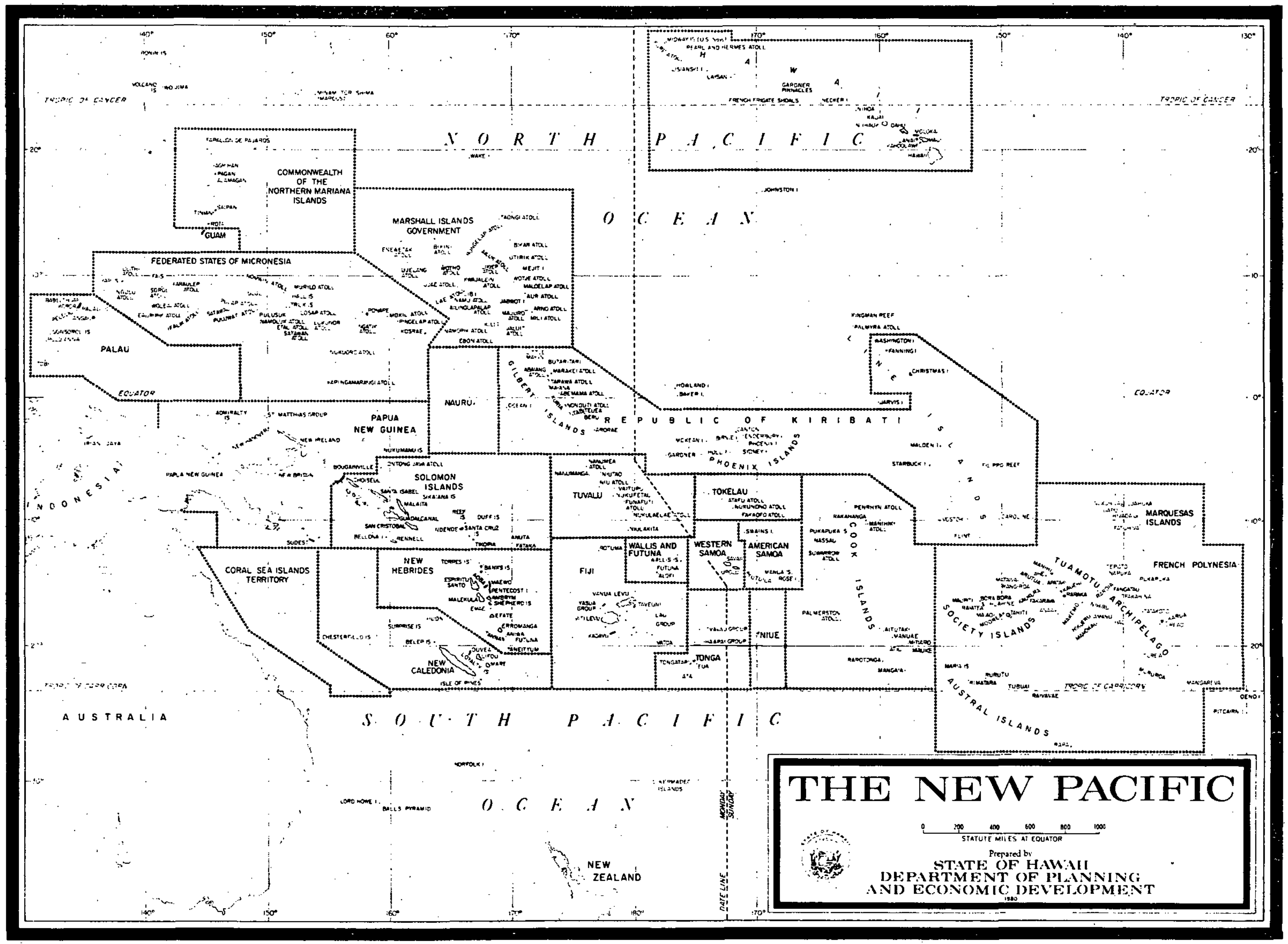

FIGURE 1 - MAP OF THE PACIFIC

Table 1

Summary of United States Pacific Territory Islands

Entity	Location	Political Status	Number of Islands	Land Area (Main Island in square km)	Administration Center	Population (1978)
American Samoa	In the Samoan group east of 171° W long.	Unincorporated U.S. territory	7 (Samoan group)	197	Pago Pago	30,600
Guam	13°26' N lat. 144°43' E long.	Unincorporated U.S. territory	1 (Mariana Islands)	549	Agana	102,000 (1975)
Commonwealth of the Mariana Islands	15°12' N lat. 145°43' E long.	U.S. Common-wealth (formerly Trust Territory)	16 (Mariana Islands)	471	Saipan	15,200 (1975)
Palau *	2° to 11° N lat. 130° to 136° E long.	Independent state (formerly Trust Territory) **	Approximately 200 for the main group (Western Caroline)	559	Koror	13,500
Yap	Equator to 11° N lat. 136° to 148° E long.	Federated state (formerly Trust Territory) ***	Approximately 20 for the main group (Western Caroline)	–	Colonia	8,500
Truk	Equator to 11° N lat. 148° to 154° E long.	Federated state (formerly Trust Territory)	Approximately 90 for the main group (Eastern Caroline)	–	Moen	35,200
Ponape	Equator to 11° N lat. 154° to 162° E long.	Federated state (formerly Trust Territory)	Approximately 25 for the main group (Eastern Caroline)	703	Kolonia	21,200
Kosrae	Equator to 8° N lat. 162° to 166° E long.	Federated state (formerly Trust Territory)	1 (Eastern Caroline)	110	Lele	4,500
Marshall Islands	5° to 15° N lat. 162° to 173° E long.	Independent state (formerly Trust Territory)	Approximately 34 for the main group (Marshall Islands)	171 (total for all islands)	Majuro	27,100

Principal Source: Pacific Islands Year Book, New York, N.Y., Pacific Publications, 1978.

* Palau has been renamed Belau.

** As of September 1981, the Trust Agrreement has not been terminated.

*** Federated States refers to the Federated States of Micronesia - both the Federated States and the Independent States are negotiating a compact agreement with the United States.

Table 2

Unemployment in the Trust Territory District Centers in 1973*
(Ref. 2, p. 1089)

Palau (Koror)	13.6%
Marshall Islands (Majuro)	21.6%
Federated States of Micronesia	
Yap (Colonia)	12.3%
Kosrae	20.4%
Ponape (Kolonia)	22.4%
Truk (Moen)	20.8%

* Office of Planning and Statistics, Quarterly Bulletin of Statistics, Trust Territory of the Pacific Islands, Saipan: Office of the High Commissioner, March 1979, vol. II no. 1, at 7. 1973 is the most recent year for which figures are available.

Table 3

Electric Generation Capacity and Peak Demand for the Territories*
(Ref. 2, p. 1089)

Territory	Electric Generation Capacity (MW)	Peak Electric Demand (MW)
Guam	314	150
American Samoa	24	18
Northern Marianas (Saipan only)	21	13
Palau	3.7	**
Marshall Islands	6.1	**
Federated States of Micronesia		
Ponape	5.4	**
Kosrae	0.8	**
Yap	3.1	**
Truk	4.5	**

* Data from Dept. of State, 1978 Trust Territory of the Pacific Islands 31st Annual Report, Washington, D.C.: Dept. of State, 1979, Publication No. 8972, Part XIII, at 23, Table 20, and from testimony presented at hearings on H.R. 7330, collected in Pacific Basin Energy.

** Peak demand data not available.

Table 4

Elements Contributing to a Successful Project (1978 Projects)

	Satawan Solar	Univ. of Guam Solar	Marshall Is. Solar	New Guam Res. Inst.	Wind Buoys	Fishdri	Pedro's Farm
Support of the local energy office	X	X	X	—	—	X	—
Project is monitored by DOE	—	X	X	—	—	X	—
Established institution is doing the work	X	X	X	—	—	—	—
Workers are dedicated	X	X	X	—	—	—	—
Workers are experienced	X	X	X	—	—	—	X
Realistic plan/schedule	—	X	X	—	—	—	X
Project is sensitive to the culture	X	N/A	X	X	—	X	X
Project uses village/local help	—	X	—	—	—	X	X
There are contributing funds/help locally	X	—	X	—	—	—	—
Project is accessible	X	—	X	X	—	—	—
Project uses mostly local materials	—	X	X	X	—	—	X
Proven technology for area	X	X	X	X	—	X	X
Elegant engineering	X	X	X	?	—	—	X
Parts available	—	X	X	?	—	—	X
Engineered for elements	?	X	X	X	—	X	X
The original applicant is in charge of work	X	X	X	—	—	—	X
Project is properly sized (including grant amount)	X	X	X	X	—	—	X
Realistic anticipation of problems	—	X	X	X	—	—	X
Problems beyond control of project (i.e., sickness)	X	—	X	—	X	—	—
Training of local help	—	—	—	—	—	—	—
TOTAL	12	15	18	7	1	6	12

Table 5

Elements Contributing to a Successful Project (1979 Projects)

	Tuna Sludge	Univ. of Guam Solar	Guam Greenhouse	CMI Solar	CMI Biomass	CMI Solar/Wind	Yap Inst.	Kosrae Hospital
Support of the local energy office	X	X	–	X	X	X	X	X
Project is monitored by DOE	X	X	X	X	X	X	X	–
Established institution is doing the work	X	X	–	X	X	X	X	X
Workers are dedicated	X	X	–	X	X	X	X	X
Workers are experienced	X	X	X	X	X	X	X	X
Realistic plan/schedule	X	X	X	X	X	–	X	–
Project is sensitive to the culture	X	N/A	X	X	X	X	X	X
Project uses village/local help	X	–	–	X	X	X	X	–
There are contributing funds/help locally	X	–	–	X	X	X	X	–
Project is accessible	X	–	X	X	X	X	X	X
Project uses mostly local materials	X	X	X	X	X	–	X	–
Proven technology for area	X	X	X	X	X	X	X	X
Elegant engineering	X	X	–	X	X	X	X	X
Parts available	X	X	X	–	X	–	X	X
Engineered for elements	X	X	–	X	X	X	X	X
The original applicant is in charge of work	X	X	X	X	X	X	X	–
Project is properly sized (including grant amount)	X	X	X	X	X	X	X	X
Realistic anticipation of problems	X	X	–	X	X	–	X	X
Problems beyond control of project (i.e., sickness)	–	–	–	–	–	–	–	–
Training of local help	X	–	–	X	X	X	X	X
TOTAL	19	14	10	18	19	15	19	13

Table 6

Elements Contributing to a Successful Project (1980 Projects)

	A.S. Energy House	Photovoltaic Fence	Photovoltaic Refrigerator	CMI Solar	Guam Aqua.	Univ. of Guam Solar	Cocos Island	Palau Alcohol	Aramas Kapw	Majuro Water	Yap Refrigerator	Yap Dryer	Woodstoves
Support of the local energy office	X	X	X	X	X	X	X	X	X	X	X	X	X
Project is monitored by DOE	X	X	X	X	X	X	X	X	X	X	X	X	X
Established institution is doing the work	X	X	X	X	X	X	—	X	X	X	X	X	X
Workers are dedicated	X	X	X	X	X	X	X	X	X	X	X	X	X
Workers are experienced	X	X	X	X	X	X	X	X	X	X	X	X	X
Realistic plan/schedule	X	X	X	—	X	X	—	X	X	X	X	X	X
Project is sensitive to the culture	X	X	X	X	X	X	X	X	X	X	X	X	X
Project uses village/local help	—	X	X	X	X	—	X	X	X	—	X	X	X
There are contributing funds/help locally	X	X	X	X	X	X	X	X	X	X	X	X	X
Project is accessible	X	X	X	X	—	X	X	X	X	X	X	X	X
Project uses mostly local materials	X	—	—	—	—	X	X	X	X	—	—	X	X
Proven technology for area	X	X	X	X	X	X	X	X	X	X	X	X	X
Elegant engineering	X	X	X	X	X	X	X	X	X	X	X	X	X
Parts available	X	X	X	X	X	X	X	X	X	X	X	X	X
Engineered for elements	X	X	X	X	X	X	X	X	X	?	X	X	X
The original applicant is in charge of work	X	X	X	X	X	X	—	X	X	X	X	X	X
Project is properly sized (including grant amount)	X	X	X	X	X	X	X	X	X	X	—	X	X
Realistic anticipation of problems	X	X	X	—	X	X	—	X	X	X	X	X	X
Problems beyond control of project (i.e., sickness)	—	—	—	—	—	—	—	—	—	—	—	—	—
Training of local help	—	—	X	X	—	—	—	X	X	X	X	X	X
TOTAL	17	17	18	16	16	17	14	19	19	17	17	19	19

TABLE #7

DOE SMALL SCALE GRANTS FOR THE PACIFIC TERRITORIES - 1978

PROJECTS	TECHNOLOGY	LOCATION	GRANT AWARD	STATUS
SATAWAN HOSPITAL SOLAR HOT WATER SYSTEM	SOLAR HOT WATER	TRUK	$7,000	IN PROGRESS
SOLAR HOT WATER HEATER CONSTRUCTION DEMO.	SOLAR HOT WATER	GUAM	12,000	COMPLETED
SOLAR WATER HEATING SYSTEM FOR THE EQUATORIAL TROPICS	SOLAR HOT WATER	MARSHALL IS.	7,000	COMPLETED
SOLAR COOLING FOR A SMALL PUBLIC MARKET	PASSIVE SOLAR	GUAM	5,000	TERMINATED
WIND POWERED LIGHTED NAVIGATION BUOY	WIND - ELECTRIC	GUAM	3,000	TERMINATED
UTILIZATION OF FARM WASTES TO GENERATE POWER	BIOMASS - METHANE	GUAM	7,500	COMPLETED
FISHMEAL FROM SOLAR HEATED DRYERS	SOLAR DRYERS	TRUK	14,000	TERMINATED

TABLE #8

DOE SMALL SCALE GRANTS FOR THE PACIFIC TERRITORIES - 1979

PROJECTS	TECHNOLOGY	LOCATION	GRANT AWARD	STATUS
AMERICAN SAMOA TUNA SLUDGE PROJECT	BIOMASS - METHANE	AMERICAN SAMOA	$20,000	COMPLETED
TYPHOON-PROOF SOLAR GREENHOUSE	SOLAR GREENHOUSE	GUAM	3,000	COMPLETED
YAP INSTITUTE OF NATURAL SCIENCE	SOLAR - VARIOUS	YAP	4,500	COMPLETED
SOLAR WATER HEATER FOR A HOSPITAL	SOLAR HOT WATER	KOSRAE	13,000	IN PROGRESS
RECYCLED USED FLUORESCENT LIGHT TUBES SOLAR WATER HEATER	SOLAR COLLECTOR	GUAM	7,500	COMPLETED
WIND-PUMP AND SOLAR STILL DEMO.	WIND/SOLAR	CMI	1,200	IN PROGRESS
FARM BIOGAS DIGESTER DEMO.	BIOMASS - METHANE	CMI	1,500	COMPLETED
SMALL SOLAR HEATER DEMO.	SOLAR HOT WATER	CMI	600	COMPLETED

TABLE #9

DOE SMALL SCALE GRANTS FOR THE PACIFIC TERRITORIES - 1980

PROJECTS	TECHNOLOGY	LOCATION	GRANT AWARD	STATUS
AMERICAN SAMOAN ENERGY HOUSE	CONSERVATION	AMERICAN SAMOA	$35,000	IN PROGRESS
FERAL PIG CONTROL BY PHOTOVOLTAIC POWERED ELECTRIC FENCE	PHOTOVOLTAICS	AMERICAN SAMOA	1,100	COMPLETED
ARAMAS KAPW DEMONSTRATION	VARIOUS	PONAPE	26,500	IN PROGRESS
SOLAR POWERED REFRIGERATOR FOR DISPENSARIES	PHOTOVOLTAICS	YAP	3,000	IN PROGRESS
SOLAR DRYER CONSTRUCTION AND DEVELOPMENT	SOLAR DRYERS	YAP	8,500	IN PROGRESS
SHALLOW LENSE WELL PUMPING USING WIND POWER	WIND - WATER	MARSHALL IS.	10,000	IN PROGRESS
SMOKELESS STOVE DEMONSTRATION	WOOD COOKING	VARIOUS	12,000	IN PROGRESS
ALCOHOL DISTILLATION PLANT FOR TROPICAL VILLAGE COMMUNITIES	ALCOHOL DIST.	PALAU	40,000	IN PROGRESS
RECYCLED FLUORESCENT TUBE COLLECTOR DEMO.	SOLAR HOT WATER	GUAM	7,100	IN PROGRESS
WIND-POWERED ELECTRIC DEVICE FOR AQUACULTURE	WIND/AQUACULTURE	GUAM	8,000	IN PROGRESS
METHANE GAS PLANT FOR COCOS ISLAND	BIOMASS - METHANE	GUAM	10,000	IN PROGRESS
SOLAR REFRIGERATOR	PHOTOVOLTAICS	CMI	1,600	IN PROGRESS
SOLAR WATER HEATER FOR A HOSPITAL	SOLAR HOT WATER	CMI	4,000	IN PROGRESS

TABLE #10

DEPARTMENT OF ENERGY SMALL SCALE GRANTS PROGRAM

FOR THE PACIFIC TERRITORIES

	1978	1979	1980	TOTAL
NUMBER OF GRANTS:	7	8	13	28
AMOUNTS AWARDED:	$55.5K	$51.3K	$166.8K	$273.6K
AVERAGE GRANT SIZE:	$7.9K	$6.4K	$12.8K	$9.8K
AVERAGE PROJECT TERM:		- 2 years -		
LARGEST GRANT (for three years):		- $40.0K -		
SMALLEST GRANT (for three years):		- $0.6K -		
PROJECTS COMPLETED (June 1, 1981):	3	6	1	10
PROJECTS IN PROGRESS (June 1, 1981):	1	2	12	15
PROJECTS TERMINATED (June 1, 1981):	3	-	-	3

TABLE #11

RECIPIENTS OF DOE SMALL SCALE GRANT AWARDS

TYPE OF RECIPIENT	1978	1979	1980	TOTAL
LOCAL ENERGY OFFICE:	1	4	3	8
SMALL BUSINESS:	—	—	—	—
INDIVIDUAL:	4	2	4	10
NON-PROFIT INSTITUTION:	1	1	5	7
PEACE CORPS:	1	1	1	3

TABLE #12

DOE SMALL SCALE GRANTS PROGRAM FOR THE PACIFIC TERRITORIES:

TYPES OF TECHNOLOGIES *

TECHNOLOGY TYPE	1978	1979	1980	TOTAL
ALCOHOL DISTILLATION:	-	-	1**	1
AQUACULTURE:	-	-	1	1
BIOMASS CONVERSION - METHANE:	1	2	1	4
CONSERVATION:	-	-	2	2
SOLAR DRYERS/COOKING:	1	1	1	3
SOLAR DESALINATION:	-	1	-	1
SOLAR WATER HEATING (DOMESTIC):	2	2	2	6
SOLAR WATER HEATING (INSTITUTIONAL):	1	1	1	3
SOLAR PASSIVE (INCL. GREENHOUSES):	1	2	-	3
SOLAR PHOTOVOLTAICS:	-	-	3	3
WIND - ELECTRIC:	1	-	2	3
WIND - WATER PUMPING:		1	1	2
WOOD COOKING:	-	1	1	2

* Some projects include a number of different technologies.

** This project is funded by the DOE Alcohol Fuels Program.

FIGURES AND CAPTIONS:

Figure #1	(CBB809 - 10654)	Moen, Truk, 1978: Peace Corps Headquarters on the far left - Truk general store, which has since burned down, in the center.
Figure #2	(CBB809 - 10644)	Romanum, Truk: Discussing the Fishdri Project with the Romanum chief.
Figure #3	(CBB816 - 5402)	Yap: Solar oven and food dryer built by the Yap Institute of Natural Science.
Figure #4	(CBB816 - 5380)	Yap: Solar copra dryer showing termite damage on the frame.
Figure #5	(CBB816 - 5392)	Ponape: Nett Point in the foreground - Aramas Kapw on the end of the wharf.
Figure #6	(CBB816 - 5382)	Ponape: Various energy devices built or installed by students at Aramas Kapw.
Figure #7	(CBB816 - 5398)	Majuro, Marshall Islands, 1980: High tides swept over this part of the island in 1979.
Figure #8	(CBB816 - 5394)	Majuro, Marshall Islands: Rebuilt hot water system which had previously been destroyed by high tides.

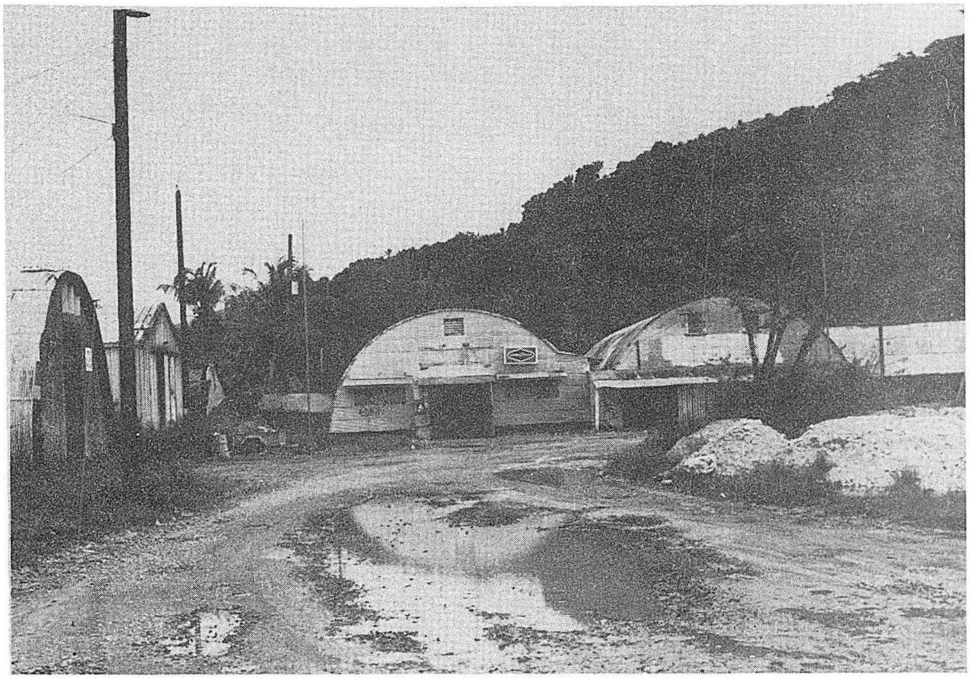

Figure 1 CBB 809-10654

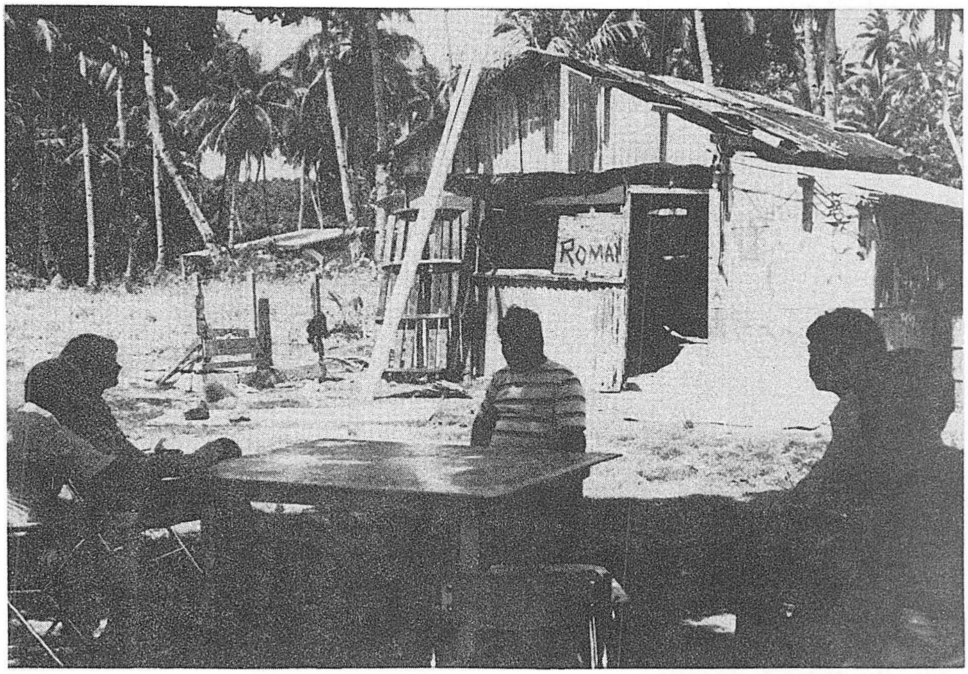

Figure 2 CBB 809-10644

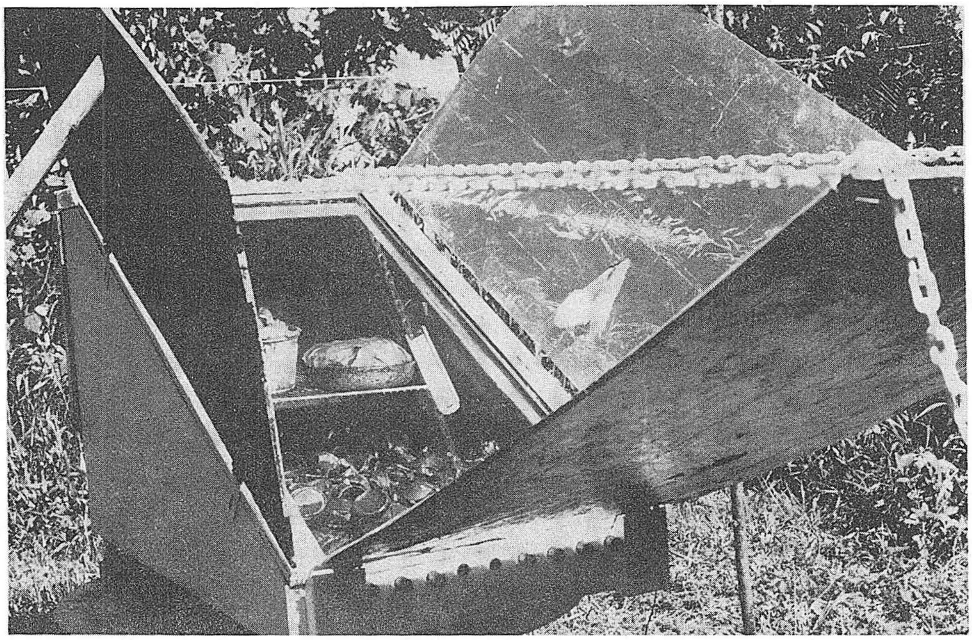

Figure 3 CBB 816-5402

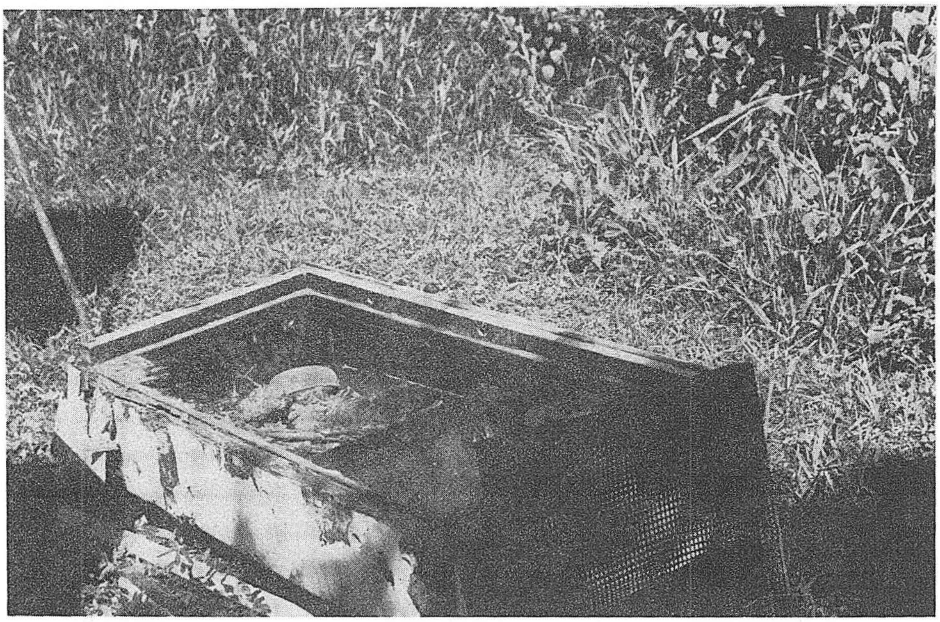

Figure 4 CBB 816-5380

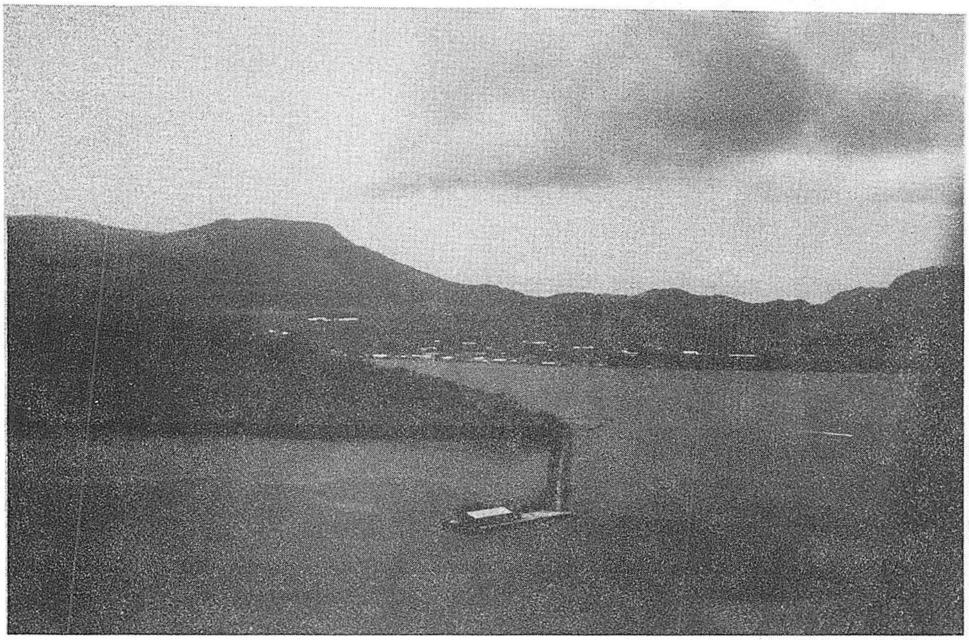

Figure 5 CBB 816-5392

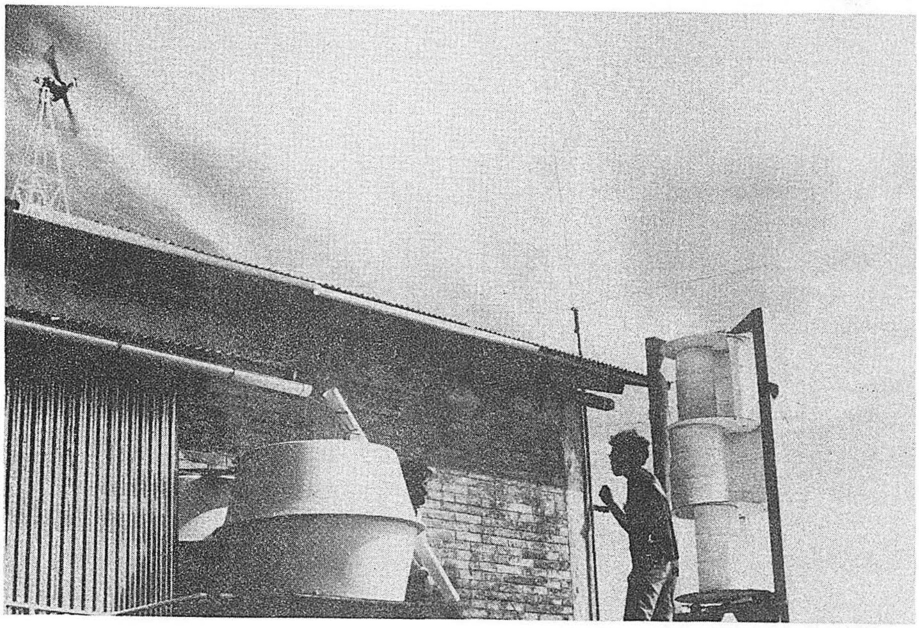

Figure 6 CBB 816-5382

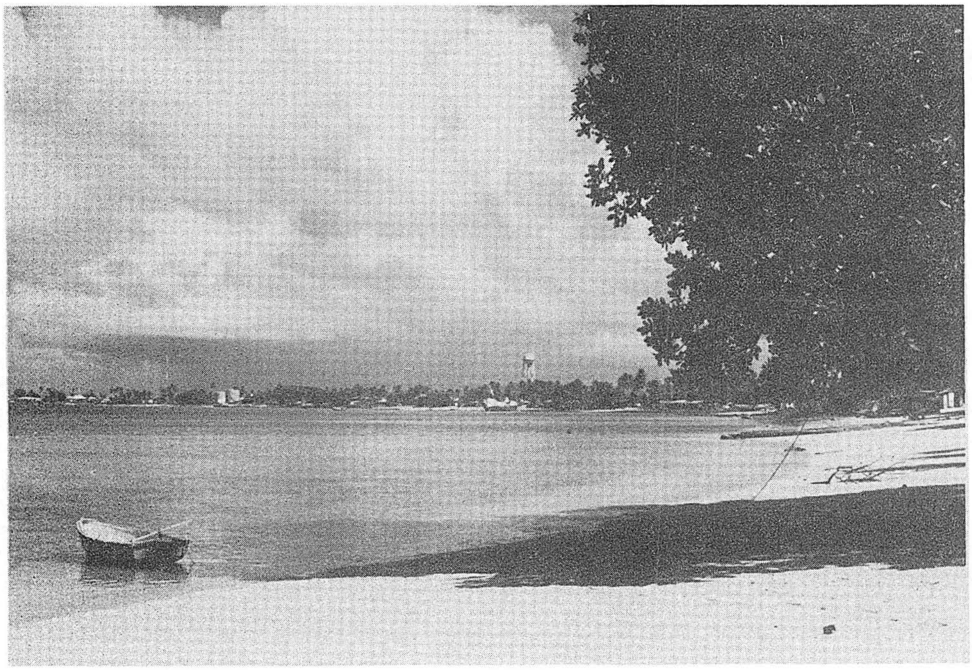

Figure 7 CBB 816-5398

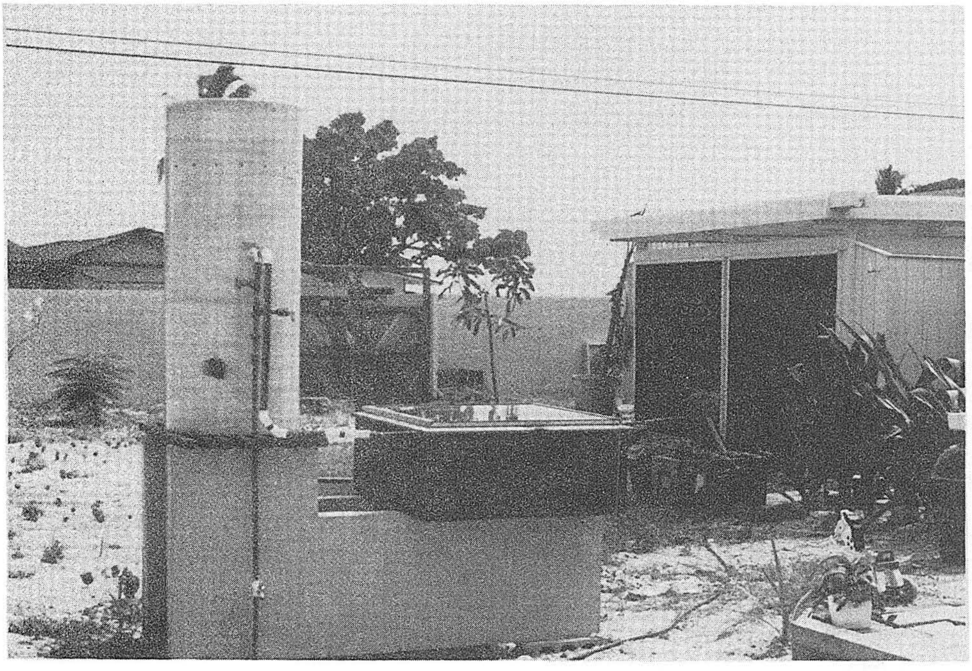

Figure 8 CBB 816-5394

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