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National Rural Electric Cooperative Association
El Salvador

RURAL ELECTRIFICATION PROJECT
PROYECTO DE ELECTRIFICACION RURAL
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PD-ABM-647

A final Evaluation of The El Salvador Rural Electrification Project

1988-1996

Bringing Light, Jobs and Peace

to

Rural Communities in El Salvador

A Final Evaluation
of
The El Salvador Rural Electrification Project
(519-0358)

Submitted to
USAID/El Salvador

By

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March 8, 1996

EXECUTIVE SUMMARY

This final evaluation of the El Salvador Rural Electrification Project (519-0358) by the National Rural Electric Cooperative Association (NRECA) assesses its effectiveness, impacts and lessons-learned. The evaluation attempts to answer how rural electrification helps advance AID strategic objectives for broad-based economic development, environmental protection and democracy building.

The project, from August 12, 1988 and scheduled to end March 31, 1996, financed $22.3 million in construction, technical assistance and training. NRECA also monitored additional resources by the national utility; and carried out a separate program to extend services to conflictive areas following the end of the 12 year civil war.

The evaluation found that the project achieved and exceeded all of its outputs by wide margins. Project savings in rural electric line extensions through innovative design methods resulted in increased resources that were redirected to technical assistance, training and other components.

Project impacts of broad-based economic growth include:

- 180,000 direct rural beneficiaries with electric service that generated $79 million in economic development.
- $51 million generated by 12,000 micro-enterprises and 40,000 new jobs.
- 937,000 women days saved through electric grist mills, and 30,000 additional garments per year due to electric sewing machines in women-operated cottage industries.
- $1,500 addition income per week for 150 metal workers through more efficient electric sharping of machetes, and a savings of about 156,000 hours a year in grinding and mixing corn and mulch for cattle.

Energy savings, as a result of the project, include:

- 1,000 metric tons of fewer carbon emissions by substitution of electricity for kerosene, candles and firewood for cooking.
- 3,200 metric tons of fewer carbon dioxides emissions through more efficient transformers as well as more efficient compressors for locally-produced refrigerators.
- 14,000 trees saved through innovative routing of electric lines.

- Creation of local NGO, The Salvadoran Center for Energy Efficiency, to promote energy efficient technologies.

Democracy-building promoted by the project includes:

- Strengthening of local municipalities, community centers and other public facilities through the provision of electricity.

- Extension of electricity to former conflictive regions as part of the Peace Accords.

- The first two electric distribution cooperatives in El Salvador.

Many elements of the project are sustainable, most notably electric service through the 30,000 connections by consumer payments of their electric bills. New designs and standards have been adopted by local utilities and 2,473 trained utility personnel who can use them and continue to be available to support rural electric efforts. Yet, only 2 of 3.5 million rural residents now have electricity and an additional $80 million over 15 years would raise this level to 80%.

Lessons-learned are:

- The importance of flexibility in project management that allowed the project to redirect saved resources and respond to changing conditions including the Peace Accords.

- Through co-location with the counterpart, joint productive uses demonstrations and objective site selection criteria, the project remained close with its beneficiaries.

- The project demonstrated the importance of rural electrification to achieving AID's strategic objectives of broad-based economic growth (including micro-enterprise development and poverty alleviation), environmental protection through reduce green house effects and democracy-building by strengthen local municipalities and promoting cooperatives and NGOs.

- Rural electrification faces an uncertain future with limited resources for infrastructure projects, privatization of utilities and increased construction costs. Some ways to respond to these challenges are: more focus on rural communities for co-financing; loan rather than grant programs; lower cost systems; and reliance on NGOs to provide on-going technical assistance for rural electrification over many years.

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The El Salvador Rural Electrification Project
1988-1996

I. Introduction

The purpose of this final evaluation is to assess the effectiveness, impacts and lessons-learned of the El Salvador Rural Electrification Project (519-0358) by the National Rural Electric Cooperative Association (NRECA).

The evaluation team consisted of Ted Weihe and Alfredo Szarata. Ted Weihe, the team leader, is an expert in evaluation, project design and cooperative development with over 20 years of development experience worldwide. Alfredo Szarata, a native of Guatemala, is an engineer who spent nine years as an AID project manager of water and rural electric infrastructure projects. They reviewed all of the project documents and traveled to El Salvador from March 1, 1996 until March 10, 1996. They interviewed key headquarters and project staff, counterparts, AID project managers, trainees of the project and other officials. They took field trips to observe rural electric (RE) impacts at recently electrified sites and interviewed beneficiaries.

The evaluation report is organized to assess project impacts based on USAID and USAID/El Salvador strategy objectives of broad-based economic growth, environment protection, democracy and reconciliation. The report quantifies impacts where possible. It also reviews key training and procurement systems; discusses the sustainability of activities after project termination; and provides lessons-learned for consideration by AID, other donors and implementors.

In sum, the evaluation tries to answer the question of how rural electrification advances AID's strategic objectives of broad-based economic development, environmental protection and democracy building.

II. Project Description

In 1985, NRECA conducted a major AID-financed study of rural electrification in the Central American region as part of the Kissinger Report (enacted into law as the Jackson Plan).

In May 1987, AID and NRECA began the Central American Rural Electrification Support (CARES) program. As a follow-on activity in early 1988, AID and NRECA agreed to establish a parallel bilateral program for the rural electric power sector in El Salvador. The current cooperative agreement for the project was signed on August 12, 1988 initially for $5 million. An additional $5 million was added to the project in the following year through an amendment. The project also received $10 million in locally-generated AID currencies and $2.3 million in host government contributions.

A major objective of the project was to build rural electric lines into areas controlled by the government during the civil war. Later, the project extended lines to reestablish rural electricity for ex-conflictive areas as part of the reconciliation that followed cessation of the 12 year civil war.

The project had six basic components: productive uses, technical studies, rural electrification sector management, training, small power generation and construction technical assistance. Following a mid-term evaluation in 1991, the small power pilot component was deleted.

Project milestones:

1985	Regional rural electrification study in Central America
1988	Initial cooperative agreement of $5 million
1988	Project team leader arrives in country
1989	Second cooperative agreement of $5 million
1989	Distribution line design initiated
1989	First procurement begins
1990	Construction begins

1990	First productive use mobile unit created
1991	Mid-term evaluation
1992	Study on privatization of utilities
1992	Energy efficiency component added
1992	Second productive uses mobile unit created
1994	Project takes over FASE III construction
1995	Project extended until 1/96 (to complete line construction due weather-related delays)
1996	Project extended until 3/31/96 (same as above)

The evaluators found that the project achieved and exceeded all of its outputs by wide margins. Project savings in rural electric line extension through innovative design methods resulted in increased resources that were redirected to technical assistance, training, efficiency programs and studies, including privatization of electric utilities.

In particular, the evaluators found that improved rural electric distributions standards, better management systems and demand analysis exceeded project expectations. Training far exceeded projected levels, originally projected at 70 and later 90 utility management staff. Instead, the project trained 2,473 utility personnel on mostly technical subjects.

The team also assessed the impacts of major additional activities not in the original project documentation and cooperative agreements. These included the creation of two private distribution cooperatives, provision of U.S. surplus materials donations, introduction of energy efficiencies and two additional separate contracts for rural electrification reconstruction. These additional AID contracts could not have been carried out without the underlying project.

A major factor in project success was continuity and expertise of U.S. project staff. Myk Manon, project manager and country team leader, has been with the project since its inception, and worked on rural electrification projects over 26 years in Nicaragua, Peru, Ecuador, Bolivia and Bangladesh. Alden Kitson, project coordinator for procurement, productive uses and video production, has been with the project since July

1989. Bob Dalton, systems operations specialist, and Henry Weiss, training officer, joined the project in 1991 and 1992, respectively.

See figure 1 for project performance: a comparison of outputs with results.

III. Project Impacts

A. Broad-based Economic Development

1. Rural electrification extensions

Over the seven and one-half years, the project built 1,000 kilometers of lines (average extensions of less than 3 kms) for 30,000 connections. Based on a typical household size of six, there were 180,000 direct project beneficiaries.

A 1989 AID-financed study of electrical energy impact in El Salvador estimated that each kilowatt hour of electricity generated $4 in economic benefits (Source: USAID/El Salvador IRD Engineer Tibor Nagy). Prorating the benefits as rural electric extensions took place, thus, generated total economic impacts of about $79 million. See figure 2 for chart of economic benefits per project year.

2. Micro-enterprises and employment generation

Based on its survey and demand assessment model, the project provided electricity to about 12,000 micro-enterprises and 1,500 small businesses (over 10 employees). Of $79 million in economic benefits, about 65% or $51 million was generated by micro-enterprises (65% of electric loads).

About 80% (9,600) of the micro-enterprises were small family-owned shops that provide groceries and small eateries. About 1,000 corn grist mills and some 1,400 cottage industries (e.g., sewing, carpentry, tailors) were electrified. Most connections were to very small enterprises of two or three family members/employees. However, some

larger businesses such as dairies (automatic milkers and separators), agricultural cooperatives (coffee preparation) and private irrigation pumps were electrified.

Throughout the life of the project, it is estimated that 40,000 jobs were created which usually meant the addition of another family member or employee for the micro-enterprises. This is based on demand analysis that an electrified business increased employment by a factor of 3.5 per unit.

3. Productive Uses of Electricity

The project conducted 162 productive uses demonstrations that reached 49,000 rural residents (about one half female). Two productive uses demonstrations were provided to small towns after electrification. The demonstrations emphasized the benefits of electricity and economic opportunities through 33 identified uses in six areas: agro-industry, carpentry, metal work, refrigeration, water pumps and home-based activities such as sewing, ironing and blenders.

The follow-up unit focused more on credit mechanisms for households (e.g. connections and wiring) as well as 25 new demonstrations in carpentry and metal working. In most cases, private vendors of electric equipment also sold goods in newly electrified areas. A key constraint to the project was an inability to develop a line of credit for the purchase of electric equipment either through government and private banks or through the project itself. Credit to rural areas was non-existent during the civil war and began to be advanced by some banks and private companies when the war ended.

In 1995, the project carried out a major analysis of economic impacts of electricity and developed estimates of productive uses by categories. The analysis was based on surveys in newly electrified areas in some 15 communities. The initial demand study prior to project implementation had over-estimated initial productive activities, but reached expected levels within 20 to 30 months after electrical connections.

Overall, the heaviest loads in new RE areas were refrigeration by small shops that increased their sales of cold drinks and other foods. Previously, local residents drank

water rather than warm drinks. Thus, refrigeration stimulated sales by small shops. The ability to use electric grist mills freed up women for more productive activities. Usually, rural women in El Salvador must grind corn by hand for about 2.5 to 3 hours per day (about 6 times a week). An equivalent time spent with an electric grist mill is about six minutes for the same quality of corn meal. Thus, an average rural woman saved 2.5 hours per day per household. This represented a savings of 75,000 hours per day with electricity or a total of 360,000 hours over 7.5 years of the project per household. Overall, electric grist mills saved rural women in El Salvador about 937,000 women days over the project life. See figure 3 for summary of these impacts.

Many rural women in El Salvador make dresses, pants and other garments as a cottage industry. An electric iron and sewing machine is twice as efficient as non electrified machines. About 1 in 20 connections included the purchase of electric sewing machines and electric irons (the latter, necessary for cottage industry sewing). Thus, the project generated 1,500 electric sewing machines which resulted in some 30,000 additional garments per year due to efficiencies of electric machines and longer working hours through electric lights.

About 1 in 100 connections were for carpentry shops that in rural El Salvador produce doors, tables and coffins. Electric power tools enabled a 200% increase in production. Thus, about 300 carpenters can now produce three more doors per day over 25 weeks for an increase in additional doors of 22,500. Each door valued at 500 colones ($57.50) represented additional sales of some $1,290,000.

For metal working, electricity provides greater efficiencies in grinding and welding. For example, the shift from manual to electric sharpening for machetes is dramatic. Some 150 metal workshops (1 per 200 connections) can now sharpen a machete in about 10 minutes compared to 40 minutes by hand. In the RE impacted areas, this was a savings of 450 man hours per day or 22,500 hours per week. At four colones per sharpening, this created some $1,500 in additional income per week for an estimated 150 metal workers now served with electricity.

Another important productive use is grinding and mixing corn and mulch for cattle. For example, to grind and mix a 100 pound bag of grass mulch takes 8.5 minutes by electricity compared to 20 minutes by hand using a machete (which is also more dangerous). About 1 in 150 connections provided electricity for mulching machines or about 200 total machines. Production for mulch doubled using electricity which meant a total savings of about 156,000 hours a year.

See figure 4 for summary of productive uses impacts.

B. Environment

1. Energy substitution (greenhouse gas reductions)

Based on a November 1994 project study of the California Substation Project in Usulutan, El Salvador, the overall impact of reductions in greenhouse effects can be extrapolated for the entire project. This study analyzed the uses of kerosene for lighting, charcoal for heating irons, candles for lighting and firewood for cooking in a non-electrified region. The study found that average uses per family per year for these energy uses were: 88 bottles of kerosene (.83 kg carbon emissions per liter); 150 lbs of charcoal (.86 lbs of carbon per lb); 22 lbs of candle wax (.22 lbs of carbon per lb of candles); and 4.4 tons of firewood (484 lbs of carbon per ton) In the case of firewood, the study reduced carbon emissions by only 20% given the mix of generation sources from the grid.

Prior to electrification and based on total households served by the project, there were 37,600 metric tons of carbon emissions. The total savings in carbon emissions for the project per year was 1,000 metric tons. Factored into this savings is the substitute value of carbon emissions replaced with electricity (generated by a combination of hydropower, geothermal and bunker oil).

For comparison, a 60 kw generator emits 1,000 metric tons of carbon emissions when run 24 hrs, 365 days of the year. Such a generator would provide sufficient power in rural El Salvador for 250 houses.

2. Energy efficiencies

In 1993 the project created a local NGO, The Salvadoran Center for Energy Efficiency, to promote energy efficient technologies in the electrical, industrial and residential sectors. The center carries out educational programs on energy efficiency through television, schools, government programs and industrial fairs. NRECA and the Center collaborated in an educational campaign for primary school students, an efficiency lighting project at a local orphanage, the production of educational videos and assessments of alternative energy sources and uses.

The project directly contributed to energy efficiencies through new system designs and efficiency standards for the electrical grid. The project studied local conditions (e.g., climate, geography and manufacturing capacity) in developing innovative and more energy efficient designs that resulted in major environmental benefits.

One of the major environmental impacts was achieved through a reduction in the removal of trees for line construction. Using the new design features, line designers changed routing that followed the curves of roads and, instead, reduce angles with more straight sections. A typical traditional line removes about 600 meters of trees. The new design reduced this amount to about 100 meters of trees; thus, saving 46 trees per km. Over the last six months of the project using these standards, over 14,000 trees were saved. At the current rate of RE expansion, the new routing design has the potential of saving 30,000 trees per year compared to less ecologically sensitive designs.

About 90% of the poles used in El Salvador are concrete which are locally fabricated. These poles are made from a non-renewable resource that is energy intensive to produce. The new project designs resulted in a 35% cost savings in poles and about 3,600 fewer concrete poles. This meant a BTU cost savings of $72,000 in bunker fuel for the production of poles.

Through minimizing line losses, the project was able to generate a savings of $1.6 million during the life of project. It is estimated that a secondary savings of these loss

reductions over the 30 year life of installed lines is about $6.4 million at net present value (The figure includes energy production savings through better conductors).

The project specified and procured energy efficient transformers for El Salvador. As a result, the project saved about 250,000 kw hrs per year for an overall reduction of 106,000 tons of carbon dioxide emissions per year. Over the life of the transformers (1,000 units), the carbon dioxide emissions will be reduced by 3,200 metric tons.

The project encouraged the local manufacturer of refrigerators to adopt efficiency standards including providing the company with test results and a test bench. As a result of this new awareness, the company shifted from inefficient Brazilian to modern Italian compressors and developed a energy guide in Spanish placed on each refrigerator. This represented a major energy savings because about 50% of the loads in newly energized small towns are for refrigeration.

Finally, the project carried out a showcase project in creating an energy efficient neighborhood in which the energy demands of 55 houses were analyzed. Through energy saving measures such as the replacement of incandescent with fluorescent light bulbs, simple conservation practices and improved house wiring, demand loads was reduced over 12%.

3. Alternative energy sources

Originally, the project included development of a pilot hydropower project. An inventory of small hydropower sites was undertaken and four sites were identified as economically viable. But with the absence of adequate laws on nationalization and rates, small hydropower alternatives were not judged as practical to implement.

The project studied the use of wind as a source of electrical generation for isolated rural areas. Fourteen professionals were trained in wind software and carried out extensive wind measurements. The data indicated that wind generation was not financially viable in El Salvador.

Through the Salvadoran Center for Energy Efficiency, the project held an international conference and analyzed biomass cogeneration from sugar cane residues. While cogeneration is technically and legally possible, legislation is needed for adequate rates in selling excess energy to the electrical grid to make it more financially feasible.

In sum, alternative energy sources were found to have several promising uses in El Salvador for specific applications. But, given the country's small size, extension of the electrical grid to rural communities is more economical especially in reaching large unserved populations.

C. Democracy and Reconciliation

1. Civic society

Rural electrification builds a stronger civic society in rural areas. Examples are the strengthening of local governments (e.g., lighting for town halls for evening meetings, police stations, community centers, street lighting). The network of micro-enterprises generates employment in poor rural areas and builds economic opportunities that undergird a democratic economy.

While the economic impacts of rural electrification can be easily measured, the cultural impacts are more difficult to assess. For example, rural people gain access to information and entertainment through television. This provides a "connectedness" to the entire nation and world. Some studies have suggested that rural electrification may result in smaller family sizes as one of its modernizing impacts.

2. Demobilization

Following the civil war, El Salvador is carrying out a major resettlement program for about 20,000 demobilized ex-combatants and thousands of displaced persons. Infrastructure is a critical component in building these new communities to receive them. They expect electricity along with new homes, water systems, roads and other community facilities. A major component of the NRECA project was to identify the

energy needs of these newly planned communities where land has been provided through the Land Bank and funding for resettlement programs by AID, InterAmerican Development Bank and other donors as part of the Peace Accords. The costs of electrification are considerably lower for these communities compared to traditional rural towns where housing is more scattered.

NRECA found that about 80% of these resettlement communities are without electricity or about 16,000 of the 20,000 ex-combatants. The shutdown of the NRECA program will leave these communities unserved because no other electric programs are in place. Thus, electrification will cease and an important component of the demobilization process under the Peace Accords will not be achieved. Without electricity to generate jobs and improved living standards, these former soldiers may turn increasingly to crime. Rather than rebuild their lives in rural areas, they may return to already overcrowded urban centers where electricity (and other services) are available.

3. Extensions to ex-conflictive areas

In 1991, Ambassador William Walker traveled to the guerrilla stronghold of Santa Marta, near the Honduran border; and committed the U.S. Government resources to bringing reconstruction and economic development to the area. This become a showcase for the U.S. Government to demonstrate its sincerity in advancing the peace process and bringing the civil war to an end.

At the USAID mission's request, NRECA altered its work plan and assigned full-time construction staff to build 15 kms of distribution lines to Santa Marta and surrounding towns. This effort became a case study of how to optimize line design, streamline contracting procedures and construction methods to expand electrical coverage at reduced costs. In this case, the project reached 40% more consumers with service than the original design. As a result of this experience, the USAID mission agreed that NRECA was capable of carrying out direct RE construction (rather than mere supervision and technical assistance) when DISCEL within the national utility, with these responsibilities, was disbanded.

Thus in two closely related projects, NRECA/El Salvador carried out reconstruction of electric lines to ex-conflictive areas through the Secretariat for Reconstruction. This project (financed through 519-0394) began in February 1994 and ends on March 31, 1996, totaling $1 million in local currencies. As a result, 92 kms of line were rebuilt in eight towns. Direct beneficiaries were some 56,000 inhabitants in Arcatao, Suchitoto, Aguilares, Apopa, Nejapa, Tonacatepeque, Quezaltepeque and Tecoluca. About 60% of the 9,500 connections were to family-operated micro-enterprises and the remainder to homes. In restoring electricity, the project upgraded systems and introduced major efficiencies.

In addition, the project team supervised construction by the national utility, Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL) of some $10 million in local currencies for 600 kms of line, four substations and 65 towns. Generally, the project provided spot visits to construction sites to assure quality construction. About 50% of connections were to micro-enterprises and some 65 city halls were electrified, supporting the restoration of local government.

4. Electric Cooperative at Perquin (ACAEM)

Located in Perquin near the Honduras border, the cooperative is situated in one of the major centers of the FMLN forces. The cooperative was formed in May 1992. Initially, it provided electricity through a diesel generator and was connected to the national grid in August 1994.

The cooperative has a seven person board and 42 of its 65 members attended its first general assembly. Board members were democratically elected in contested races. The board is composed of ex-combatants, but at an upcoming annual meeting, several non ex-combatants are expected to be elected to bring more balance to the cooperative's leadership. The cooperative is a democratic institution where residents can learn and practice democratic decision-making with direct relevance to their lives.

The cooperative has 10 employees who install house wiring, read meters and provide line extensions and maintenance. All of the board and employees were trained by the

project. NRECA arranged and placed a U.S. Peace Corps volunteer on site who provides the cooperative with administrative support (e.g., accounting, computer training and other administrative support). The next stage of institutional development is for the cooperative to become licensed as a distribution company (soon possible under privatization) and more line extensions to outlying areas.

A project-sponsored demand study indicated a potential service area of about 3,000 people. Currently, the cooperative has about 190 members/consumers. About 60% of its customers are micro-enterprises (115). They include about 80 small stores, five restaurants, three carpentry stores, and one each pharmacy, hardware store, tailor and stationary store. In addition, the cooperative provides electricity to municipal and community institutions including: four schools, a day-care center, five mayor's offices, two police stations, three Justices of the Peace, a telephone company office, two health clinics, four community centers and public/security lighting (21 security lights). A tourist hotel, electric-powered mills for agricultural products and an electric pump for a full-time water system to the town are soon to be connected to the electrical grid.

As a result of electricity, Perquin is undergoing an economic boom and has grown 40% since receiving electric service six months ago. Lights and refrigeration are the heaviest loads. Women have benefited through labor saving devices including an estimated 75 irons (replacing coal irons), 15 refrigerators, 100 TVs and 190 radios. There was been substantial savings in the cost of kerosene and candles (lighting costs went from about 70 to 90 colones per household per month to 15 to 60 colones per household). Additional savings are in the purchasing of less batteries compared to minimum costs of playing a radio with electricity.

According to interviews by the evaluators, residents of Perquin felt safer with public lighting (police reported fewer thefts in lighted areas) and enhanced prestige with having electricity just like major towns. Refugees from Honduras and from the U.S. (20-30) have returned and opened up small businesses. A women's center now carries out evening educational programs. A hardware store sells electric equipment. A dentist clinic operates dental equipment and several computers supplied by the cooperative. Nearly every store and small restaurant sells cold drinks. The sister of one of the

residents came to her home to use a sewing machine which cut her work in half. Televisions help to babysit children while their mothers work in restaurants and stores. Restaurants and a community center stay open at night with new lighting.

3. Meanguera Islands Cooperative

The project helped established another RE cooperative for three small islands in the Gulf of Fonseca with a population of about 4,000. The administrative center, Meanguera del Golfo, had about 300 dwellings with no running water and very limited rudimentary electric service. The long-neglected fishing communities took on significance to the government when a territorial dispute with Honduras came to a head. The extension of electric service was a factor in the decision by the International Court at the Hague that awarded ownership of the islands to El Salvador.

The system involved the laying of three underwater cables and a distribution network including transformers. President Alfredo Cristiani inaugurated the system and the cooperative on February 7, 1991. The project provided technical assistance to the electric cooperative, including help in writing its by-laws. In addition, NRECA arranged for a Irish volunteer to provide the cooperative with electrical technical assistance.

The cooperative is one of the only democratic institutions on the island in which local residents have a direct voice and vote in electing a five member board of directors and in making basic decisions about electric service.

The benefits to the fishing communities are multiple: refrigeration for food, drugs and other products; and freezers to increase incomes from fishing through better marketing when prices are higher. Electricity has helped increase agricultural production in food processing, mulching grinders and the use of electric tools. For example, canoe and boat builders benefited by shifting from hand to electric tools. The island's elementary school also was electrified.

IV. Additional Project Impacts

A. Design Standards

Innovations in RE design standards and methodologies resulted in major project savings which were redirected to other activities such as technical assistance, training, efficiency programs and studies. These design standards were institutionalized through mandatory training of line design consultants in some 25 companies who bid on these rural electric projects. Over 250 construction design books were sold by the project.

The project virtually eliminated all pole clamps and provided less expensive bolt connections which reduced costs per pole from $7-$11 to $.70-$1.20. This saved $9 each for 12,000 poles which would have used pole clamps for a total savings of $108,000 in procurement costs.

Through reducing the number of individual items in construction from 250 to 100 (e.g., fewer cross arms from 5 to 3 designs, cross arm braces from 7 to 2), there was a 10% project savings in materials costs, including warehouse management and lower cost bulk purchases.

Significant savings were achieved through new staking tables that allowed field design engineers to minimize the use of poles through longer spacing over various terrains. Traditional primary pole staking was less than 100 meters; the NRECA project extended the distance to an average of 135 meters. This resulted in major materials savings (e.g., poles, hardware and installation costs) that saved about 35% of construction costs (from $10,000 per average single phase line to $6,500).

B. Training

Initially, the project contemplated training for senior management of the public utility. However, high turnover of this staff resulted in a new strategy to train linemen and lower level supervisory staff. The actual needs of training required a wide variety of

training, especially for design engineers and linemen in the newly introduced, more efficient RE construction techniques.

Other important training carried out by the project were: basic computer training for the demand assessment model; computerized electrical system coordination; use of new staking standards in field designs; quality construction techniques; metering and commercial billings; substation maintenance (reduced high interruptions due to operational problems); lineman safety (resulting in a 16% reduction in accidents in a single year); RE operations; materials management; energy efficiency; decentralized energy alternatives (e.g., biomass from sugarcane, wind power); and cooperative organization, management and governance,

See figure 5 for a breakdown of training types per participants.

The project introduced video training widely used throughout the rural electric systems in the U.S. These videos as well as manuals were adapted to El Salvador and translated into Spanish. The project also conducted train-the-trainer sessions on training materials and audio-visual training techniques, and provided computers for the training center in CEL.

The evaluators interviewed the project trainer, CEL training center staff (3), the coordinator for training of an electrical company, linemen foreman (2) and a lineman. All of the trainees praised the training. The methodology of late afternoon training for lineman permits them to be trained after work hours. The interviewed company plans to continue to pay NRECA for training after the project ends.

C. Procurement System

At start up, the project contemplated using a procurement agent, but instead initiated its own procurement system using host country contracting procedures as a reference and adapting them to grantee procurement. Through bulk purchases of items, the project achieved from 20 to 25% savings, worth about $1.5 million that was reprogrammed to other components.

Through more efficient procurement procedures, the project saved $400,000 through efficient contract administration and the successful application of liquidated damages (late and missing deliveries from suppliers) for an additional 10% savings.

Because of its hands-on contracting methods, the project staff was able to detect two cases of fraud that were referred to the Regional Inspector General for investigation and prosecution. In one case, the project uncovered fraudulent non-U.S. sourced pole-line hardware and inferior meters. In the other case, the staff uncovered fraudulent claims for a substation where testing records had been falsified and did not meet specifications.

Because of its procurement expertise, the USAID mission used the NRECA procurement staff to inventory mission procurement and they uncovered similar substandard equipment (e.g., pole line hardware, insulators, poles, meters and meter testing equipment) that had been procured by the national utility (CEL) through AID financing. Finally, project staff conducted seminars for AID staff in procurement procedures.

D. U.S. Equipment Purchases and Donations

The project resulted directly and indirectly in the purchase of over $8.34 million of imported U.S. equipment. The project itself generated $5.34 million in U.S. equipment procurement ($4.4 million in line construction and $940,000 in equipment and materials such as vehicles, computers, software and instruments). In addition, the project generated $3 million in equipment through the introduction of more efficient electric meters (e.g., $1 million in industrial meters from Schlumberger/Sangamo of Norcross, Georgia, $1.5 million in residential meters from TMD of Waco, Texas and $500,000 in meter reading systems from ITRON of Spokane, Washington). Unusual among AID projects, 97% of the direct project procurement were delivered on U.S. flag carriers, worth about $800,000 to American companies.

The project also spurred the sales of American equipment such as Black and Decker electric tools, GE Refrigerators and Red Jacket pumps.

In addition, about $320,000 (estimated at service value) in refurbished and donated equipment was provided through the NRECA Foundation from the following U.S. electric cooperatives: Oconee, Tallahatchie Valley, Tri-State, Joe Wheeler, Poudre Valley, Adams, East Kentucky, Singing River and Delhi Rural Electric Cooperatives. The shipment of this equipment was mostly financed through AID's Ocean Freight Reimbursement Program (total shipment costs, $64,500). See figure 6 for list of U.S. cooperatives and donated equipment.

V. Sustainability

A. Beneficiaries of Rural Electrification

The project achieved 30,000 electric connections to micro-enterprises and households in rural areas. While currently subsidized, these services will be maintained through consumers paying their utility bills. These services result in on-going benefits. However, the GOES continues to subsidize electric rates at about 79% of costs (or a subsidy of 21%). The national utility (CEL) plans to eliminate subsidies by the year 2000. A 16% rate increase is soon planned to take effect that would reduce the subsidy to 13%.

B. New System Designs and Standards

The NRECA project designs and standards have been adopted by the Secretaria de Reconstruccion Nacional, and four public and three private utilities.

C. Trained Personnel and Training Center

About 2,473 utility personnel have been trained throughout the utility sector of El Salvador who will be on-going resources to private and public institutions involved in electric service. The project has become self-sufficient in its training courses and now trains about 400 lineman per year for a projected gross revenue of $273,000 in 1996. This fee-based training center is expected to continue after completion of the project.

In addition, three of the five distribution utilities have adopted the project's engineering software applications.

D. Cooperatives and Local Foundations

The Meanguera Islands Electric Cooperative is self-sufficient and expected to continue to provide meter readings, collection and maintenance. The Perquin Electric Cooperative is only a few months old and receives some donations (e.g., Oxfam). It is expected to become self-sufficient within a year.

The Salvadoran Center for Energy Efficiency will continue to carry out educational programs, technical assistance and training. In addition, the project created a local Rural Electric Foundation and proposed its capitalization through the sell of excess electrical materials, financed by USAID and not used during the life of project. This foundation has the potential to be locally sustainable.

E Privatization and Sustainability

The GOES is in the process of privatizing its distribution electric service. The NRECA counterpart (DISCEL) in the national utility (CEL) was disbanded in June 1994 as the first step in privatization. DISCEL was responsible for RE construction with some 220 employees (75 of which were reassigned in CEL). The NRECA project picked up the DISCEL responsibilities for virtually all RE construction in January 1995. In addition, GOES has identified the territories for four distribution companies to be privatized. NRECA provided the information to determine the book value of the companies, but stock options for sale have not been made public. The process was supposed to have taken place one and a half years ago; but the timetable has yet to be publicly announced.

With the termination of the NRECA project, nearly all RE construction will be ended in El Salvador (except for some extremely modest InterAmerican Development Bank-funded activities of Fondo de Inversion Social and Secretaria de Reconstruccion Nacional). Newly privatized companies will not be particularly interested in serving non-profitable rural areas.

Today, only about 40% of rural El Salvador is electrified with 2.5 million out of 4.0 million rural residents not served. To reach about 80% of the rural populations would cost about $80 million over 15 years using the NRECA systems. The availability of new funding sources is the major constraint in sustaining future RE construction activities.

VI. Lessons-Learned

A. Flexibility in Project Management

The NRECA El Salvador RE project is a good example of the importance of becoming more customer and results focused. AID and NRECA exhibited a strong partnership under the cooperative agreement. Project flexibility enabled resources (freed up through project designs and tight procurement rules) to be shifted to new priorities as they arose. As a result, project effectiveness was enhanced and more impacts achieved.

AID and NRECA also carried out continuing reassessments throughout the project with 11 amendments that resulted in changed programming to meet unexpected and new challenges. For example, NRECA shifted away from training utility managers because of high turnover of staff and, instead, focused training on more technical subjects. With the project in place, AID and NRECA were able to respond quickly to concentrate on ex-combatant areas and to the disbanding of the NRECA counterpart in the national utility (CEL) at the privatization process began.

Because NRECA is a PVO, AID was able to maintain continuity in the project despite shifts in government policies, new political leadership and high turnover of the management staff in CEL. NRECA also provided AID with strong oversight of its government-to-government RE programs through monitoring of construction, contracting, procurement and inventory controls.

B. Getting Close to Beneficiaries

The project is also an example of getting to know the ultimate beneficiaries in AID-supported development assistance programs. NRECA co-located its offices within the

national utility (CEL) and helped create a consumer services division for productive uses. This meant that rather than focus only on the provision of electricity, CEL and NRECA followed up in newly electrified communities to stimulate productive uses and respond to problems such as houses and businesses that were inadvertently left out of the grid extensions. The productive uses demonstrations provided positive publicity for AID, NRECA and CEL throughout rural El Salvador and demonstrated their ongoing interest and support for rural residents.

Because of the NRECA demand assessment model, discussions on where to provide new electric service were based on objective criteria, rather than politics. It also analyzed constraints such as credit availability of new customers who must pay about $100 each for a connection and home wiring. As a result of this analysis, a revolving credit fund was created with average payments of $12 a month over two years. This made electrification more economically viable to CEL and reduced subsidies while expanding services to lower income customers.

The demand assessment model also enabled NRECA and CEL to rank communities for line extension based on economic and cost benefits. This made clear what lines were more financially feasible and where greater subsidies were necessary to reach poorer communities.

C. Importance of Rural Electrification

The project demonstrates the importance of rural electrification to achieve AID's strategic objectives of broad-based economic development, environmental protection and democracy/reconciliation. The project had major impacts in:

- Micro-enterprise development,
- Rural development and job creation,
- As a significant component of housing, water, roads, health services, municipal decentralization and other projects,
- Resettlement of ex-combatants and displaced persons

- Poverty alleviation, and
- Reductions in migration to urban centers.

If the USAID/El Salvador decides to refocus its programs on poverty alleviation, it may want to reconsider the benefits of rural electrification and include a small component to round out a full array of critical assistance. Rural electrification addresses poverty alleviation through:

- Employment generation,
- Health clinics where electricity is critical to on-site storage of vaccines and medicines and the ability to perform minor operations,
- Schools where lights enable night school for double shifts (rather than build additional schools, adult literacy training and distance learning), and
- Lighted community centers for skill development, evening activities, strengthened local NGOs that must meet during non-working hours, etc.

D. Rural Electrification in the Future

There are a number of trends that make rural electrification more difficult in the future. Governments, including national utilities, are being decentralized and privatized. This results in cutbacks in nationwide, comprehensive programs such as RE. External and host government resources are diminishing for all types of infrastructure projects. Costs of RE programs (e.g., labor, poles and conductors) are rising.

To respond to these trends, future RE programs will have to be:

- More focused on consumers and local rural communities whose participation can leverage additional resources including co-financing and sweat equity.

- Loan programs, rather than grants, for electrification including new financing systems such as private financial organizations (similar to the Cooperative Finance Corporation in the U.S.)

- More cost efficient with optimized design standards to control construction costs.

- More reliant on PVOs and NGOs, such as NRECA and the Salvadoran Center for Energy Efficiency, since newly privatized utilities will be unwilling to extend lines to poor rural areas.

- Responsive to new strategies that take into account the geography and energy resources of countries (e.g., smaller countries with national grids and larger ones with more reliance on alternative energy sources such as wind, solar and hydropower).

- Longer term to keep available qualified rural electric professionals in host governments and supportive NGOs who can stimulate and maintain quality; improve efficiencies; and provide technical assistance to local communities, NGOs, electric cooperatives, municipal governments and others involved with bringing electricity to rural communities.

FIGURE I
PROJECT PERFORMANCE
COMPARISON OF OUTPUTS WITH RESULTS

OUTPUTS/NUMBERS	E.O.P. STATUS	RESULTS	COMMENTS
1) Line Extensions/1000 Kms.	Exceeded	1,030 Kms.	Already at 1,000 Kms: 30 Additional Kms. to be Completed with 3 Month Extension.
2) Improved Distribution Standards/ Costs Reduced by 5%	Exceeded	30-40% savings	Developed and Widely Distributed Line Construction Manual.
3) Improved Management	Exceeded	same as above	Quality control, Optimized Line Design, Improved Efficiencies, and Material Standards.
4) Improved System Operational Procedures/3 in place	Exceeded	15 procedures	Substation Maintenance, Substation and Residential Metering, Equipment and Tool Maintenance etc.
5) Demand Side Management Program/2 DSM Programs Peak Load Reduction 2%	Exceeded	3 new DSM Programs	12% Peak Reductions.
6) Trained Utility Personnel/70	Exceeded	5,000 Man-days	Heavy Emphasis on Lineman Training including Safety, Accident Rate Reduced by 16%.
7) Productive Uses Programs/ 20 On Farm Demonstrations.	Exceeded	162 Demonstrations	49,000 Attendees.
Credit Program In-place/1	Exceeded	2 Credit Programs	Utility Managed Housewiring and Service-drop Program, and Commercial Bank Equipment Program.

FIGURE I
PROJECT PERFORMANCE
COMPARISON OF OUTPUTS WITH RESULTS p2

OUTPUTS/NUMBERS	E.O.P. STATUS	RESULTS	COMMENTS
7) Productive Uses Extension Agents/2	Exceeded	19 Trained	Consumer Services Division Setup in Utility.
8) Mini-Hydro Pilot Project	N/A	N/A	Removed in Response to Mid-term Project Evaluation.
ADDITIONAL OUTPUTS NOT IN PROJECT FRAMEWORK			
9) Energy Efficiency/3 Activities	Exceeded	3	Energy Efficiency Elementary School Training, Efficiency Public Relations Campaign, Efficient Neighborhood Program.
10) Private Distribution Coops/2	Exceeded	2	CoopeMeanguera, ACAEM.
11) Distribution System Strengthening Study	Exceeded	1	Funded with Project Resources at Request of AID. Disregarded by GOES.
12) Surplus Material Donation Program	Exceeded	$385,000	Partially Supported by USAID Ocean Freight Reimbursement Program.
13) SER/Reconstruction Program	Exceeded	92 Kms. Line 8 Towns	$1 Million from 519-0394 Under National Reconstruction Program.
14) SER/Supervision MEA Projects	Exceeded	600 Kms Line 7 Substations 65 Towns	$450,000 from 519-0394 Under National Reconstruction Program.
15) SETEFE "FASE III"	Exceeded	330 Kms. Line 84 Towns	$1.75 Million from 519-0358 from Local Currency. Savings of $1 Million over Initial Design.

Figure 2

Annual Economic Benefits

Year >>	** 1	2	3	4	5	6	7	Total
Consumers/year/connected	0	1,000	3,000	4,000	8,000	4,000	10,000	30,000
Economic Benefit/year	0	$2,640,000	$7,920,000	$10,560,000	$21,120,000	$10,560,000	$26,400,000	$79,200,000
		2.64	10.56	21.12	42.24	52.8	79.2	

** The first year no new connections were made because lines were under construction

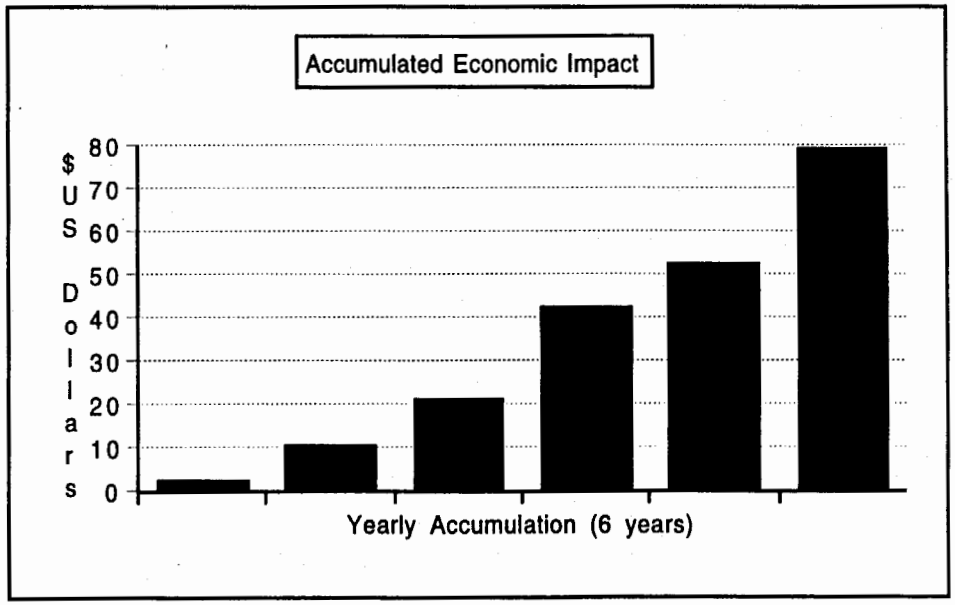

Figure 3

Women Time Savings Due to Electric Grist Mills

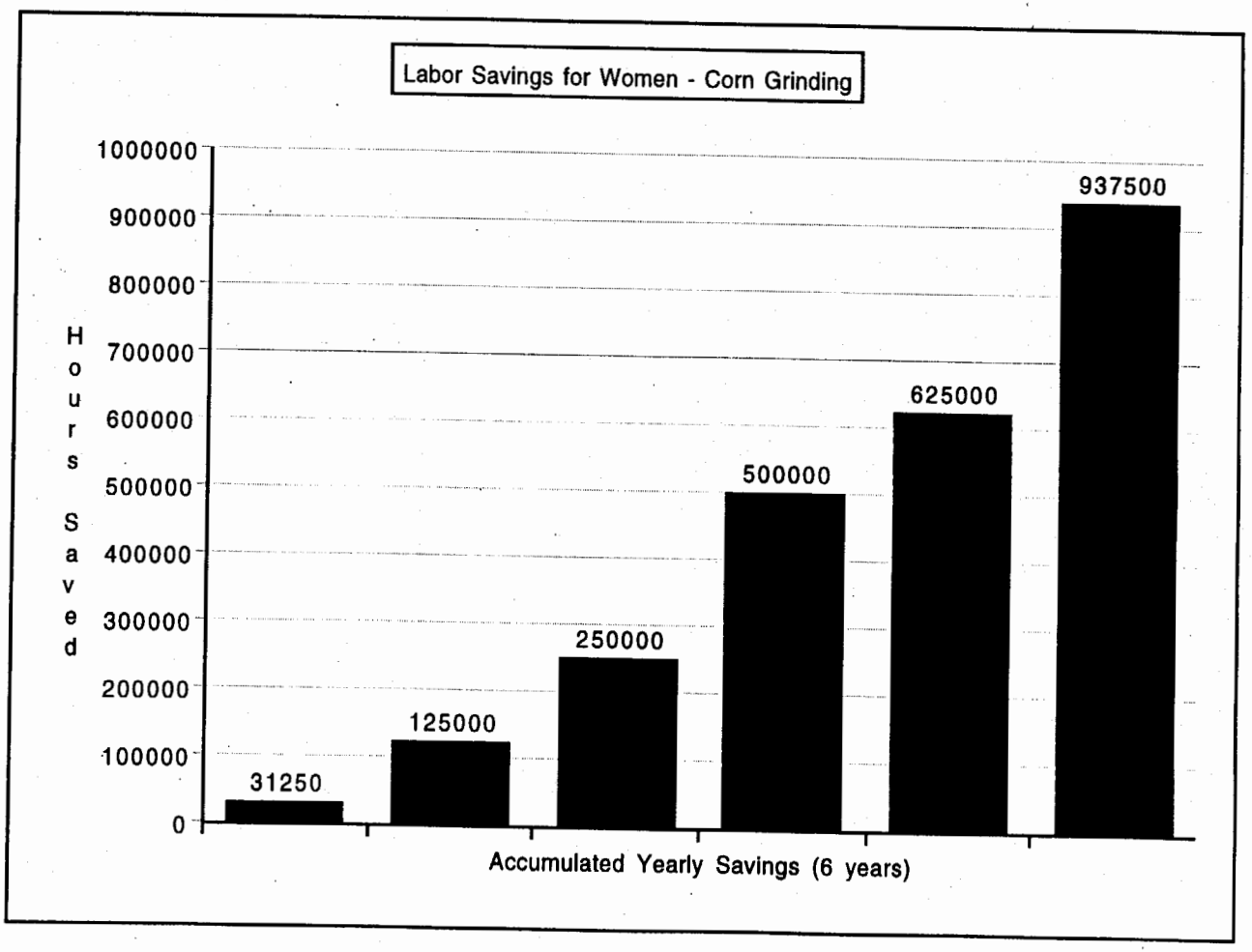

FIGURE 4
PRODUCTIVE USES INFORMATION BREAKDOWN
DURING LIFE OF PROJECT

ECONOMIC ACTIVITY	BENEFICIARIES	SAVINGS/ECONOMIC INDICATORS
1) General Economic	39,000	$79 Million ($4 per KWH Served).
2) Micro-Enterprise	15,600	$51.35 Million in New Businesses.
3) Corn Grist Mills	30,000 Women	937,000 Women-days Saved.
4) Sewing/Ironing	1,500 Women	30,000 Additional Garment Per Year.
5) Carpentry	300 Carpenters	$1.3 Million in Additional Doors.
6) Metal Working	150 Users	$ 1,500 per Week in Machete Sharpening.
7) Animal Feed	150 Producers	156,000 Hours Saved Per Year.

FIGURE 5
TRAINING

Training Area	Contents	Impact	No. of persons
DESIGN	DAM; Basic Data; Computer Software; Staking	improved site selection, construction quality, safety, and reduced cost	562
LINEMEN	Basic Lineman qualification based on US program	Improved construction and operation, reduced accidents	1,243
OPERATION	Substation Operation and Maintenance; metering; Commercial Billing	More reliable operation, less interruptions, better billing	357
MATERIALS MANAGEMENT	Materials Management from procurement to warehousing	Improved construction, efficiency, reduced costs.	60
TRAINING MATERIALS DEVELOP.	Production of Video and written material for training	Training center improved	49
ENERGY EFFIC.	Seminars and courses for Elect. Companies and end users on energy efficiency.	Use of high efficiency equip. and better practices ,reduced energy consumption	151
ALTERNATIVE METHODS	Renewable energy technology, wind power generation, cogeneration using biomass, Privatization Seminar	Obtained wind data, two sugar mills cogenerating. Distribution sector undergoing privatization.	51
			2,473

FIGURE 6
SURPLUS MATERIAL DONATIONS TO EL SALVADOR
DURING THE LIFE OF THE PROJECT

MATERIAL DONATED	DONATING COOPERATIVE	ESTIMATED SERVICE VALUE $	SHIPPING COSTS $
1) Bypass & Disconnect Switches (187)	East Kentucky	50,000	7,800
2) Substation Voltage Regulator	Adams Electric	2,000	1,000
3) Pole-line Hardware & Insulators	Poudre Valley	20,000	6,500
4) Residential Meters (3,000)	Joe Wheeler	15,000	4,500
5) Substation Transformers (4)	Singing River	40,000	13,500
6) Service Pickups (2)	Empire Electric	10,000	5,700
7) Residential Meters (2,000)	Oconee EMC	10,000	6,700
8) Switching Stations (2)	Oconee EMC	20,000	8,800
9) Substation Transformers (4)	Singing River	100,000	9,600
		(Renovation) 8,000	
10) Substation Transformers (7)	Delhi	46,600	6,350
		TOTAL VALUE ---> 321,600	TOTAL SHIPPING ---> 64,100

LIST OF PERSONS CONTACTED

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COOPERATIVA ELECTRICA DE PERQUIN

Sandra Medrano, President of the Board

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Lcda. Julia Saldivar, Human Resources Director

Ing. Rigoberto Garcia, Director of Technical Training

Ing. Georgina de Flores, Electrical Training

Ing. Douglas Guevara, Power line Instructor

CAESS-ORIENTE

Nelson Bonilla, Design Section

CAESS SUR

Ing. Luis Noyola, Chief of Engineering and Design

Ing. Mauricio Figueroa, Operations Chief

Miguel Gomez, Supervisor

Napoleon Rivera, Linemen Supervisor

Luis Alfonso Santos, Lineman

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Stanley Kuehn, NCBA/CLUSA

CRECER, Equitable Rural Economic Growth Activity

Richard L. Clark, Chief of Party

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