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The primary objective of this study was to examine the social and economic impact of rural electrification in selected areas of Costa Rica and Colombia. Secondary objectives were to determine the relationships of rural electrification to infrastructure development; to suggest alternative techniques, methodologies and criteria for measuring social and economic change attributable to rural electrification; to determine the comparative effectiveness of lending to private or state owned or controlled agencies and to rural electric cooperatives; to develop research instruments which may be used effectively for evaluating the impact of rural electrification in different cultural and national settings; and to record benchmark data. All heads of household (or in some case their representatives) were interviewed within the selected survey areas. In Costa Rica, 452 interviews were obtained and in Colombia 443 were completed. Among data obtained from the interviews were characteristics of household members, such as age, sex, occupation, and education, migration and propensity to migrate, exposure to mass media, occupation and employment, land use and ownership, satisfaction with life situation, level of living, and social participation. In addition to the saturation survey of households, case studies of commercial, farm, and agri-business enterprises were conducted. Also, some of the users of electricity surveyed in previous benchmark studies were re-interviewed.

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AN EVALUATION OF EFFECTS ON ECONOMIC AND SOCIAL CHANGES IN COSTA RICA AND COLOMBIA

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RURAL ELECTRIFICATION: An evaluation of effects on economic and social changes in Costa Rica and Colombia

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Washington, D. C.

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PREFACE

Financing distribution of electric energy to rural areas in developing countries is a relatively recent activity. The United States Agency for International Development (AID) was the first to loan funds for this purpose. In 1963 it authorized $400,000 to establish an electric cooperative in Nicaragua.

Since then 11 loans have been made by AID for establishing or expanding electric service in non-urban areas of eight countries in Latin America. Two loans have been authorized to develop electric cooperatives in the Philippines. Three grants have been made to India for the development of electric cooperatives through state agencies. Grant funds also have been made available to Vietnam for village electrification. At the present time, AID has made 18 loans or grants in the amount of $186,490,000 for establishment or improvement of 91 electric distribution systems.

The World Bank Group (the International Bank for Reconstruction and Development and the International Development Association) became the second institution to make an international loan for electrification of rural areas. In 1972 the World Bank Group granted a credit, which contained $450,000 for village electrification, to the Government of Ecuador. The funds are to finance part of the foreign exchange costs needed for electrification of about 15 rural villages in the north and northwest parts of Canton Quito.

Development of the AID and World Bank Group financed projects is providing a unique opportunity to study the effects of electrification on economic and social changes. Such studies were not conducted when rural communities in the United States or other developed countries were electrified. If analytical data on the development value of rural electrification had been available, it would have helped provide criteria for judging the priority of electrification among other capital projects.

Because of the lack of guidelines, feasibility studies of proposed rural electrification projects, largely, have been based on financial projections. While financial costs and benefits can be quantified, they are not an adequate indication of the social and economic impact of rural electrification. Financial projections reveal more about the effect of pricing policy than they do about the project's value to the region.

Social and economic costs, also, can be determined with a relative degree of accuracy, but benefits are more difficult to measure. Emphasis in this study, therefore, has been placed on identifying benefits and, within the time and resources available, developing social indicators to place beside economic measurements. Techniques were developed for adaptation to determining project feasibility as well as in evaluating projects after construction.

Gainesville, Florida
August 31, 1973

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Victor Hugo Cespedes and Alvaro Vargas of the Institute of Economic Investigations, University of Costa Rica greatly facilitated our efforts in constructing research instruments and in conducting the Costa Rican field survey. Oscar Benavides of the Costa Rican Electricity Institute and Bolivar Cruz of the National Bank of Costa Rica strongly supported our study. We would like to especially thank Fredy Arroyo, manager of the rural electric cooperative in San Carlos and Alfredo Chavarria, our chauffeur, for both their support and friendship. The good offices of Oscar E. Mazuera and Alfredo Roa of the Department of Economic Studies, CVC, greatly eased our work in Colombia.

Our computer expert was Oleh Wolowyna. Without his assistance in programming, the analysis would have been substantially curtailed. We would also like to thank Norman Markworth, Terry Jabaly, and Maria Leon for their uniformly superior coding, our typists, Claudia Larimer, Joan Kaputa and Neva Clark, Helen Huseman for designing the cover, and the Editorial Department of the Institute of Food and Agricultural Sciences for publication of this report.

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ABSTRACT

By evaluating the effects of rural electrification on economic and social change in two countries in Latin America, this study attempts to provide a basis for more effective utilization of international loan funds. In the United States benefits of electricity in rural areas were taken for granted. Following World War II, when a major expansion of rural electrification took place, a relatively favorable environment for development existed and financing rural electrification projects was not the principal problem. But in developing countries resources are scarce and alternative uses of available funds must be considered carefully.

Objectives

The primary objective of this study was to examine the social and economic impact of rural electrification in selected areas of Costa Rica and Colombia. Secondary objectives were to determine the relationship of rural electrification to infrastructure development; to suggest alternative techniques, methodologies and criteria for measuring social and economic change attributable to rural electrification; to determine the comparative effectiveness of lending to private or state owned or controlled agencies and to rural electric cooperatives; to develop research instruments which may be used effectively for evaluating the impact of rural electrification in different cultural and national settings; and to record benchmark data.

Methodology

The basic approach of this study was to select areas in both Costa Rica and Colombia that were relatively homogenous in all respects with the exception of the availability of central station electricity. Populations of users and non-users of electricity were identified, including a sub-group labeled non-adopters--those within an electricity service area who had not connected to the distribution lines. The objective of this approach was to establish a comparative basis by which the socio-economic impact of rural electrification could be analyzed.

All heads of household (or in some cases their representatives) were interviewed within the selected survey areas. In Costa Rica, 452 interviews were obtained and in Colombia 443 were completed. Among data obtained from the interviews were characteristics of household members, such as age, sex, occupation, and education, migration and propensity to migrate, exposure to mass media, occupation and employment, land use and ownership, satisfaction with life situation, level of living, and social participation.

In addition to the saturation survey of households, case studies of commercial, farm, and agri-business enterprises were conducted. Also, some of the users of electricity surveye' in previous benchmark studies were re-interviewed.

Socio-Economic Impact

Analytical techniques for measuring the socio-economic impact of rural electrification concentrated on the statistical differences between households designated as electricity users, non-adopters, and inaccessibles--those beyond the reach of the distribution lines. The social or economic impact of technological change is often subtle and may, as with education, develop only over extended time periods. Causality beyond a doubt can rarely if ever be definitively demonstrated in the social sciences. No such claim is made for any of the findings.

Social Indicators. Various social indicators, beneficial to the well-being of rural inhabitants appear to be closely associated with the adoption of the domestic use of electricity. The association is shown through indexes developed to quantify level of living, satisfaction with life situation and mass media exposure.

The level of living (a non-cultural specific scale based upon the performance of basic household functions) is the variable most consistently associated in a positive relationship with the use or non-use of electricity. Another variable, mass media exposure, is also positively associated with both the level of living and electricity use. A third variable, satisfaction with life situation, indicated that users of electricity are more satisfied than either those who do not have access to electricity or those who have access but have not become users.

It is probable that all three variables interact to some extent with one another. Unidirectional causality between two variables to the exclusion of all others, however, does not negate the value of findings for the purpose of obtaining sound guidelines for policy. For example, it is noteworthy from a policy-making viewpoint that the use of electricity provides perceived social benefits for the users and creates a sense of relative deprivation for the non-users.

In addition to the above relationships, data from the household survey revealed:

-- electricity users were generally better educated than were non-users. Data suggest that when a rural area is electrified it is usually the better educated members of the population living along distribution lines who are more likely to connect.

-- farm operators are more likely to be electricity users than are farm laborers. Within electrified areas, the highest percentages of consumers, according to occupation, are found among merchants, teachers, and farm operators. Thus those who, because of occupation, can most profitably utilize electricity are most likely to become electric consumers.

-- electricity users tended to own larger farms than non-adopters. In Costa Rica, power users were more prevalent among livestock producers than among agronomic farmers.

-- no association was found between electricity use or non-use and the following variables included in the saturation survey: age of household head, migration, home industry, use of leisure time, bedtime and time of getting up in the morning.

-- some 90 percent of the non-users stated they would use electricity if they had the opportunity. However, in areas where electricity was available, only about two-thirds of all households had become users.

-- electricity use in the household, for the vast majority of respondents, was primarily for lighting and ironing. Ownership of refrigerators, television sets, electric stoves and other larger appliances was concentrated among those in higher socio-economic positions.

-- roadblocks for adoption of electricity by the rural population appear to be both social and economic. Although adoption of the use of electricity is not necessarily a function of economic means, data do indicate that once the decision to use electricity has been made, the level of average monthly electric consumption is more closely related to economic means. On the average those using more than 40 kwh of electricity per month for household purposes were appreciably younger and better educated.

Resource Savings. To determine the cost of energy sources as well as comparative expenditures between electricity users and non-users, respondents were questioned about their use of candles, kerosene, and bottled gas. Distributor records were examined to determine electricity consumption. The cost of firewood for cooking was not estimated since most households provided their own without incurring any direct expenditures.

For Costa Rica, average monthly expenditures for candles, kerosene, bottled gas, and electricity were estimated at US$2.49 for electricity users. The average monthly cost of candles, kerosene, and gas for all non-users of electricity was US$1.05. The difference in energy costs was largely due to a comparative direct cost advantage of candles over electric lighting. The cost comparison, however, does not take into consideration the quality, dependability, and convenience of electricity for lighting and other household purposes.

In Colombia, electricity users also had higher expenditures (US$2.54) for candles, kerosene, and electricity than non-user expenditures (US$2.23) for candles and kerosene. In this case, however, the difference was due to a greater ownership of kerosene stoves by electricity users and consequently greater expenditures for kerosene. Because of the low electric rates in Colombia, electricity appeared to be cheaper for household lighting than candles, based on the stated expenditures of non-users of electricity. (In Costa Rica, 40 kwh of electricity for household purposes cost US$1.50 compared to US$0.66 in Colombia.)

The major economic benefit of central station electricity for farm, business and industrial use was its cost compared to obtaining energy from privately-owned diesel plants. By comparing the cost of private generation immediately prior to energization with the cost of central station power for an initial operating period of seven months, a cost comparison was calculated for several plants in Costa Rica. Where such comparisons could be made, results showed central station electricity was substantially less expensive than the fixed and operating costs of private generating units. Furthermore, it was not uncommon for respondents with small generators to indicate they could not use all the electric appliances they owned at one time without overloading their system.

Increased Productivity. Productive functions that could not be carried out with alternative energy sources were made possible by central station electricity. Findings of the study showed that the availability of central station electric power contributed to increased productivity of dairy farms. The use of cooling equipment permitted marketing of higher quality milk, with less contamination and spoilage at the farm level. This increased returns to milk producers. Productivity gains and some reduction in labor costs were beginning to be realized in Costa Rica with the introduction of electric milking equipment. In Colombia, however, various government policies were causing a decline in the dairy industry near Cali, despite the availability of electricity.

Most sugar and coffee mills were utilizing private hydro-electric energy sources in the study area in Costa Rica and comparative economic benefits of central station electricity were limited. Because of minimum demand charges, these operations were not willing to use central station power as long as their own plants were functioning. When replacement or expansion of existing systems becomes necessary, central station power should have a comparative advantage.

Power for irrigation was the primary productive use of electricity on farms surveyed in Colombia. Many farm owners had changed or were in the process of changing from diesel to electric motors. They cited the advantages of electric motors as lower initial cost (including transformer and switches), lower maintenance cost, reduced labor input for operating the motors, and avoidance of delays in irrigating during critical periods while waiting for parts to repair diesel motors.

Investment, Employment and Income. An easily over-looked benefit in rural areas of central station electricity is its effect on investment by commercial, farm, or industry operators. With a constant and relatively unlimited supply of energy, new or existing firms may begin or expand operations and have their gradually increasing energy needs met without the necessity of heavy initial outlays for generating equipment.

Use of central station power has not led to an appreciable displacement of labor in any of the study areas. The slight reduction in demand for labor in the dairy industry is expected to be offset by absorption of displaced labor in other farming activities. Central station electricity, except for a few small rural industries, has not yet been effectively utilized to create substantial new employment. Until alternative employment opportunities are developed, whatever labor is saved through the use of electricity cannot be exploited profitably except during peak seasonal harvesting periods.

Skilled dairy farm workers in Costa Rica were receiving increased wages as a result of rural electrification. Small farmers should increase their incomes as planned processing plants, such as for yuca, become operational and provide improved markets. One of the greatest income equalizing effects from rural electrification is for small merchants who can now afford to refrigerate soft drinks and compete with larger merchants who previously owned private generators.

Infrastructure Development

Construction of a rural electrification project is affected by and has an impact on other infrastructure development. The objective is to initiate electrification projects when a higher infrastructure level can most aid electricity utilization and the infrastructure projects in turn receive the maximum development boost from the availability of electric energy. This suggests a minimum level of infrastructure prior to rural electrification which will vary with development objectives.

As a minimum, a basic road network is essential to facilitate construction and maintenance of the electric distribution system. The quality of road networks for effective utilization of electricity will depend on the extent to which electric energy can be utilized for processing and marketing of agricultural products and for rural industrialization.

Electricity contributes to the development of educational and health facilities to the extent personnel and funds are available. Without funds and personnel for purchasing equipment and providing services, electricity cannot be utilized effectively to provide minimum levels of health and education services.

Comparative Systems

Rural electrification in developing countries, generally, is characterized by low consumption and a low load factor of energy use. Direct financial returns on electric supply and distribution investments, consequently, also are low. In some cases, the returns may not be sufficient to cover operation and maintenance costs. On the other hand, high rates will deter energy consumption and defeat the basic objectives of rural electrification.

Determining the most efficient organizational mechanism for distribution of electricity, therefore, is crucial. With few exceptions, private electricity suppliers rarely extend distribution lines to less profitable rural areas. Thus, rural electrification in developing countries almost always requires government support. The general pattern has been for the State or National Government to supply electricity directly to the most promising rural areas or indirectly through creation of rural electric cooperatives.

In the four areas studied in Costa Rica and Colombia, two were serviced by cooperatives and two were administered by government agencies--one a municipal system and the other a state system. Neither of the government-owned systems appeared to exert any impact on development beyond that of providing electricity. Neither, apparently, had the cooperative form of ownership. During the formative years of both cooperatives, awareness of cooperative principles generally was high because of organization meetings. Following energization, however, consumer education apparently lapsed. In the formative stages the cooperatives apparently had been successful in achieving a higher rate of adoption of electricity than the government-owned systems. Another advantage of the cooperative mechanism, from the operational standpoint, was lower line loss resulting from theft of electricity.

Cultural, social and economic factors differ by country and even by area within a country; therefore, each area to be electrified should be appraised separately. Consideration should be given to various organizational structures in order to determine which type of distribution system would best meet the needs of the local area.

Application of Findings

Findings of this study may be applied to the conduct of project feasibility and evaluation studies. Certain factors emerge as having significance for the adoption and use of electricity, and hence impact on economic and social development. For example, when an area is being considered for a rural electrification project or an on-going project is being evaluated, data pertaining to occupation, age and education of the potential and/or existing consumers should be obtained. Size and type of farm, the land tenure arrangement and alternative energy sources and costs should be included in the appraisal process. In addition, it is recommended that data be gathered to permit construction of three social indicators --the level of living scale, satisfaction with life index and mass media exposure index.

These data, along with the methodologies and techniques for obtaining and analyzing the data, should add perspective to current guidelines for capital project appraisal.

CHAPTER I

INTRODUCTION AND SUMMARY

It is evident that in the United States rural electrification has had a significant impact in rural areas. The availability of electric energy has meant labor saving electrical appliances could be used within the home alleviating burdens of the homemaker and permitting her to engage in other activities with the time thus saved. Especially in certain types of agricultural operations, such as dairy and poultry production, electricity has become an important, if not indispensable, factor in the efficiency of production. Industries have been able to locate in rural areas by virtue of the availability of electricity. It is safe to say that rural electrification in the United States contributed substantially to the improvement of the quality of life in rural areas and to some degree to the efficiency of agricultural production.

In general, the benefits of rural electrification were taken for granted in the United States and the advisability of extending electric distribution lines throughout the countryside was rarely questioned. It should be remembered, however, that the major expansion of rural electrification occurred in the United States during the 1940's and beyond in a highly favorable economic and social environment. The economic means to finance electrification projects was created through the Rural Electrification Act of 1936 and potential users of electricity in rural areas worked diligently to organize cooperatives and contribute to construction costs to whatever extent possible. The introduction of electricity into homes and onto farms resulted in ever more diverse uses for electric energy. At a national level, the other demands placed upon the body politic for the provision of services to the population were not such as to compete seriously with the demand for electricity in rural areas nor was the expenditure for rural electrification of such magnitude as to require the serious curtailment of other projects in a nation that was already highly developed and which had relatively few pressing needs for investments in the social or economic infrastructure.

It must be remembered that the Rural Electrification Administration (REA) was created in a depression period and developed following World War II--both conditions were influential in American agriculture. On the technological front, the payoff from research initiated by the land grant colleges and experiment stations began to be felt. The war effort created a demand for labor off the farm and thus made it more economical to utilize labor saving electrical equipment in farming operations. Rising farm incomes also permitted the purchase of more farm machinery and home appliances.

The developing nations of Latin America do not, at present, enjoy this favorable set of circumstances. Development funds are in short supply and alternative uses of available resources must be carefully considered. Multiple demands for investments in new industry, roads, health services, educational services, colonization projects and a multitude of other developmental endeavors clearly point to the advisability of careful assessments of the economic and social consequences of each kind of investment, given the scarcity of resources. While this study in no way attempts to compare the returns of rural electrification with those of other investments, it does attempt to answer questions concerning the impact of rural electrification in social and economic terms.

Objectives

The primary objective of this study is to examine the social and economic impact of rural electrification in selected areas of Costa Rica and Colombia. Secondary objectives are to determine the relationship of rural electrification to infrastructure development; to suggest alternative techniques, methodologies and criteria for measuring social and economic change attributable to rural electrification; to determine the comparative effectiveness of lending to private or state owned or controlled agencies and to rural electric cooperatives; develop research instruments which may be used effectively for evaluating the impact of rural electrification in different cultural and national settings; and the recording of benchmark data.

The study is designed to provide a basis for more effective utilization of AID loan funds for distribution of electric power in the rural areas of developing countries. Thus, it examines previously assumed benefits of rural electrification through extensive interviewing of electricity users and non-users in Costa Rica and Colombia. It also, presents characteristics of areas and respondents on which future feasibility or evaluation surveys may focus.

Methodology

Previous studies of rural electrification conducted in the United States have been primarily concerned with technical and engineering aspects, with the history and politics of rural electrification and with utilization of electric energy. Previous studies in Latin America have attempted to determine initial impact of cooperative rural electrification, primarily, by projecting energy utilization. This study is the first to attempt to evaluate the social and economic benefits of on-going projects. It is based on an intensive examination of social and economic factors among users and non-users of electricity in rural areas serviced by two electric distribution systems, with supplementary observations from two additional systems.

The four study areas were selected from projects located in Costa Rica and Colombia. Detailed surveys were made of a rural electric cooperative in San Carlos, Costa Rica and a state owned distribution system in the Cauca Valley of Colombia. Supplementary observations were recorded from a municipal distribution system in Cartago, Costa Rica and a rural electric cooperative in the Sevilla-Caicedonia area of Colombia. Previous studies of pilot rural electric cooperatives in both countries provided some baseline information. Also, previous contacts with local government officials and electric institution personnel were instrumental in obtaining host country cooperation.

The study relies principally, although not exclusively, on survey research for the bulk of its data. The major dependent variable employed is the use or non-use of electricity which is termed the users variable. The populations interviewed are divided into three categories according to their use or non-use of electric energy. USERS are those who are connected to a major central distribution network; NON-ADOPTERS, those who are within reach of power lines but have not connected; and INACCESSIBLES, those who live beyond the reach of power lines. In Costa Rica and Colombia homogeneous rural areas were identified in which these three types are found. The INACCESSIBLES who, because of the homogeneity of the study area are essentially similar to USERS and NON-ADOPTERS in major respects, serve as a control group. Differences found between the USERS and the INACCESSIBLES may be attributable to the impact of rural electrification. A survey schedule, a list of questions to be asked of respondents by interviewers, was developed at Florida and revised in the field--in Costa Rica and then again in Colombia. In each country, trained interviewers were utilized to collect the data. In Costa Rica 452 interviews were obtained and in Colombia, 443. Re-interviews were conducted in Costa Rica to verify the reliability of the data obtained through interviews.

Whenever possible the head of the household was interviewed. Data were obtained on the basic characteristics of members of the household, such as age, sex, occupation and education; on migration and propensity to migrate; on exposure to the mass media; on occupation and employment; on land use and ownership; on type and size of farm; on residential, commercial and agricultural use of electricity; on satisfaction with life situation; on level of living; and on social participation. The data were coded and transferred to computer cards for analysis.

Additional data were obtained through interviews with the owners or managers of selected large agricultural units, both in Costa Rica and in Colombia, and with those that had been interviewed some years earlier during previous studies.

Indexes were developed to quantify level of living, satisfaction with life situation and mass media exposure. Typologies were developed for size of farm, and type of farm.

Electric and alternative energy consumption was analyzed to determine expenditures for household energy between users and non-users of electricity, the increase or decrease of electricity consumption over time, and the energy consumption of selected appliances.

Comparisons of management structure, member relations, and handling of service line extensions were made for the state, municipal and cooperative forms of power distribution. Benchmark and current data were compared for the cooperative systems in Costa Rica and Colombia.

Description of Study Areas

The principal Costa Rican study area is located in tropical lowlands, an area of high rainfall and humidity distributed throughout the year. It has been settled relatively recently and much virgin land still remains in and beyond the area. Diversified crop and livestock activities are found and stands of timber provide an important forest resource. Coffee, yuca, maize, and sugarcane, are among the crops grown and dairy and beef cattle are also produced. The farms included in the interview survey range in size from less than two manzanas(one manzana equals .64 hectares) to 100 manzanas or more. They were classified as belonging to a variety of types: coffee, mixed agriculture, livestock and dairy, etc. There are a few large plantations devoted to sugarcane and other commercial cash crops. The nearest city of any size is Ciudad Quesada, an agricultural trade center of some 20,000 inhabitants. The nearest metropolitan area is San Jose, the country's capital, about eight hours away by road from the farthest survey point.

The main Colombian study area is also located in a tropical area, but about 2,000 feet above sea level in the broad valley of the Cauca River. Rainfall is seasonal with distinct dry and wet seasons. It is an area which was inhabited and cultivated in pre-Colombian times and in which agricultural activity continued following the Conquest. Large sugar estates dominate the area commercially and agriculturally although livestock is also raised on large landholdings. The farms included in the area where the interview survey was conducted are considerably smaller on the average than those found in Costa Rica. Ninety-six percent are under ten hectares, or 24.7 acres in size, and more than half are under five acres in size. A variety of crops is grown on all these farms which are essentially of the same type and much of the production is destined for household consumption. It appears that these small farms were made available by large land owners as a means of assuring a resident labor supply, and owners of the smaller plots, particularly, work part-time on nearby plantations. The area is within the zone of influence of Cali, a metropolis of one million inhabitants, which can be reached by public transportation in an hours time or less, and of Palmira, an urban center estimated to have 180,000 inhabitants.

A major difference between the Colombian and Costa Rican survey research areas is the length of time that electricity has been supplied to the rural population. In Colombia some areas have been served for as long as twelve years, many for close to ten years, while in Costa Rica the area has, generally, been energized for about three years, and at the extremities of the distribution system for a shorter period of time.

Social and Economic Impact

The following summary synthesizes the major findings of this report as determined by intensive surveys of users and non-users of electricity in project areas of Costa Rica and Colombia. The reader interested in fuller definitions, greater detail and more extended discussion is referred to the body of the report. Following the presentation of analytical results and inter-country comparisons are the interpretation and implications of these findings based on the considered judgment and observation of the research team.

Socio-Economic Factors

Education. As compared to NON-ADOPTERS and INACCESSIBLES, USERS are better educated. In both Colombia and Costa Rica the difference in educational level, as measured by the number of years of school completed, between those who had connected to power lines and those who had not was considerable. The data suggest that when a rural area is electrified it is, on the average, the better educated members of the population living along the lines who connect. In both countries, there were USERS at every educational level. However, the probability that a person would connect increased with his education. Concurrently, the probability that a person living in an electrified area would not connect increased with decreasing educational attainment.

Occupation. Farm operators are more likely to be connected to an electric distribution line than are farm laborers. Within electrified areas, the highest percentages adopting, according to occupation, are found among merchants, teachers and farm operators. Of the 47 merchants interviewed in the electrified areas of Costa Rica and Colombia combined, all but three were receiving electric service from a central source. It appears that the availability of electricity may have an equalizing effect among merchants. In the absence of central source electricity the more prosperous merchants can enhance their economic advantage by installing private generating units. The cost of connecting to a power distribution line is more nearly accessible to all.

Level of Living. The level of living was measured by a scale which is based upon the performance of basic household functions. These are water storage in the house, transportation of water to the house, storage of perishable foods, cooking facilities, means for cleaning floors, means for washing clothes, means for human waste disposal, personal transportation means, lighting, shelter as reflected by materials used for the construction of the front wall of the house, the floors and the roof, means for washing dishes, and means for bathing. A household could score from low (1) to high (5) on the performance of each of these functions. Thus, for instance, with regard to means used for cooking, none or three stones on the ground scored 1 while an electric or gas range scored 5, with other cooking devices ranked from 2 to 4. The score based on all of the functions listed above is referred to as LEVEL. To avoid a possible electricity bias, an electricity-free level of living scale was devised (LEVELNOE) which simply removed from consideration those household functions such as storage of perishable foods, means for cleaning floors, means for washing clothes, means for washing dishes, and lighting, which can only be performed at level 5 with the aid of electricity.

Users of electricity in both Costa Rica and in Colombia had significantly higher scores on LEVEL and LEVELNOE than did INACCESSIBLES or NON-ADOPTERS. In both countries the probability that a household would be electrified increased with its LEVELNOE score, while the reverse was true for households in the INACCESSIBLE and NON-ADOPTER categories. Control variables were introduced in Costa Rica and in Colombia, to determine their effect on LEVELNOE. For Costa Rica these were age of household head, education of household head, size of farm and number of persons per household. The first three of these were used as controls for the Colombian data. The control variable was used as a device to compare the LEVELNOE of USERS, INACCESSIBLES and NON-ADOPTERS, while holding the control variable constant. Thus, for instance, the LEVELNOE of households in each of the three user categories can be compared for those household heads having the same educational level, for instance 5 or 6 years of schooling. Similarly the same can be done for heads of households in the same age brackets, etc. In both Costa Rica and Colombia, although the education of the head of the household was positively related to his LEVELNOE score, USERS consistently had higher LEVELNOE scores than INACCESSIBLES or NON-ADOPTERS who had completed the same number of years of school. In both Costa Rica and Colombia there was no relationship between age of household head and LEVELNOE. However, USERS consistently scored higher on LEVELNOE than did INACCESSIBLES or NON-ADOPTERS regardless of age. In both Costa Rica and Colombia size of farm was positively associated with LEVELNOE. Yet, once again, when size of farm was controlled for, USERS continued to score higher on LEVELNOE than did INACCESSIBLES or NON-ADOPTERS. Finally, in Costa Rica no relationship was found between size of household and LEVELNOE, but USERS scored higher on this measure regardless of size of household than did household heads in the other two categories.

Satisfaction with Life. A new measure, satisfaction with life situation was developed for use in this study. Respondents were asked to compare their present life situation, stating whether it is much worse, worse, better or much better, with: (a) that of their father, (b) their own five years earlier, (c) that of their neighbors (d) their expected life situation five years into the future and (e) that which they expected for their children when they grow up, or, if applicable, that which they expected for today's children when they grow up. A reply of "much worse" was given a value of 1, of "worse" a value of 2, "same" 3, "better" 4 and "much better" 5. The arithmetic mean of these values is termed the total satisfaction with life situation score or SIT TOT.

In both Costa Rica and Colombia USERS scored higher on total satisfaction with life situation than either INACCESSIBLES or NON-ADOPTERS. The differences were greater in Costa Rica than in Colombia. Variables were again controlled to examine the effect this would have on the observed differential in SIT TOT scores between USERS and others. In Costa Rica and in Colombia these were age of household head, education of household head, size of farm and LEVELNOE. In Costa Rica the higher SIT TOT scores of USERS persisted when each of these controls was used. In Colombia, however, when the variables mentioned were controlled, the differences in the SIT TOT scores of each user category became erratic and no consistent relationship was found between these scores and the users categories.

Mass Media Exposure. A mass media exposure index was constructed based on degree of exposure to magazines, newspapers, radio and television. In both Costa Rica and Colombia, mass media exposure was found to be positively associated with electricity use. The availability of electricity explains only part of the difference since transistor radios were common in the homes of INACCESSIBLES and NON-ADOPTERS and most television viewing occurred away from home in stores or in the homes of friends. Mass media exposure was also found in both countries to be positively associated with LEVELNOE and SIT TOT. Each of these, in turn is positively associated with electricity use.

Social Participation. Social participation as measured by membership in organizations was found to be minimal in Costa Rica and in Colombia. Data indicate that in Costa Rica membership in the electric cooperative was mainly a means to obtain service. Based on research population response, the cooperative had little meaning for its members beyond being a supplier of electricity.

Farm Size and Type. In both Costa Rica and Colombia USERS owned larger farms than NON-ADOPTERS. In Costa Rica USERS were more prevalent among producers of livestock than among farmers whose principal production was of crops, a finding which is consistent with the larger size of USERS' farms. In Colombia all farms in the survey were of the same type--small general farms.

Lottery Question. The Colombian survey schedule included two "lottery" questions. Respondents were asked what they would do with lottery winnings of 3,000 pesos (US$150) and of 15,000 pesos (US$750). When the responses were grouped into the categories of farm and home, savings, family and children, and other, it was found that a larger proportion of NON-ADOPTERS than of USERS or INACCESSIBLES would invest in farm and home, a finding consistent with their lower level of living and smaller farms. The same difference is found at the 15,000-peso level, but a larger proportion of household heads in each user category would invest in farm and home if this amount were won.

Services. The Colombian respondents were also asked a series of questions regarding services: (1) "What thing or service do you need most to improve your life?" (2) "What ought the government do to improve this community?" (3) "What services do you receive from the government?" The responses to the first question fell into six specific categories: improved housing, farm improvements, more money, more work, more services in general such as water, sewage, roads, electricity, and "other." The principal difference between user categories was the more frequent mention of housing by NON-ADOPTERS, a finding also consistent with their low level of living scores. It is also not unexpected that INACCESSIBLES mentioned electricity more frequently than persons in the other two user categories. When asked what the government ought to do to improve the community the most frequently mentioned item was services. This need was felt especially by the INACCESSIBLES, more than one-third of whom mentioned services. Items related to agriculture were mentioned by more USERS than INACCESSIBLES or NON-ADOPTERS. When asked what services they received

from the government, the overwhelming reply of the respondents was "none." This was the response of nearly two-thirds of the total. Electricity was mentioned by 19 percent of the USERS, none of the INACCESSIBLES, and two percent of the NON-ADOPTERS. These NON-ADOPTERS may indeed have been receiving free electric service by tapping into lines without the use of meters.

Indeterminate Variables. No association was found between electricity use or non-use and the following variables included in the saturation survey: age of head of household, migration, home industry, use of leisure time, bedtime and time of getting up in the morning. Additionally, there was no productive use of electricity made on any of the farms included in the intensively surveyed areas.

Use of Electricity. Examination of the use of electricity as demonstrated by appliance ownership revealed 96.5 percent of surveyed USER respondents in Costa Rica owned electric irons. Percentage ownership of major appliances was: refrigerators, 27.5; television sets, 24.6; electric stoves, 18.7; and washing machines, 16.4. Ownership of all appliances was considerably more limited among electricity users in the Rozo, Colombia area. Corresponding percentage ownership of appliances for these respondents was: irons, 76.6; refrigerators, 10.6; television sets, 11.1; electric stoves, 7.7; and sewing or washing machines, 1.7. The use of electricity for household lighting was universal. However, 66 percent in Costa Rica used three or fewer bulbs (generally of 50 watts or less), while 58.1 percent in Colombia used five or less bulbs for household lighting.

These appliance ownership figures follow the use of central station electricity for less than one year by 25 percent of all user respondents. In Costa Rica, 42 percent had received Cooperative power from one to two years, and 27 percent from three to four years. Central station electricity had been available over a longer period in the Rozo area. Thus, 49 percent had used CVC energy for one to two years, 10 percent from three to four years, and 18 percent five years or more.

When major appliance ownership was examined in relation to respondent occupation, it was found that ownership of stoves, refrigerators, and television sets was concentrated among those having higher socio-economic occupations. This concentration was somewhat greater in Costa Rica than in Colombia. While 40 percent of COOPELESCA members owned at least a stove, refrigerator, or television set, only 20 percent of those in the Rozo area owned one of these appliances. In both countries, of those owning at least one of these major appliances, nearly 20 percent owned all three.

Reflecting the ownership of appliances in both areas, were responses concerning the use and importance of electricity in USER households. Lighting was the most important perceived use of electricity, followed by ironing. Similarly, respondents stated that the major problems of a prolonged power failure would involve lighting and ironing. In relation to more extensive use of electricity, 90 percent had no plans to purchase additional household appliances.

The expected use and advantage of electricity among non-users (both NON-ADOPTERS and INACCESSIBLES) was similar to that for USERS. Thus, non-users considered lighting and ironing the primary use of electricity in their households if it were available. In Costa Rica, NON-ADOPTERS were less likely to consider electricity an economic advantage than were INACCESSIBLES.

Alternative Energy Costs. A common characteristic of households in the rural areas of developing countries is a relatively low level of energy consumption. To determine the cost of these energy sources as well as comparative expenditures between electricity users and non-users, respondents were questioned concerning the use of candles, kerosene, and bottled gas. Distributor records were examined to determine user electricity consumption. The cost of firewood for cooking was not estimated since most households provided for their own without incurring any direct expenditures.

For Costa Rica, average monthly expenditures for candles, kerosene, bottled gas, and electricity were estimated at US$2.49 for electricity users. The average monthly cost of candles, kerosene, and gas for all non-users of electricity was US$1.05. This difference in energy costs was largely due to low electricity use primarily for household lighting, where candles had a comparative direct cost advantage. However, the cost comparison does not take into consideration the quality, dependability, and convenience of electricity for lighting and other household purposes.

In Colombia, electricity users also had higher expenditures for candles, kerosene, and electricity (US$2.54) than non-user expenditures for candles and kerosene (US$2.23). In this case, however, the difference was due to a greater ownership of kerosene stoves by electricity users and consequently greater expenditures for kerosene. Because of the low electric rates in Colombia, electricity appeared to be cheaper for household lighting than candles, based on the stated expenditures of non-users of electricity. (In Costa Rica, 40 kwh of electricity for household purposes cost US$1.50 compared to US$0.66 in Colombia).

Characteristics Related to Electricity Consumption. Since household electricity consumption normally increases over time, it was necessary in the analysis of characteristics to select survey respondents who had the use of central station electricity for a comparable period of time. In Costa Rica, it was possible to conduct this analysis for 65 COOPELESCA members having had electricity for nearly four years.

Results showed the major differentiation in characteristics between levels of electricity consumption occurred around the 40 kwh per month point. Those on the average using more than 40 kwh of electricity per month for household purposes were appreciably younger, better educated, and included a higher percentage of teachers and merchants. (All three of these characteristics of course may well be closely interrelated.) Experience with electric service prior to the Cooperative and the ownership or amount of land did not clearly differentiate electricity consumption levels for these respondents. Household electricity consumption

increased by 3.5, 7.0, and 3.6 percent following the first, second, and third years, respectively, of service for the respondents on which the characteristics analysis was based.

Electricity users in Rozo, Colombia were more widely distributed with respect to the number of years of continuous service. The largest group on which to base an analysis of electricity consumption were respondents with central station service for only two years. The relatively small sample resulting was analyzed around the 40 kwh per month average electricity consumption point. In contrast to Costa Rica, those using an average of more than 40 kwh were somewhat older and had slightly less formal education. The majority in both consumption groups were small farmers.

Inter-Country Comparisons

Demographic Characteristics. The Costa Rican survey population is considerably younger than the Colombian. This is no doubt a reflection of the fact that the Costa Rican survey area is still in many ways a pioneering area with new lands available for occupation and employment opportunities in agriculture which attract migrants. The reverse is true of the Colombian area, long settled, static, and an exporter of people. Consequently the median age of USERS was 38.6 years in Costa Rica and 47.1 years in Colombia; for INACCESSIBLES, the comparable figures are 39.8 and 50.3 and for NON-ADOPTERS, 40.0 and 47.0.

The heads of households interviewed in Costa Rica have, as a whole, had more schooling than is the case for their Colombian counterparts. This probably reflects, in part, the higher educational level of the Costa Rican population as a whole. The median number of years of school completed by USERS in Costa Rica was 3.5 as compared to 2.7 for the comparable group in Colombia. The corresponding figures for INACCESSIBLES are 1.9 and 1.7, for NON-ADOPTERS 2.1 and 2.1.

The contrast between the two areas is particularly sharp when migration is considered. Eighty-eight percent of the Costa Rican survey population was born in a district other than that in which they currently reside, while this was true of only 47.0 percent of the Colombian heads of households.

Almost identical proportions of household heads in each study area were farm laborers, 37.2 percent in Costa Rica and 37.3 percent in Colombia. Farm operators, farm administrators and teachers, however, were more prevalent in Costa Rica, while merchants, unemployed and "other" were more prevalent in Colombia. Most of the differences are not striking, however, and in general the occupational composition of the two populations is similar. The two categories in which sharp differences exist between the two areas are teachers and "other." In both instances, the difference is probably due to the proximity

of the Colombian area to the cities of Cali and Palmira, as contrasted to the sizable distance both in terms of miles and travel time between the Costa Rican study area and a city of any size. Thus, only one teacher was found in the Colombian area as compared to 10 in the Costa Rican area because in Colombia teachers can commute to work. Likewise, the proximity to urban centers makes a variety of urban occupations on a commuting basis available to residents of the Colombian area. Hence, 20.5 percent of the Colombian respondents fall into the "other" category as opposed to 8.5 percent of those interviewed in Costa Rica.

Social and Economic Characteristics. The level of living of the Colombian heads of households was somewhat higher than that of those in Costa Rica. For the first, the mean score on LEVEL was 3.808, for the second, 3.462. When LEVELNOE is compared, the means for Colombia by user categories are higher with the exception of INACCESSIBLES for which the score is virtually the same in both countries. The mean LEVELNOE score for Colombia and Costa Rica, respectively, are for USERS, 3.787 and 3.462; for INACCESSIBLES, 2.500 and 2.592; and for NON-ADOPTERS, 2.536 and 2.082.

The Costa Rican respondents generally scored higher on the satisfaction with life situation indexes than the Colombians. The SIT TOT scores for Costa Rica and Colombia, respectively, in each user category are as follows: USERS, 4.265 and 3.639; INACCESSIBLES, 4.178 and 3.429; NON-ADOPTERS, 3.826 and 3.485. A comparison of scores for the two groups on SIT PRES, SIT PAST and SIT FUT by user categories reveals that the Costa Ricans scored higher than the Colombians in eight of the nine comparisons, the exception being the SIT PRES score for NON-ADOPTERS which was virtually identical in both countries. The SIT TOT score for all respondents was 4.137 in Costa Rica and 3.553 in Colombia.

Perhaps because of the proximity of the Colombian study area to major urban centers and the relative isolation of the Costa Rican respondents, substantial differences were found in the level of exposure to the mass media. Sixty-seven and seven-tenths percent of the Colombian respondents were at levels 3 and 4 (high) of the mass media exposure index, and 42.6 percent were at level 4. The corresponding percentages for Costa Rica are 25.9 and 8.4.

Social participation as measured by membership in organizations was minimal in both areas. Forty Colombian respondents or 9.0 percent acknowledged membership in an organization. Of the Costa Ricans, 132 or 29.3 percent did so, but when membership in the electric cooperative, a prerequisite for service is excluded, 47 respondents or 10.4 percent are classified as members of organizations other than the cooperative.

The area of San Carlos surveyed was one of moderate sized farms. Among all farmers interviewed, 41 percent had 2 to 9.9 manzanas and 33.6 percent used 10 to 49.9 manzanas. Slightly over 10 percent owned less than two manzanas while 5.6 percent operated farms of 100 manzanas or more. USERS, INACCESSIBLES, and NON-ADOPTERS were represented in all farm size categories. While NON-ADOPTERS tended

to own smaller farms than either USERS or INACCESSIBLES, there was no clear association between electricity use and size of landholdings.

Slightly more than three-fourths of the farms in San Carlos successfully classified by type were primarily concerned with the raising of crops. However, electricity users were more likely to be involved in livestock production than were non-users. Analysis of the relationship between size and type of farm revealed that the crop producing entities in the area surveyed were smaller than those enterprises devoted to pastoral activities.

In Colombia, the large landholdings which dominate the Rozo area were excluded from the intensive survey population. Only 6.1 percent of the remaining farms had more than 10 hectares (about 25 acres). Slightly more than half of the farms were of less than two hectares, while the remaining 44 percent ranged from 2.0 to 9.9 hectares. While nearly equal proportions in each electricity user category own some land, household use of electricity is positively associated with size of farm; USERS have more "large" farms than either INACCESSIBLES or NON-ADOPTERS.

Interpretation of Findings

Causality beyond a doubt can rarely if ever be demonstrated in the social sciences. No such claim is made for any of the findings. The level of living is the variable most consistently associated in a positive relationship with electricity use or non-use. It is probable that the two variables interact, that it is those persons who enjoy the higher levels of living in an area who are the most likely to adopt and that adoption in turn has an effect on their level of living.

Another variable, mass media exposure is also positively associated with both the level of living and electricity use. In this case, all three variables probably interact to some extent with one another. Mass media exposure may raise aspirations which lead to improvements of the sort that increase the respondent's score on the level of living scale and the use of electricity in turn facilitates achievements of high scores on those items of the LEVEL scale that require electric equipment, in turn (by the acquisition of a television set, for instance) raising the mass media exposure.

Uni-directional causality between two variables to the exclusion of all others is virtually unknown in the social sciences except at the very simplest level of analysis. However, it is not necessary to demonstrate such causality in order to obtain sound guidelines for policy. It is a well-known fact, for instance, that in American society lifetime earnings are directly related to the educational level achieved by the income earner. The relationship obviously is not perfect and there are intervening variables such as native intellectual ability, personality factors and others. Still, this does not negate the value of an education in cash terms.

Furthermore, as happens with the results of this study, high income earners will be found who have educational attainments ranging from very little to very high, from less than an eighth grade education to a graduate degree. Likewise, low income earners will be found who fall into the entire range of educational achievement. So this relationship as many others must be stated in probabilistic terms: the higher the educational attainment the greater the probability that income also will be high. Still, this does not deter government from investing in education based on the proposition that it yields economic as well as social benefits for the society.

The results of this study can be viewed in essentially the same light. The relationships are not perfect, intervening variables, no doubt exist. Yet, this fact should not deter the use of these findings, applied and interpreted judiciously, in a practical way for making judgments. The probability that wrong judgments will be made, although not eliminated will be reduced.

Survey Results. This study has demonstrated that various social indicators, beneficial to the well-being of rural inhabitants, appear to be closely associated with the adoption of domestic use of electricity. Although we have not posited causality in the documented relationships, we do feel that the prevalence of the associations between the adoption of electricity and other social indicators gives a clear indication that the use of electricity, per se, in a rural area, must be accepted as a social benefit. And if this benefit, indeed, has any independent, as opposed to dependent, characteristics, then it influences phenomena which we view as indicators of increased social well-being. Thus we believe that the use of electricity provides perceived social benefits for the users and creates a sense of relative deprivation for the non-users, most strongly expressed by the NON-ADOPTERS.

Approximately one half of those interviewed were non-users of electricity. Some 90 percent of them stated that they would become USERS if they had the [illegible]nity (the question asked specifically used the word "opportun[illegible] The responses did not fluctuate greatly between the INACCESSIBL[illegible] those beyond the lines, and the NON-ADOPTERS, voluntary non-users. B[illegible]use their households are in non-electrified areas, the INACCESSIBLES clearly do not have the opportunity to become users. The NON-ADOPTERS, however, apparently feel for some reason that they do not have the opportunity to connect with the distribution lines, even though in some instances power lines virtually pass over their homes. Yet they express a desire to avail themselves of what they perceive as a social benefit.

The main roadblock preventing INACCESSIBLES from becoming USERS appears to be obvious, the lack of electricity lines in the vicinity of their residences. The only way for these people to receive the advantages of electricity use is to have the lines extended. But even if lines were to be extended into the zones inhabited by INACCESSIBLES, experience shows that only about two-thirds would become USERS, with the remainder, even three years after energization, NON-ADOPTERS.

T'. obstacles to becoming USERS for both NON-ADOPTERS and the potent,al NON-ADOPTER portions of the INACCESSIBLE population are perhaps the more difficult to comprehend and hence to overcome. These roadblocks appear to be both economic and social in nature. Many either cannot or will not expend the funds necessary to install electricity in their homes. Others have less well defined reasons for not being willing to pay for electricity. Aside from those who have a fear of electricity, these reasons appear to be social.

The mere adoption of the use of electricity cannot be seen as purely a function of economic means. At least some NON-ADOPTERS appeared in all categories of occupation, LEVELNOE, and size and type of farm, which were used as income related variables. Furthermore, Cooperative members in San Carlos could receive household electricity by paying the ₡5 membership fee and purchasing ₡300 of shares which could easily be obtained on credit through a special program of the national bank. This sum represents approximately three weeks wages for a farm laborer or it could be obtained by other household members working on a piece-rate basis in the seasonal coffee harvest. Through this payment, original Cooperative members had the right to three lightbulbs and two electrical outlets.

In the Rozo, Colombia area, payment for household connections was somewhat less straight forward due to varying arrangements for obtaining electric service at the local or community level. However, here also it appears that the economic factor was not an over-whelming deterrent to the adoption of electric service for at least minimal household functions.

The data do indicate that once the decision to connect with a central station distributor has been made, the level of average monthly electricity consumption is more closely related to the economic means for purchasing electrical appliances. This was most clearly demonstrated in Costa Rica where those using more than 40 kwh per month were younger, better educated, and in higher occupational categories. Because of a small sample size for this type of analysis, the results were somewhat inconclusive for Colombia, where age, education, and occupation did not substantially differentiate levels of electricity consumption.

It is noteworthy to observe that as a progressive, developing area, with substantial migration, San Carlos was more likely to attract younger and better educated people, who after making their way would be larger electricity consumers. In contrast, the Rozo area of Colombia was a more static area experiencing the out-migration of younger people to the nearby urban areas of Palmira and Cali.

The question of who benefits from the availability of electricity and how they benefit naturally follows from the use of electricity demonstrated by consumption levels. The conclusion is that the household benefits of electricity to the majority of respondents stem from its use for lighting and ironing. The ownership of stoves, refrigerators, and television sets is concentrated among those in the higher socio-

economic occupations and the potential benefits of electricity for use with these appliances is not even perceived by most consumers, despite the availability of electricity for several years.

The rate charged for electric service also determines the direction and amount of benefits. Relatively high rates in Costa Rica resulted in low consuming electricity users paying more (on a direct cost basis) for electric lighting than for candles. In Colombia, low electric rates and substantial expenditures for candles resulted in a comparative advantage to electric lighting for household purposes. For consumers of both countries, as the ownership of major appliances increases central station electricity becomes a cheaper energy source in relation to such alternatives as kerosene and gas.

Thus the use of electricity simply for lighting and ironing may result in higher household energy expenditures by the low electricity consuming households. However, as demonstrated by the willingness to continue service, any additional expenditures are apparently covered by the convenience and dependability of electricity for these purposes. The relative savings in energy expenditures do not really begin to take effect until one is able to substitute central station electricity for a private generator, or eliminate expenditures for kerosene or gas with an electric stove or refrigerator.

The objective of examining selected characteristics of survey respondents in relation to their average monthly electricity consumption was to determine if certain of these factors could be isolated for use in estimating household power consumption in feasibility studies or as selection criteria for potential project areas. While age, education, and occupation were important factors among Costa Rican respondents, somewhat inconclusive results in Colombia suggest the use of population characteristics for predicting future electricity consumption requires more study and further refinement. In terms of project selection, however, it appears that among several potential project areas, those with a population in the higher socio-economic occupations, better educated, younger, and with previous experience with electricity will more likely make greater utilization of electricity for household purposes.

The above findings and their interpretation result from the analysis of saturation survey data in both Costa Rica and Colombia. Supplementary interviews and observations were recorded in both countries with available electricity users who had been surveyed in previous benchmark studies. These findings together with case study analyses of farm, commercial, and industrial use of electricity follow.

Re-Interview Analysis. The objectives of re-interviewing a sample of members of the San Carlos Rural Electric Cooperative after a period of four years were: (1) to evaluate the baseline survey approach and methodology, (2) to determine characteristics related to initial and continuing household consumption of electricity, and (3) to determine the effectiveness of projecting power consumption based on surveys of anticipated appliance purchases prior to project construction.

Through means of a stratified cluster sample, the 1968 survey sought to obtain data from a small sample, which, when statistically manipulated could be applied to the 1968 population of rural electric cooperative members. Re-interview of this sample was expected to yield data for calculating changes and benefits to the original population of the Cooperative and hence indicate the impact of a rural electrification project after a given period of time.

This approach, in its original application was conceptually and statistically valid, but did not anticipate the extent of migration and the degree to which a follow-up survey would find previous respondents unavailable for re-interview. Consequently, the sampling procedure must be considered flawed for purposes of baseline (benchmark) studies.

The number of 1968 respondents who had moved out of the San Carlos area by 1972 was surprising, especially since the area may be considered progressive, with substantial economic potential in relation to other areas. Characteristics of these migrants showed them to be a progressively oriented group rather than an illiterate, constantly shifting, uninvolved people. It is obvious the arrival of central station electricity was not in itself sufficient to keep them from moving out of the area. The extent of migration in an area such as San Carlos indicates that this factor must be considered when estimating increases in the number of consumers and electricity consumption.

Examination of billing records and respondent characteristics showed that higher initial levels of average monthly electricity consumption were associated with previous experience with electricity, fewer years residence in the area, more years of education, and a more sophisticated occupation level. It may be reasonable to assume that previous experience with electricity and years of education are extensions of the merchant-farmer occupation group. Thus, in terms of estimating future consumption, occupation appears to be one of the most significant characteristics to examine. Continuing levels of electricity consumption were similarly associated with these characteristics, with formal education appearing to be less significant as experience with electricity increased.

Analysis of anticipated compared to actual appliance ownership revealed that the relatively short planning horizon of the average rural family together with income uncertainty, provided little reliability concerning expected appliance purchases beyond a one-year time span. Thus, a respondent's stated intention to purchase electric appliances within the first year following system energization is more likely to be carried out than such intended purchases stated to be made from one to three years following energization. Experience with rural populations to date indicates that estimated appliance purchases beyond three years would be highly unreliable.

Furthermore, the discrepancy is greater for larger electricity consuming items such as refrigerators and television sets. The

analysis suggests that those who migrate may overestimate appliance purchases and that those with stoves and refrigerators operated by kerosene or gas are likely to underestimate their exchange of these items for electric appliances. This means that careful attention must be given to questions dealing with anticipated appliance purchases where these survey responses are to be used in feasibility studies to estimate future electricity consumption.

In addition to analyzing anticipated compared to actual appliance ownership, the relationship between appliance ownership and electricity consumption was examined in the re-interview survey. By computing the average consumption of each appliance owned based on previously determined figures for rural households in the United States and comparing this total with average monthly consumption, the applicability of the average appliance figures could be determined for rural areas of a developing country. The ultimate purpose of such a procedure was to determine the validity of estimating future project electricity consumption based on respondents' actual or anticipated purchases and the average electricity consumption of each appliance.

Examination of estimation errors for respondents within high and low socio-economic occupation groupings suggests that appliance electric consumption errors resulting from the use of United States calculations are most prominent for such appliances as refrigerators, stoves, and television sets. These are items which use substantial amounts of electricity and are more commonly owned by the higher occupation group. In contrast, United States consumption figures for smaller items such as light bulbs and irons appear to have greater applicability and reliability in the Costa Rican situation.

If these results are upheld through further testing, it suggests that estimated household electricity consumption in rural electrification projects should be calculated separately for at least the two occupation groupings analyzed here. For the low socio-economic occupation group the 3.5 kwh average monthly figure for light bulbs and 6.5 kwh for irons appears to be reliable. However, further testing will be necessary to determine the actual energy use of larger appliances such as stoves, refrigerators, washing machines, and television sets in the rural areas of developing countries.

General observations derived from statements of family heads or members re-interviewed from the 1968 survey found all respondents in agreement that the Cooperative was doing a good job in providing dependable electric service. Thus, from the personnel and technical standpoints, the Cooperative was successfully completing its function to on-line consumers. One remark concerning electric service was, "it is the only thing with which we are satisfied." The convenience of electricity for lighting was the universal benefit expressed. Further reaction tended to be a function of the appliances owned by the respondent.

The primary complaint of those interviewed, especially those in low income occupations, was the high cost of electricity to operate major appliances such as refrigerators and, especially, stoves. It will be a difficult problem for the Cooperative to overcome. Assuming the regular use of a stove would consume at least 100 kwh per month, this would add approximately ₡30 ($3.40) per month to a base bill for light bulbs, an iron, and some other small appliance. This could represent seven to nine percent of a peon's monthly salary for daily labor. Consequently, it appears to be more than many are willing or able to pay on a regular basis. Some who had purchased stoves have either sold them or are using them only occasionally.

The problem stems from several sources over which the Cooperative has no control; the kwh rate for electricity, which is regulated by the National Electric Service, the inefficiency of low voltage stoves, and family cooking habits. It would appear to require a substantial rate reduction to alleviate the cost problem of operating electric stoves for low income families.

A suggested benefit of rural electrification is its use as an energy source for the development of household industries. This use of electricity has not been exploited in the San Carlos area. One reason perhaps, is that Costa Rica does not have a handicrafts tradition. Secondly, the women of some households indicated there was only a small local market for home-produced apparel or other items since most households individually made whatever items they did not purchase from commercially mass produced stocks.

Some women indicated this left few employment opportunities (outside of the coffee harvest) for themselves or their children. Furthermore, children who were educated had to leave the rural communities to find employment other than agricultural labor if there was no family business for them to enter. Some small-industry activity was being developed and this would be one area where the Cooperative could take a more active role in investigation, development, and promotion of electric energy utilization.

Case Studies in Costa Rica. In addition to re-interviewing available respondents from the 1968 survey in San Carlos, interviews were conducted with selected farm, business, and industrial owners, managers, or workers outside the area of the saturation survey. The objective of these interviews was to determine the variety of uses for electricity by a broad spectrum of Cooperative members, to determine the general degree of satisfaction with the electrical distribution system, and where possible, to obtain specific examples of economic or other benefits or disadvantages attributable to the electrification project.

The primary advantage of electricity for these users, from a technical standpoint, derives from its use as a stationary source of energy for permanent equipment installations. The major economic benefit of central station electricity in San Carlos was its cost compared to obtaining energy from private diesel or hydro plants. (The possibility of wind or thermal energy sources has not been

investigated for the areas considered in this report.) In addition, economic benefits result from productive functions performed by central station electricity that cannot be provided by an alternative energy source.

The cost of electricity from private generators was estimated for a few plants in existence prior to Cooperative energization. These particular units were used primarily by businessmen for lighting and to operate commercial coolers or refrigerators, blenders, jukeboxes, and other electrical apparatus found in general stores and cantinas. An exact comparison of costs would require the same usage of the same appliances with both the private generator and Cooperative energy. By comparing the cost of private generation immediately prior to energization with the cost of Cooperative energy for the initial seven-month period, this cost comparison was most accurately approximated. Where such comparisons could be made, results showed Cooperative energy was substantially cheaper than the fixed and operating costs of private generating units.

With the smaller private generators, it was not uncommon for respondents to indicate they could not use all the electric appliances they owned at one time without overloading the system. With Cooperative energy, however, there was no limit to the supply of power for normal demands, assuming that proper transformers were available and internal wiring was adequate.

For dairy farmers, no precise data on the cost of operating private generators for milk cooling purposes were available for the period immediately prior to system energization. Most of these units had been sold by 1972. Many of these units had been utilized to provide electricity for productive purposes in the dairy operation and for the operation of appliances and lighting in the farmers' homes, making it difficult to compute the cost for productive purposes only. However, farmers indicated Co-op electricity was much more convenient and the more economically minded individuals considered it cheaper than their private plants.

The comparative economic benefit of central station electricity to the large sugar and coffee mills was limited. This is due to the fact that these mills could produce energy for seasonal needs more cheaply from private hydro sources for which investments had been made in the past. Because of minimum demand charges these operations were not willing to wholly use Co-op power until such time as their own systems required extensive repairs, maintenance, or construction for expansion. These enterprises were benefiting from economies of scale and the harnessing of water power for energy production - factors which generally did not apply to smaller commercial or dairy operations.

It is expected, however, that economic benefits of central station electricity will accrue to these enterprises in the future when the cost of Co-op electricity will have a comparative advantage to the replacement or expansion of existing systems. In addition to operating cost savings of large electric motors, their initial cost is approximately one-half that of comparable diesel units.

Besides comparative cost benefits, increased productivity of dairy farms was attributable to the availability of Cooperative energy. This was due to the use of cooling equipment which permitted the marketing of high quality milk and less contamination and spoilage at the farm level. This increased returns to milk producers. Productivity gains and some reduction in labor costs was beginning to be realized with the introduction of electric milking equipment which most private generators could not have operated.

On the larger dairy farms, the availability of electricity in fields bordering roads and the distribution system, meant milking operations could be conducted at various locations without investments in multiple generators. This could encourage more effective pasture utilization since cows would not have to be brought to a central point for milking. The milk at these decentralized locations could also be cooled and handled more efficiently without loss or spoilage.

Dairy farmers further noted that money received from the sale of private generators had been used for productive investments in their dairy operations or to purchase shares in the Co-op. This also could contribute to increased productivity.

Commercial respondents in two towns, generally, did not indicate more productivity in the form of increased sales following system energization. In areas with relatively low incomes the ability of consumers to increase consumption is also low. The consumer is not interested in whether his cold soda or beer comes from a cooler operated by kerosene or a private generator. However, if the malfunction of these energy sources does not enable him to purchase cold refreshments he will go to the competition. It is this factor together with the reduced loss of perishable goods which increases the economic advantage of Cooperative electricity to the commercial operator.

In more rural areas, Co-op electricity has permitted the development of marginal businesses which are able to provide cold refreshments and entertainment using Co-op electricity where they previously could not have afforded to begin operation because of the necessary investment in private generation facilities. Thus it has enabled, to a limited extent, the development of small-scale entrepreneurs. These operators indicated the availability of television in their store attracted the business of those who could not afford their own sets. Furthermore, it aided sales of items where expenditures might previously have been made in the urbanized areas.

An easily over-looked benefit of central station electricity stems from its affect on investment by commercial, farm, or industry operators. Because of the relatively unlimited availability of central station electricity, it helps to smooth out the investment of risk capital. One furniture maker provides perhaps the best example. Starting on a modest scale with limited equipment, the Cooperative enabled him to meet his energy needs as the business expanded without the substantial initial investment in a private generator sufficient for

estimated future needs, which might then have been replaced by still larger generating facilities. With Cooperative power he avoided the "lumpy" investment problem while continuing to meet his energy demands. If such an enterprise fails, monthly electric bills are reduced accordingly and he is not saddled with an investment in a private generator which he might have to sell at a loss. Similarly for any enterprise, the availability of central station electricity would permit them to experiment with electrical equipment and if it should not prove profitable they could dispose of the equipment without having committed themselves to the substantial expansion of private energy sources.

Finally, benefits of rural electrification to the region and nation may also be noted through commercial, industrial, and farm use of electricity. While the impact on the nation of a small area such as San Carlos may be negligible, nevertheless, the displacement of private diesel generators should reduce, however slightly, the importation of fuel oils. Secondly, the increased productivity of the dairy industry attributable to rural electrification can assist in improving the nutritional standards of people in Costa Rica and may result in some increase in trade from the exportation of dairy products.

It can definitely be stated then, that electricity from the San Carlos Rural Electric Cooperative provides economic benefits to commercial and dairy farm enterprises. The primary benefit lies in the cost of electricity compared to private generation facilities based on diesel units. Secondary benefits result from greater efficiency, increased productivity, and enterprise expansion potential. For major industrial users in San Carlos these same benefits will be realized in the future when existing hydro plants become depreciated.

Case Studies in Colombia. Case studies of agricultural and industrial enterprises were conducted in the Rozo area of Colombia with objectives similar to those in Costa Rica. However, the two areas provided a study of contrasts more than similarities. The Colombian experience thus demonstrated the difficulties of developing meaningful generalizations concerning the use of electricity and impact of rural electrification projects among productive users of electricity in rural areas.

Characteristics of the agricultural industry in the Cauca Valley area surveyed which contrasted with San Carlos, Costa Rica were: absentee land owners, large size of farming units, intensive cultivation under irrigation, a declining dairy industry, proximity of large urban markets, large poultry operations, and a lack of strong cooperative or producer organizations. The major similarity with Costa Rica was the need for seasonal labor, in this case for the cotton harvest. All of these factors were significant in relation to the farm use of electricity.

Since most farm owners did not live on the land, farm connections were generally not made unless there was a productive use of electricity on the farm. Electricity merely for use in the homes of administrators or farm workers was often not provided, except through the use of small diesel or gasoline generators for lighting and pumping water for the household and farm animals.

Among the farms surveyed, electricity was used to varying degrees in dairy and poultry activities and for irrigation purposes. Most farms consisted of extensive landholdings of over 500 acres devoted to the production of sugar cane, cotton, soybeans, milo, or dairy and beef cattle. The favorable climatic conditions of the Cauca Valley together with irrigation permitted multiple cropping. A number of the enterprises contacted were corporate type farms and most were operated by administrators, while the owners resided in Cali or other cities. Many of these owners were engaged in business or professional activities in the cities.

The large size of farms meant electric lines had to be strung some distance to service irrigation wells, dairy barns, machine shops, and homes. Farm operators were responsible for the total cost of connections from the nearest transmission line to point of use. An electrical contractor indicated the cost of extensions was around US$2,500 per kilometer for materials and labor (without transformers). All private connections were done by contractors approved by CVC and under plan approval and site inspection by CVC personnel. The substantial cost of electric service to farm owners meant intensive use of electricity was necessary to justify the investment.

The use of electricity for irrigation pump motors was the primary productive use of electricity on surveyed farms. Opinions varied as to whether electric or diesel motors were a more economic energy source for irrigation purposes. An economist at one large sugar plantation estimated the fixed and operating costs of their diesel

irrigation pump motors were less than for electric motors. This was based, however, on the fact that the enterprise had over 20 irrigation wells spread over extensive landholdings. With trained personnel, standby units, and their own repair facilities, this enterprise did not experience costly delays from breakdowns, lack of spare parts, and employee negligence, problems common to smaller enterprises with only a few wells and motors.

Many other farm owners had changed or were in the process of changing from diesel to electric motors for their irrigation needs. They cited the advantages of electric motors as lower initial cost (including transformer and switches), lower maintenance cost, reduced labor input for operating the motors, and avoidance of delays in irrigating during critical periods while waiting for parts and repairs to diesel motors.

The cost of drilling wells and constructing most other facilities for irrigation are the same regardless of the power source used for pumping water. Productivity increases from irrigation result from the application of water regardless of the energy source. Consequently, the relevant cost comparisions are the fixed and operating costs of the commonly used energy sources. Specific studies of farms in the Rozo area indicated that in most cases electricity provided a more economic source of energy than diesel motors for operating irrigation pumps.

Such a conclusion, however, is not generalizable to all farms or all areas. Where irrigation needs are limited due to cultivation practices or irregular rainfall, diesel motors might prove more economical because of the fixed demand charge for electricity common to most distribution systems. Other factors to consider would include the cost of fuel, availability of skilled labor, construction cost of electricity lines, and the dependability of electric service (possibly critical when drought conditions force rationing of electricity generated by hydro-electric facilities).

The use of electricity on dairy farms in the Rozo area provided one of the most interesting contrasts with the situation in San Carlos, Costa Rica. Despite the proximity of mass urban markets, dairy farmers surveyed were switching from dairy to crop activities. This fact was attributable to rising land values and taxes, lack of security for dairy herds, the government controlled price for milk, fear of agrarian reform legislation, and lack of skilled labor. Consequently, dairy herds were being sold or reduced and where electric lines had previously been constructed, available electricity was not being used for milking equipment (and in a few cases such equipment had been sold).

Despite an apparent potential application of electricity in the dairy industry, factors often beyond the farm level reduced or eliminated this possibility. This situation demonstrates the care which must be taken in feasibility studies to examine all factors, both short and long range, which might possibly disturb the potential productive application of electricity on which a project area might be selected.

A limited number of poultry operations were also examined to determine the use of electricity in this agricultural activity. Egg production of several operations surveyed ranged from 200 to 500 dozen per day. Electricity was utilized for water pumps, feed mixers, heat lamps, and security and general lighting. However, electricity was not being used to provide a totally controlled environment for optimum production in the enterprises surveyed. Furthermore, eggs were marketed every two days and cool storage facilities were not used at the production site.

Rural industrial activity was limited, with the exception of sugar mills, despite the availability of electricity in many areas for over 10 years. This was probably due in large part to the proximity of the established marketing, trade, and industrial centers of Palmira and Cali. The only non-agriculture manufacturing activity sighted was a metal furniture maker which had begun operation on a part-time basis. The reason given by the owner for locating in a rural area was a tax incentive provided by local government.

Other industrial activities included a milk pasteurizing plant with a capacity of 40,000 bottles per day and an ice cream plant. (The latter had converted its dairy operation to sugar cane and was purchasing milk from other producers for manufacturing purposes.)

Employment and Income Factors

Because central station electricity has been used primarily to replace alternative generation facilities in commercial establishments, farms, and industry, it has not led to any appreciable displacement of labor. (The operation and maintenance of private generators was previously conducted by owners or labor employed for other duties.) In existing commercial and industrial enterprises, this situation is not likely to change much in the future.

However, on the dairy farms of San Carlos, there will be a slight reduction in the demand for unskilled labor as electric equipment replaces hand milking. This will require fewer but more skilled dairy workers who will be paid more than general labor. Workers presently employed on dairy farms are not likely to be displaced, but will be transferred to other jobs on the farms. In Colombia, the declining dairy industry around Rozo may result in some labor displacement, but more likely these workers can be absorbed in other farm activities.

Central station electricity has not yet been effectively utilized to create substantial new employment in rural areas. A small furniture manufacturing operation and planned yuca processing plants were two examples of the creation of new employment opportunities for people in the San Carlos area. Construction of a sawmill may in part be attributable to the availability of Cooperative power. The cooperative milk receiving station and a new coffee beneficio provide a few more jobs, but non-traditional, labor intensive activities have not developed around the available power supply in San Carlos. The domination of Cali

and Palmira as trade and manufacturing centers have resulted in relatively little industrial employment creating activities in rural areas of the Cauca Valley.

The utilization of available electricity for household industries has not been realized in either area surveyed in Costa Rica or Colombia. Consequently, this potential for increasing incomes has not been realized. Without alternative employment opportunities, whatever household labor is saved by the use of electric appliances cannot be profitably exploited except perhaps during the seasonal coffee harvest in Costa Rica and cotton harvest in Colombia. Skilled dairy farm workers, or those who can be trained, will receive increased wages as the San Carlos dairy industry modernizes. Also in Costa Rica, the development of two planned yuca processing plants should increase the income of numerous small farmers. Development of additional processing activities such as this could do much to increase income to all sizes of agricultural enterprises. Of course, the Rural Electric Cooperative itself has provided employment and income to approximately 30 local inhabitants.

Alternative Methodology and Techniques

Another objective of this project was the creation, development, and testing of research techniques and instruments for conducting benchmark studies and evaluating the impact of rural electrificatior projects. Primary efforts in this aspect of the endeavor are directed towards sampling procedures, evaluating alternate methodologies, and constructing survey schedules.

No discussion of alternative techniques, methodology, and criteria can be presented without consideration of the objectives for which the survey or research is being conducted. Research techniques and methodology concerning rural electrification will differ somewhat according to whether the objective is a baseline, feasibility, or evaluation study. The present survey has attempted to establish criteria which may be applicable in part or totally to these three types of studies. The following discussion concerns the application of team experience with the present study to additional or alternative survey objectives.

At this point in the examination of rural electrification projects in developing countries several fundamental sampling or data collection procedures may be analyzed. The first is what is referred to here as saturation sampling, which is predicated on the ability to carefully select a research area and interview everyone having pre-determined characteristics within the area delineated. The second is stratification sampling (and its variants) where potential respondents are grouped according to a given characteristic and then individuals within these groups are randomly selected for interviewing. Finally through case studies, a generally limited number of respondents are subjectively chosen for interview data.

The saturation technique was employed for the administration of survey schedules by trained nationals of Costa Rica and Colombia, respectively. This procedure was considered to be the most acceptable to procure the data required with the least expense in the shortest amount of time. Basic to this technique is the selection of a specific research area containing pre-determined characteristics. One must be cognizant of the fact that the selection of the area will significantly influence the type and quality of much of the data. Thus, for example, if one seeks to assess the value of electricity for irrigation purposes, an area needing irrigation must be selected.

The procedure is also predicated on the assumption that the area contains one major variable being examined, in this case the use or non-use of electric energy. In order for the results to have validity, the area should be as homogeneous as possible so as to afford maximum control of other variables.

The practicality of this approach is that variations in the primary variable can be readily observed. If sufficient control variables are introduced and if the sub-groups studied within the population are sufficiently similar, the results portraying variations in the principal variable should be valid.

This type of sampling procedure has, however, a major limitation. Its use is restricted to viewing variations in a characteristic. It is valid for studies in which variations in a primary characteristic are to be generalized to others either having or not having that particular trait. It is not, however, valid for use in generalizing specific characteristics of a portion of one population to the entire population. Specifically, this technique has legitimately been utilized to ascertain the effects of the use or non-use of electricity on the people of a portion of San Carlos and Rozo. The findings can be generalized to others who either have or have not adopted the use of electricity. And although we have accurately depicted many of the other characteristics of the research populations, we cannot say that others in Costa Rica or in Colombia will have the specific secondary characteristics similar to those of the respondents. In contrast, stratification sampling permits the extrapolation of findings from a sample to a larger population under the assumption that characteristics other than that on which stratification was based are similarly distributed.

The practical application of these two sampling techniques in relation to baseline studies was demonstrated in both Costa Rica and Colombia. A 1968 baseline study by Moses of the San Carlos Rural Electric Cooperative utilized a stratified cluster sampling approach to obtain data from a small sample which would be applicable to the Cooperative population at that time. Attempts in 1972 to re-interview original respondents revealed several had died and many others had moved out of the area. Consequently, a complete analysis of baseline data could not be completed. A similar result occurred in Colombia where Ross found many of those interviewed in his 1965 study were no longer available for re-interview in 1973. These facts demonstrate that random sampling techniques are generally inadequate for gathering baseline data of rural electrification

projects. (Substantially expanding the size of random samples is an alternative which would alleviate but not completely resolve the problem.) Furthermore, locating pre-selected individuals for interviewing creates time-consuming logistical problems both in the baseline and follow-up periods.

The technique of saturation surveying was specifically utilized at the present time to provide data comparable to that which might be obtained in a follow-up study of San Carlos, Costa Rica and Rozo, Colombia. Everyone in carefully defined areas meeting previously determined criteria were interviewed. In five years it can be assumed that numerous respondents will have either died, moved into other dwellings, or moved out of the area completely. A follow-up survey using the same saturation technique will include not only many of the same respondents, but also the replacements for original respondents. Because the objective is the evaluation of individual and community change resulting from a technological innovation, the effect of replacements is a valid component of the total project impact. (Using stratification sampling it would be virtually impossible to assess the influence of replacements.)

A stratified or cluster sampling approach may still be considered the best alternative where data applicable to an entire project area are desired. If the objective of the survey is to obtain data against which quantifiable costs and benefits of an electrification project may be weighed in an evaluation or feasibility study, then it would generally be necessary to utilize a sampling procedure such as stratification or clustering over a definable project area. This results from the problem of extracting fixed and operating costs for a given sub-sector of the total project.

Informal interview techniques may also be used to gather data for baseline, feasibility, or evaluation surveys. In fact, these techniques were also used, to some extent, in the present study.

Informal interviews were conducted with numerous persons in the research populations and elsewhere in both countries. These conversations were basically of three types. The first were those designed to elicit primary data of a type not covered in the more formal survey research encounters. These were generally carried out with respondents who had been surveyed previously and with those from whom specific types of economic data were being sought. The second type consisted of follow-up conversations with respondents who had already been formally interviewed. These interviews were conducted, in some instances, to pursue interesting points which had been brought up in the process of survey research and to check on the validity of data collected and effectiveness of the interviewers. The final type of informal interviews were those where background information was being gathered from government officials, community leaders, and those knowledgeable on special facets of this study.

Major bits of information gathered in these informal interviews have been incorporated into this report. Primarily, it has been of the sort which either buttresses or clarifies points resulting from the

survey research. It should be noted, however, that the use of informal interviews was a secondary methodological technique. Data compiled using this technique are subject to two serious flaws; it may be subjective or impressionistic and not directly comparable to data from other sources or time periods. In order for a study to be valid, it must be conducted such that it can be replicated. Because no two people observe a situation in an identical manner, it is virtually impossible to replicate a study based primarily on he observations of even a trained observer. Unless the data are collected and presented such that they can be properly assessed, it is difficult to separate facts from impressions. Thus, the data of one trained observer may not be legitimately compared to that of another observer or to data from other sources. Data from informal interviews, which may be at best valid for one set of circumstances, often may not be grouped with other data to be used in drawing defensible conclusions. While the use of trained observers both facilitates the collection of data and is useful for clarification in the presentation of the data, it is by itself an insufficient research technique.

Finally, the case study approach is a technique frequently used but which may lead to bias in the selection of respondents and reporting of impressionistic rather than factual data. The technique was used in the present study as supplementary interviews and observations of commercial, farm, and industrial users of electricity (and has been clearly identified as such in the report).

In the present study (as frequently occurs), it was not possible to identify all large electricity users because of the organization of distributor records and the large area over which these users were thinly scattered. Secondly, extreme variations in the size and type of these enterprises together with their limited number prohibited the meaningful use of random sampling techniques. Consequently, the bias of subjective selection was limited to the extent possible by interviewing as many establishments as time and transportation resources permitted. This virtually eliminated the possibility of a few outstanding or unusual cases representing all enterprises of the same type in a given area. To permit the comparative evaluation of data, a series of predetermined (standardized) questions were asked in each case study, with some variation in the number and type of questions to allow for different types of enterprises. A base of factual data was thus collected which may be utilized in comparison with data from other sources or in other time periods. The inherent weakness of the case study approach can only be remedied by obtaining a substantial number of examples and collecting factual data as support for subjective observations. Even so, each case study is in reality a separate entity which has limited comparability with other case studies.

It should now be clear that in addition to the use of survey research, other techniques were utilized in the present study. This discussion has presented the strengths and weaknesses of these alternative techniques in relation to the objectives by which a study is conducted.

The development of survey schedules is of course an important aspect of any field research endeavor. The original schedule prepared

for use in Costa Rica was long and necessitated conducting lengthy interviews. The final instrument was constructed after a great deal of deliberation and consultation. However, because little had been known about the impact of rural electrification, and even less about the ways of studying the phenomenon, most of the material included in the survey schedule was original. As expected, several portions of the instrument either did not elicit adequate data or produced non-significant results.

The survey schedule was modified before its re-application in Colombia. Certain questions were eliminated; others were altered; and new segments, especially on irrigation and migration were added. Many questions which had not been successful in Costa Rica were retained, mainly to give them a second chance before concluding that they were expendable.

The experience gained in the two applications of the survey schedule gave us enough information to determine which portions of it are useful in studies of the impact of rural electrification. The resulting abridged survey schedule is included as Appendix E. This document contains only those questions with a proven worth and is designed to be adaptable for studies of the impact of rural electrification conducted both in Latin America and in other regions of the world. It is understood that this survey schedule does not have instant adaptability. If no other alterations were needed, the precise wording of several questions would have to be changed to fit the local vernacular. It is assumed that the major applicability of this abridged instrument would be as the basis around which a somewhat larger survey schedule specifically designed to meet particular area or project needs would be constructed. That is, additional queries designed to answer questions pertaining to local problems should be inserted. Such studies should be conducted by trained social scientists familiar with survey research methodology.

Infrastructure Development

Identification of household characteristics associated with the adoption and level of electricity consumption is, presumably, applicable across national boundaries. The question of infrastructure and rural electrification on the other hand is more project specific. Some of the factors to be considered on a multi-country basis and the linkages between infrastructure and rural electrification, however, may be suggested.

Obviously, the construction of a rural electrification project is affected by and has an impact on other infrastructure development. The problem is to initiate projects when other infrastructure levels can most aid system construction and electricity utilization while they in turn receive the maximum development boost from the availability of electric energy.

This suggests, at least, minimal levels of infrastructure development (or the framework) prior to rural electrification. This minimal level will vary for each type of infrastructure (roads, schools, clinics, etc.) and will be subject to the objectives of the rural electrification project and regional and national development objectives. While it has been suggested that rural electrification (especially under the cooperative form of distribution) will have spinoff effects, prompting communities to undertake other self-help projects to develop infrastructure, this has not been demonstrated in the areas surveyed in Costa Rica and Colombia. The explanation, in part, is that most infrastructure projects require resources beyond the boundaries of individual communities. While a community may construct a school, it needs trained teachers and textbooks; construction of good roads generally requires materials and equipment not readily available; construction of a clinic still requires the services of a doctor and medical supplies.

Development of community infrastructure requires the involvement of regional and national government entities, as well as people at the local level. Some necessary levels of infrastructure systems, based on observations in Costa Rica and Colombia were:

Roads

A basic road network is essential to facilitate construction, and especially maintenance, of a rural electric system. The quality of this road network is, however, related to the objectives of the rural electrification project. Where social considerations may dominate and the resource base of the area does not suggest the immediate use of electricity for farm or industrial development, a road system sufficient for construction and maintenance would be adequate. In the dairy farming area of San Carlos, however, the lack of good roads is one of the factors limiting full productive utilization of electricity on dairy farms. It appears large farm owners have or can get the capital and technical knowledge to install modern milking equipment and bulk cooling tanks. But the lack of good roads is at present discouraging the adoption of tank truck pickups at the farm level. The result is a greater cost for milk cans and transportation to the receiving station and some loss in productivity due to contamination or spoilage of milk. Obviously in this area, construction of the electric system has been a benefit to dairy farmers regardless of the roads because of the advantage of central station electricity compared to private plants. Consequently, the greatest benefit of electrification at this time may have been realized for dairy farmers - only maximum utilization is retarded because of roads.

In the Rozo area of Colombia, the interaction of other factors reduces maximum utilization of electricity in many dairy enterprises. This area is linked to the major metropolitan market of Cali by adequate all-weather roads. Here, however, rising land values, government policy in relation to land tenure, and competition from suppliers of crude milk, combine to cause uncertainty among large dairy producers. While some modern dairy enterprises are operating in the area, this uncertainty has tended to limit further investments, despite an adequate road network.

The dairy industry in the two countries is but one example. In any case, where electricity has the potential to be used for individual or industrial productive activities, an adequate road network is essential to permit delivery of raw products for processing and the transportation of processed products to market centers. Until such facilities are available it might well be more beneficial (in terms of the total development picture) to continue the use of private energy sources. A distribution system is not economic without utilization of the power provided, but the power provided may not be useful unless raw products can be obtained and finished products marketed.

Communications

Large commercial and industrial establishments in the rural areas of both Costa Rica and Colombia depended on radio communications for contact with individuals or offices in urban areas. These radio systems were powered either by battery or private generators prior to central station electric service. The form of communication was not changed, only the energy source.

Central station power as the new source of energy, has some advantage in its immediate availability in the event of emergencies. Also, it is more dependable than private systems. It will probably be some time before a reliable telephone system is available in these rural areas. This is a case where previous work by electricity distributors would be beneficial in the construction of another infrastructure development project. In San Carlos, ICE was working to develop radio communications systems from various small rural communities to Ciudad Quesada and from there, connections with the rest of the country. Electricity would facilitate such systems.

Schools

The case of schools demonstrates the linkage effect of rural electrification with other infrastructure institutions beyond the boundaries of individual communities. Most schools, above the first four or five grades, are located in urbanized or nucleated rural communities. Most of these have available at least one private power source from an individual or industry. To capitalize on the use of central station electricity means the community and educational institutions of the country must be organized to provide such services as instruction by television, night adult classes, equipment for shop and demonstration classes. Again, the mere availability of electricity in schools is often not strikingly new in rural communities, because of alternative sources. Certainly the reliability and unlimited quantity of power is an advantage of central station service, but this is useless unless capitalized on by the community and government institutions.

In San Carlos, the exceptional case was a vocational agricultural school which could expand its facilities because of the availability of Co-op power. Investment in its own private plant could be directed toward educational objectives. This, however, confirms the point that outside resources were necessary to finance and develop the school. In

the area studied in Colombia, higher education was dominated by the proximity of urban centers such as Palmira and Cali.

Examination of the use of electricity in the study areas indicates the construction of rural electric systems will aid education, but only to the extent the institutional framework for school improvement exists or is developed.

Health Facilities

Observations are similar to those for education. The institutions for delivery of medical services must be developed to make use of electricity in rural areas. Most major medical services are presently performed in larger urban centers where electricity is currently available. In San Carlos, operations are performed in Ciudad Quesada, while outlying towns such as Pital, Venecia, and La Fortuna have small clinics. Electricity in these clinics is used primarily for lighting, refrigeration, and sterilizing equipment. Energy for these purposes could be provided by alternate sources, such as kerosene for refrigerators or nearby private generators. These findings also hold true for the study in Colombia. Central station electricity does provide more dependable, reliable service and, perhaps more important, permits expanded facilities to be developed in the future without investments for private generators.

Water and Sewer Systems

Much of the area served by the San Carlos Cooperative had piped water from systems constructed by the national and local governments. These systems operated by gravity because of the availability of water sources at higher elevations. Electricity, therefore, has not been used to pump water. However, in the plains of San Carlos wells and pumps are necessary and here central electricity could provide a convenient energy source for automatic equipment. Alternative energy sources would require considerably more capital and labor inputs and would be less reliable.

Conclusions

The following conclusions are based on observations in the study areas:

1. A road network is important to facilitate construction and maintenance of the electric distribution system. The necessary quality of roads for effective utilization of electricity will depend on the extent to which electricity can be used for industrial activities, processing and marketing of agricultural or other products.

2. Electricity contributes to the development of educational and health services to the extent that personnel and funds, both in local communities and at the regional or national level, are available. Funds and personnel are required to provide equipment and services for the effective utilization of electricity.

3. Private or alternative energy sources are generally used before electrification to provide minimal levels of health and education services. Allocation of scarce resources and efficiency aspects often dictate that above this level, services be provided in urban areas which are not within the province of rural electrification. (Even in the U.S. the effective delivery of health services to rural populations has not been worked out despite the availability of electricity.)

4. All the preceding discussion points to the need for continuing technical assistance regarding the effective utilization of electricity for infrastructure development. Progress may be expected to be slow, however, because of limited resources for development - both money and trained personnel in government agencies.

Comparative Systems

Villages and rural landholdings usually are far away from electrified areas. Networks to distribute electricity to the rural areas, therefore, require large investments. Construction of transmission and distribution lines, and installation of substations all must be financed ultimately by the distribution system. In addition, if power is not being purchased wholesale from an electric supplier, the system must invest in a power station and generate its own electricity. Whatever the situation may be, the investment per household or farm for rural electrification is substantial.

Complicating the situation is the generally low economic capacity of rural areas in developing countries. This discourages investment in electric appliances and maximum domestic use of the available energy. Social and cultural conditions in many areas also have an unfavorable impact on consumption of electricity. For example, the land tenure system may discourage investments in house wiring because of the insecurity of rental or other arrangements.

Thus, rural electrification in developing countries is generally characterized by low consumption and low load factor of energy use. The direct returns on power supply investments, consequently, also are low. In some cases, according to a study by the Economic and Social Council of the United Nations, the returns may not even be sufficient to cover the operation and maintenance charges. On the other hand, the Council points out, high rates for electric energy will deter energy consumption and defeat the basic objectives of rural electrification.

With few exceptions, private electric suppliers rarely extend distribution lines to less profitable rural areas. Rural electrification in developing countries, therefore, requires government support. In Latin America many State Governments have participated actively in the electric supply industry - offsetting rural losses with surpluses earned from urban and industrial users. The general pattern of approach has been for the State or National Government to supply electricity directly to the most promising rural areas or indirectly through creation of rural electric cooperatives. Thus, the profit motive in marketing electric

energy in rural areas in Latin America, ostensibly, has been removed.

In the four areas studied in Costa Rica and Colombia, two were serviced by rural electric cooperatives and two were serviced by government agencies. The two government agencies differed in that one was a municipal system and the other a state system. Both rural electric cooperatives were created with the encouragement of state and/or national power authorities. Funds for construction of the cooperative systems were channeled through the government agencies. Also, after energization the state and national power authorities became the suppliers of wholesale energy.

Cooperatives supplying electricity in the San Carlos area of Costa Rica and the Sevilla-Caicedonia area of Colombia were both established with the assistance of AID funds. Both systems had been constructed as self-help projects. Local people made financial and resource contributions by purchasing shares in the cooperatives, donating rights-of-way for construction of distribution lines and contributing labor for setting poles. The cooperatives, originally, provided the meters and line for each household to connect to the secondary distribution line.

Policy followed in both the municipally-owned in Cartago, Costa Rica and the state-owned systems in Rozo, Colombia requires consumers to purchase meters and pay for house connections from the secondary distribution line. At the time of the study, this policy also was being adopted by both cooperatives. As loan funds were expended and the operating margins proved to be inadequate, the cooperatives began charging new customers for the materials necessary to connect to the distribution line. Thus, experience in the two cooperative systems in Costa Rica and Colombia has shown that after initial funds have been exhausted, ability to receive electricity is based on ability to pay for line extensions - the same as for the government-owned systems.

The pressure for line extensions is perhaps one of the most difficult problems for beginning systems to handle. Before consolidating services in a given area, the new systems are undergoing extreme pressures to expand services. This could lead to over-extension of the financial resources of the distribution system, and, thus, difficulties in servicing the financial debt.

Little difference was noted between the municipally-and state-owned systems as mechanisms for distribution of electricity. Greater differences appeared between the cooperative as compared to the municipally-and state-owned systems. One advantage of the cooperative form of ownership was less power line loss. Apparently, individuals do not appreciate their neighbors tapping the distribution line to receive free electricity when they know the cost is being shared by members of the cooperative.

Cooperative systems in Costa Rica and Colombia did not appear to have generated the spin-off benefits usually attributed to the cooperative form of ownership. According to surveys of the cooperative memberships, cooperative identity is low and knowledge of the cooperative structure and function is not widespread.

To stimulate involvement of its membership in self-help projects a cooperative must maintain an identity with the people, both in individual communities and across the wider distribution area. In both areas in Colombia and Costa Rica during the formative years of the cooperatives, awareness of the cooperative and its primary function generally was high because of community meetings, committees, etc. Following energization, however, this cohesiveness and identity apparently lapsed.

Our findings indicate that the electric cooperatives studied serve principally, if not exclusively simply as a means of distributing electricity, and have little meaning to their members other than that of being the supplier of energy. From the standpoint of the users interviewed, it really does not matter whether electricity is supplied by a public utility, or a rural electric cooperative. From the operational standpoint, the major advantage the cooperatives studied seem to offer is a lower rate of line loss or loss of electricity through theft. Conceivably, in the future with increased consumer education, this situation may change. But at present, based on survey data and on observation of the cooperatives included in this study, the organizational structure is not of primary importance to the user of electricity.

Social, economic and cultural factors in each area to be electrified will differ and consideration should be given to various organizational structures in order to determine which type of distribution system would best meet the needs of the local area. Emphasis, also, should be given to management. For quality of management is essential to the success of the electric distribution system, whatever the organizational structure may be.

Recommendations

Those concerned with allocating scarce resources for rural development might consider this report for the contribution it can make to sharpening decision analysis tools. Methodology and techniques used in the study can be tested and improved by careful application in other regions of the developing world. Through a compilation and screening of findings, it should be possible to add to criteria for judging socially desirable and economically efficient rural electrification investments.

Investment Considerations

Two approaches may be taken to justify the large investments necessary for rural electrification projects. Rural electrification may be seen as socially desirable, a social good or service to which rural people are entitled - to be considered along with educational and health services. Another approach to the justification of rural electrification investments is the economic benefits to be obtained from such projects. Under this approach, the project might be viewed as any other business investment. The project would have to return enough on the original investment to cover all the costs as well as a reasonable profit.

Clearly, these two approaches are not mutually exclusive. Rural electrification almost by definition provides social benefits through an increase in living standards. It is perhaps one of the most direct and visible means of so doing. However, in some cases rural electrification projects may have been justified on an economic basis which later proved to be marginal, while the true benefits in the social realm were little analyzed. Yet the means for justifying the investment have important implications for the development of the country and region in which such projects are undertaken as well as implications for the cost of electric service and the institutional manner in which the people are served. It is these implications which will be examined here in regard to the approach which is taken to justify rural electrification investments.

Social Benefits Approach. If the primary and major benefits of a given rural electrification project are considered to be in the social realm, then the project should be considered in the light of other investments for such services as schools and health facilities or adequate pure water or waste disposal projects which may also provide a high degree of social benefits. Road and communication facilities may also enter consideration in the ranking of investment alternatives or priorities. In addition, political considerations may be subsumed under social benefits. Is the particular area under consideration one in which low standards of living are creating political instability, unrest, and turmoil? If so, a social benefits project might help to calm such unrest and lead to renewed confidence in the government, avoiding costly and damaging repercussions throughout the country and internationally.

But what are the implications of taking a social benefits approach to justifying rural electrification rather than an economic approach? First, if the project is expected to be economically marginal, then private investors cannot be expected to undertake the project, except through government subsidy. This means that money for the project must come from government development funds or through international loans backed by the government. This could affect the institutional structure by which the people are provided service - rather than a private corporation, it is more likely the people would be served by a governmental agency, a cooperative, or mutual organization.

Another implication of the social benefits approach to the justification of rural electrification concerns the rate structure for electric service. If the project is viewed in the same perspective as health and educational services or roads, then it may be argued that revenues from providing service do not have to cover all costs. While certainly a decision to be made by policy makers, the idea is worth considering here that urban residents with electric service might help subsidize electric service in rural areas. Justification for such a subsidy could be argued on the grounds that urban residents benefit from the products provided by the rural areas and often in underdeveloped countries, where foreign exchange is based on agricultural commodities, urban benefits may be disproportionate to the services and tools they provide in return to the rural areas.

The mere extension of secondary distribution lines is sufficient for providing social benefits to many who are currently in areas not served by power lines. Facilitating electricity to those who have not chosen to connect is more problematical. It can, however, be achieved by confronting the economic and social obstacles. Economically, these potential consumers could be encouraged to connect either by rate subsidization for the entire system or by extending special credit. The social roadblocks could be removed through a concerted educational program, initiated by the distribution system, which not only would explain the benefits but also the practical use of electricity. Such a program would also have a second objective of developing proper utilization by those who are already users.

Economic Benefits Approach. Data gathered in this study offer some guidelines for the selection of areas in which rural electrification projects might have greater economic impact. Given a choice of two or more areas, one of which is to be electrified, the area having characteristics associated with electricity adoption and use would, other considerations being equal, be the logical choice. From the standpoint of domestic use of electricity, the area having the highest mean educational level, highest mean size of farm, highest mean level of living, the smaller proportion of agricultural laborers, and the higher proportion of merchants and professionals would be the one in which the larger percentage of potential electricity users would connect. From the standpoint of determining potential social and economic benefits resulting from household electricity consumption, feasibility studies should obtain data on the variables mentioned above. It should be noted that the survey population in both Costa Rica and in Colombia, by and large, owned small farms; very large landholdings were not included in this portion of data collection.

Productive use of electricity in agriculture was found mainly for irrigation and in capital intensive operations, particularly dairy and poultry enterprises. If, therefore, the principal objective of rural electrification were to promote increased productivity in agriculture through the use of electricity, then an area in which capital intensive agriculture predominates would be the logical choice.

Finally, the utilization of central station electricity has been shown to provide economic benefits to commercial and industrial users. Where substantial numbers of private gasoline or diesel generators are being used and existing hydro facilities are out-dated or have limited capacity, central station electricity will be economically advantageous. Distributors may also expect substantial demand from these enterprises which will increase the profitability of the electrification project.

Application of Techniques

Social, economic, and cultural factors vary widely by country and large differences often exist within the same country. Therefore, it is impossible to develop a universal, detailed formula for measuring the impact of rural electrification. Methodology used in this study, however, can be adapted to a particular project area. It provides

guidance for conducting studies to determine feasibility or evaluate on-going projects in any low-income area. It needs to be emphasized, however, that these analysis tools must be used by professionally trained social scientists.

The condensed questionnaire is intended as a guideline for adaptation to a particular area being studied. Terminology in the questionnaire will need to be revised to suit local needs and to assure communication with respondents. Conducting the field survey will require assistance from people who are not only familiar with the local language, but who also understand the mores of the local population.

Social and economic information obtained in a field survey of households should be supplemented with intensive enterprise interviews. These in-depth studies of the various types of agricultural, commercial and industrial enterprises should concentrate on the economic and social costs and benefits which have resulted from the use of electricity. Studies also should be made of the infrastructure, such as transportation and communication facilities, educational and health facilities, water and sewer systems. In addition to individual household, enterprise and institution studies, impact of electrification on the community as a unit, should be examined.

The methodology and specific data collection procedures used are, and must be, a direct function of the type of research being conducted. For use in baseline studies and in evaluations of the use or non-use of a technological development such as electricity, we strongly recommend the incorporation of the survey research techniques developed for and used in the present project. We, concurrently, most strongly counsel against the use of either trained researcher observations or informal interviewing as anything but companion techniques in major studies.

Additional Studies

It is highly recommended that communications regarding studies in village and rural electrification be continued between the World Bank and AID. Substantial resources have been invested by both institutions to determine the impact of electrification in developing countries. Studies conducted so far may be looked upon as building blocks, each study providing additional information and permitting a more sophisticated approach for future efforts.

Consideration should be given to incorporating methodology developed in this study with the cost-benefit approach being pursued by the World Bank. Cost-benefit analysis provides a framework for assessing the desirability of projects. It involves a multi-disciplinary approach, especially in the case of rural electrification. Management, institutional development, and social and economic consequences are other aspects to be considered along with the financial and engineering factors.

This study has concentrated on the question of whether rural electrification provides previously suggested benefits. A logical step to follow, using findings from this and additional studies, would be to

attempt to develop guidelines for appraising rural electrification projects. It is anticipated that these guidelines would incorporate methodology developed in this study with Capital Projects Appraisal procedures currently being followed by AID. This would permit incorporation of social indicators in a cost-benefit approach.

Costa Rican Follow-up Study. This project was conceived as being the first in a series of evaluations of the impact of rural electrification in selected populations. A concerted effort was made to obtain benchmark data which could be compared with compatible data gathered using the same instruments at a later date. This objective was realized in both countries studied, but to a greater extent in Costa Rica.

Because of fortunate circumstances, a large portion of San Carlos incorporated into the study area will probably be electrified in the near future. At the time of the study, three major goups were found: those who had adopted the use of electricity within the past three or four years; those who did not adopt; and those who could not adopt. Were the study to be replicated in precisely the same area in five years, the following groups would be found: those who have used electricity for eight to nine years; those who have used electricity for three to four years; those who did not adopt; and those who still could not adopt.

The worth of the present study would be multiplied as a result of a follow-up investigation five years hence. It would be possible to observe changes in consumption patterns and social benefits accruing to the present USERS; to measure changes occurring as the result of a change from being INACCESSIBLES, and in some cases NON-ADOPTERS to USERS within a previous three to four year period; and the effect on those who would still be non-users.

Longitudinal or time-series studies which re-survey the same area after the lapse of a period of years, are particularly valuable. Control areas could be incorporated into future study designs yielding greater precision and greater accuracy to interpretation.

Domestic Electrification Adoption Factors. Future research in the social and economic impact of rural electrification should seek to build upon the findings of this effort by exploring in greater depth the interrelationships between the variables which have been shown to have some degree of covariance. For instance, why do users of electricity have higher levels of living? Does the installation of electricity stimulate the user to make other improvements in his home? More attention needs to be given to the question of why owners of medium and small landholdings do not make greater use of electricity domestically. What are the economic barriers to such use? What are the cultural barriers to such use? Would an educational campaign have any impact if one were instituted, and if so, how should it be structured and what messages or content should it stress? Since many of the level of living items are wife-centered (food storage, dishwashing, floor cleaning, etc.) are USERS more concerned, for some reason, than non-users with their wives and their welfare? Additional explanatory hypotheses could be developed and tested in order to gain an understanding of the linkages between

the two variables.

A major finding in this study is that most of the electricity used in the survey areas is limited to domestic purposes. The advantages of electrification have, therefore, been more direct for women than for men. While the husband might, equally with the wife, enjoy listening to the radio in a well lighted room, it is the wife who benefits more from being able to have an electric iron, refrigerator, stove, or washing machine.

It is assumed that the reasons for adopting electricity are economic. We have reason, however, to speculate that more important reasons might be social, especially related to the the family structure. We could hypothesize that factors such as female dominance in the family, matriarchial control of economic allocations, or well-integrated family structure versus extra-family attention of the male head of the household might well be the decisive factors in deciding to electrify.

The que[illegible] to be confronted then is what factors are responsible for the deci[illegible] to invest in domestic electrification. More knowledge of this might [illegible]l provide the means to obtain increased rates of adoption and hence increased consumption and line-load in rural areas. We feel that there is a strong enough indication based on the evaluation of informal data collected in the field investigation process of this study to warrant further examination of the influence of family structure on the adoption of domestic users.

Studies of Electricity Consumption. A common starting point in the feasibility analysis of rural electrification projects is to estimate expected consumption of electricity. One approach is a survey of potential households to determine expected purchases of appliances. With appliance purchases estimated, the average anticipated annual electric consumption of these appliances is used to calculate household electricity consumption.

Reliable estimates of the future consumption of electricity are important in the selection, planning, and implementation of rural electrification projects in developing countries. Estimates of future consumption are necessary in order to design a project with proper and sufficient load capacity, assure adequate power supply, and as a basis for estimating revenue generated by power sales. Consumption estimates could also be used to select project areas with high potential use and where projects are planned for marginal areas, prior consumption estimates could indicate the need for educational inputs to assure fuller utilization of the electric energy.

In Costa Rica and Colombia, re-surveys of households interviewed prior to energization of rural electric cooperatives revealed a low relationship between expected and actual appliance ownership. The most reliable estimates of anticipated appliance purchases resulted from respondents' stated intentions for the first year following system energization; less reliable estimates were derived from stated intentions for the first three years of the project; beyond that time intentions appeared to have little rational basis. This suggests that further

research of established electrification projects, from which data concerning the ordering and timing of actual purchases can be obtained, may result in more reliable projections of energy consumption.

Secondly, estimation of household electricity consumption based on actual appliance ownership and average electricity consumption of individual appliances derived from U.S. studies resulted in considerable discrepancy (especially for major appliances) when compared to household electricity consumption obtained from billing records. Unfortunately, it does not appear that more reliable appliance electric consumption figures for rural areas in developing countries can be calculated from data obtained in this survey. The relatively small sample of electricity users combined with the many combinations of appliance ownership and generally short period over which consumption records were available do not provide sufficient data points for sophisticated analysis. Further research in this area could determine average appliance electricity consumption figures applicable to households in the rural areas of developing countries.

Finally, it is suggested that an area worthy of further investigation would concern the relationship of selected household characteristics (such as appliance ownership, family size, length of residence, and age, sex, education, occupation of family head, etc.) to kwh consumption over time determined from electricity distributors' records. Such analysis could result in more accurate appliance electricity consumption coefficients as well as household characteristics related to electricity consumption useful in estimating potential household electricity consumption in new project areas.

CHAPTER II

METHODOLOGY

Pertinent Studies

Because, on the one hand, the value of rural electrification was never seriously questioned in the United States and, on the other, rural electrification began during a period when survey research methodology was in its infancy, systematic studies of the consequences of rural electrification were never undertaken in the United States. The need for such investigations did not, however, go unnoticed. One of the few papers written on rural electrification from a sociological perspective when only 22 percent of United States farms were electrified (Rose, 1940) consists of a series of questions which the author believed should be answered. The abstract of the paper is instructive:

> Nearly 2,000,000 of our farms now use central station electric power. Not only is much of this farm electrification very recent, but the social aspects and implications of this new factor in rural life have received very little objective investigation.
>
> In this paper a variety of questions believed to be worthy of and suited to objective investigation are raised:
>
> Does electrification increase farm income and farm value?
> What are its effects upon tenant mobility and cityward migration of youth?
> How does the farmer use his electricity?
> Does he thereby have more leisure and if so, how is his leisure used?
> Why do a considerable number of farmers along the lines not use electricity, and what are the social implications of such non-use in juxtaposition with neighboring use?
> Does this new development, particularly through cooperatives, have significant implications as to the size, organization, and governmental consciousness of the community?
> To what extent is rural electrification a directional force in the adjustment of agriculture in our problem areas?

The research challenge posed by Rose was never accepted. With regard to the United States, the questions are now unanswerable since electricity has by now penetrated into practically every nook and cranny of rural America, and no longer is an important differentiating factor in rural life. The answer to these and other questions, can, however, be discovered in the context of newly established rural electrification programs in developing countries.

Studies of Rural Electrification in the United States

Three kinds of reports have been published dealing with rural electrification in the United States. (1) Accounts written either by employees of the National Rural Electrification Cooperative Association (NRECA) or by persons sympathetic with its goals. Their reports are, naturally, very supportive of the objectives of the NRECA and emphasize improvements in rural life which, it is claimed, resulted from electrification. (2) Reports of the history and activities of the Tenessee Valley Authority. These studies are primarily concerned with the new applications of electrical energy rather than with the economic or social impact *per se* of electrical energy use. (3) Rudimentary agricultural-economic studies. They are addressed to the actual use of rural electrification. Regardless of the nature of the writings on the subject, the body of published literature is small.

Electric Development as an Aid to Agriculture by *Guy E. Tripp* (1926) is a compilation of six of his addresses on various aspects of rural electrification. The problems pointed out by Tripp had been largely resolved in vast areas of the United States by 1944 when Frederick William Muller published his *Public Rural Electrification*. Muller wrote a scholarly account of the work of the United States Rural Electrification Administration (REA) and of the functioning of rural electric cooperatives in this country.

Rural Electrification by J. P. Schaenzer (1948) is of interest as the standard text on the subject of the use of electricity in the rural areas of the United States. It deals with the technical utilization of electric current. Nevertheless, an understanding of the possible uses of electricity is necessary for comprehending the forcefulness of this technological advancement. Marquid Childs in *The Farmer Takes a Hand: The Electric Power Revolution in Rural America* (1952) provided a first-hand description of the development and spread of rural electrification in the United States. He, in effect, provided a standard with which developments in other countries can be compared.

Studies of the TVA have focused on the industrial uses of the electricity generated by that agency and on the rural grassroots involvement of the people in controlling the agency rather than on the impact of electrification. David E. Lilienthal's *TVA: Democracy on the March* (1944) is a polemical history of the TVA and a justification of the grassroots organizations created by it. Philip Selznich, a sociologist, used the TVA as a setting for his work on the theory of organizations in *TVA and the Grass Roots: A Study in the Sociology of Formal Organization* (1949). All references to electrification in this book are tangential. One of the few inspired studies of the effects of rural electrification was undertaken by Joseph E. Davis, an agricultural economist. In a report entitled *Use of Electricity on Farms: A Summary Report of Ten Area Studies* (1956) he summarized ten research projects on the impact and utilization of electricity on farms in different regions of the United States. These studies were separately published between 1950 and 1955. Davis concluded that the use of electricity on farms is directly correlated with the type and size of farm.

In general, writings on rural electrification are rife with untested assumptions concerning its benefits which are stated as fact. Among the large number of these, some of the more conservative follow:

1. Increasing agricultural productivity resulting from the use of labor-saving electrical equipment.
2. Changing crop patterns resulting from the use of seasonal labor-saving equipment and/or the use of electric pumps to provide irrigation water.
3. Development of rural industries, especially those related to the processing of agricultural commodities in rural areas.
4. Increasing per capita income resulting from increased agricultural productivity and the development of industrial employment opportunities.
5. Reduction in household labor through the use of electrical appliances.
6. Reduction in rural-urban migration of families and young people as rural living conditions improve and employment opportunities are created through industrial development and expansion.
7. Improvements in household sanitary conditions and family health resulting from the use of electricity for water systems, refrigeration, ventilation and lighting.
8. Relating to rural electric cooperatives--improved sense of community participation and involvement resulting from work on a self-help project; development of community leadership training.
9. Increased satisfaction with life resulting from amenities available following electrification.
10. Reduction in household energy expenditures with the substitution of electricity for candles, kerosene, gas, and wood.
11. Increased levels of living resulting from the availability and use of electricity.

The Study of Rural Electrification in Latin America

Rural electrification is a recent phenomenon in Latin America. Rural electrification projects are few and relatively new. Consequently, there has been little to investigate. Those few studies which have been done have dealt more with the construction of electrical distribution networks than with examining their impact.

In addition to the countries being looked at in this report, only a few other Latin American nations have rural electrification networks. The cooperative system for the distribution of rural electricity in Chile was depicted in the short paper entitled Rural Electrification Cooperatives in Chile by Sergio Carvallo (1950). A pilot project for rural electrification in the Northeast of Brazil was described in a technical report by the Banco de Nordeste de Brasil (Northeast Bank of Brazil) entitled Electrificacao Rural no Nordeste: Alternativas de Localizacao de um Projecto Piloto (1959).

One of the largest and best administered projects for the distribution of electricity in rural areas is that operated by the Corporacion Autonoma Regional del Cauca (Autonomous Regional Corporation of Cauca), (CVC), in the Cauca River Valley of Colombia. The foundation, growth, and current activities of the CVC are documented in the CVC: Challenge to Underdevelopment and Traditionalism by Antonio J. Posada, Jr. and Jeanne de Posada (1966). A second, although less ambitious, study conducted in Colombia is worthy of note. Augusto Torres, Stanley Lichtenstein, and Paul Spector conducted a research project under the auspices of AID on the placing of small diesel generators in several Colombian villages. Their report was entitled Social and Behavioral Impacts of a Technological Change in Colombian Villages (1968).

The one major publication on rural electrification projects is Cooperative Rural Electrification: Case Studies of Pilot Projects in Latin America by James E. Ross. Ross provided benchmark data from examinations of either functioning or planned rural electric distribution cooperatives in Colombia, Ecuador, Nicaragua, and Costa Rica. The data in this book were drawn mainly from feasibility and pre-electrification studies and thus deal only tangentially with the impact of electric use in rural areas.

The progressive nature of Costa Rica is readily apparent in the field of rural electrification. The Instituto Costarricense de Electricidad (Costa Rican Electrical Institute), (ICE), is the centralized agency which governs both the generation and distribution of electrical current throughout the country with the exception of the capital city, San Jose. Because of its interest in both economic and social investigation, rural electrification has been studied in Costa Rica. The published literature, however, deals mainly with the construction of generating and distribution projects and with economic feasibility reports. The evaluation of the impact of energy in rural areas has been of secondary importance.

Typical of the ICE publications is Desarrollo de la Industria Electrica de Costa Rica (1956). This pamphlet contains a well written section on the creation of ICE, a complete description of the generation and distribution of electrical energy in Costa Rica as of 1956, and a projection for increased electrical output through 1965.

Other studies of the subject have been published by the Consejo Interamericano Economico y Social (Interamerican Economic and Social Council) of the Organization of American States. Among its publications is Resena del Primer Proyecto Piloto de la Cooperativa Rural Electrica de San Jose de Naranjo, Costa Rica.

The first study in Costa Rica which alluded to the impact of rural electrification was Estudio Agricola-economico de la Cuenca Media del Rio Grande by Oscar R. Benavides (1956). Benavides working under the tutelage of Olen E. Leonard studied 371 farms in the Meseta Central of Costa Rica. Although the study concentrated on a man-land relations analysis of the area, Benavides did provide some information on the use of electricity.

An important contribution to the body of literature which pointed out the need for further analysis of the impact of rural electrification was made by Galen C. Moses. His study, Cooperative Rural Electrification in Costa Rica (1969), analyzed social and economic characteristics affected by both the present and expected electrical use in rural areas. Since his work focused on the projected utilization of electric current, his treatment of the impact of centrally distributed current was limited. Ross summarized the Moses study in a chapter of his Cooperative Rural Electrification: Case Studies of Pilot Projects in Latin America (1972).

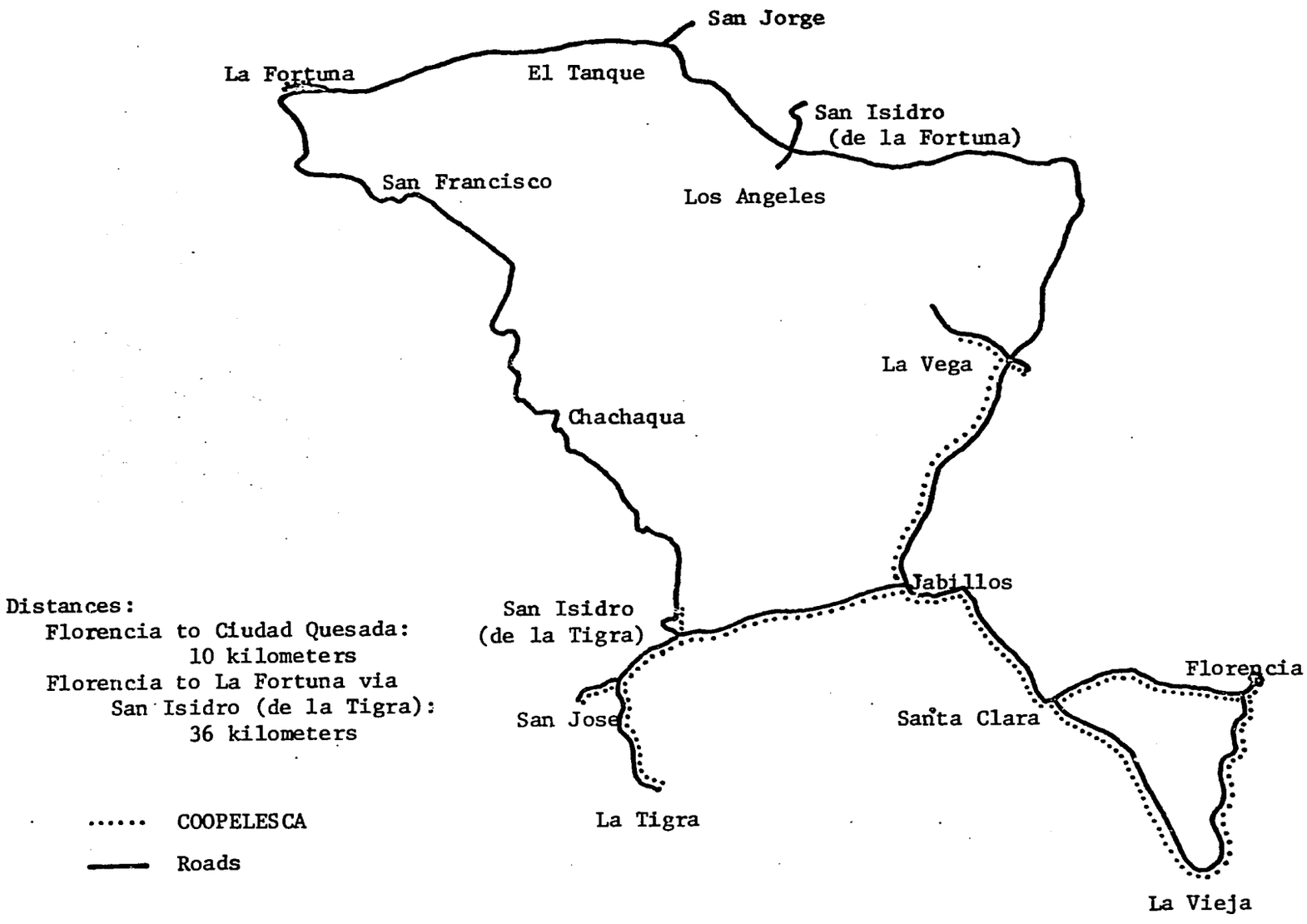
Research Design

Since the research team was limited to a one-time cross sectional measurement, an ex-post-facto experimental design was decided upon and an appropriate area for its application identified in each country. In Costa Rica the La Fortuna area of Canton San Carlos was selected. The lower (southern) half of the area (See Figure 1) is supplied with power generated by the Instituto Costarricense de Electricidad (Costa Rican Institute of Electricity) (ICE) and distributed by the Cooperativa de Electrificacion Rural de San Carlos R.L. (San Carlos Rural Electric Cooperative) (COOPELESCA). This area has been electrified for three to four years and is, in effect, an experimental area. The upper portion of the San Carlos study area is not served by a central electric distribution system. Since the entire study area is essentially homogeneous this upper or northern portion is used as a control group in what is a naturally occurring experimental situation.

The independent variable of greatest importance to the study is dichotomous: the use or non-use of electricity. However, because not everyone beyond the reach of COOPELESCA lines is a non-user and not everyone within their reach is a user, two categories each of users and non-users were identified. There are users who are connected to the cooperative distribution system (USERS) and those who, being located beyond its reach, are supplied by private generating plants or small private distribution systems (ALTERNATE USERS). Similarly, there are non-users who although located within reach of COOPELESCA lines have not become connected to them (NON-ADOPTERS) and non-users beyond the reach of these lines who do not utilize any source of electrical energy (INACCESSIBLES).

The research design took into account the possibility of encountering these four categories of users and non-users. The impact of electrical use should be most clearly revealed by comparing those who have connected to COOPELESCA, the USERS, with those who, although they had the opportunity, did not, the NON-ADOPTERS. The non-users who do not have an opportunity to use this source of power, the INACCESSIBLES, should have characteristics which differ from both the USERS and NON-ADOPTERS. They are, in reality, a control group included in the research design. Because of the small number of cases of ALTERNATE USERS found, 32 in Costa Rica and 10 in Colombia they have been eliminated from the analysis.

Figure 1
Rural Electrification Study Area, Costa Rica



The same research design was employed in Colombia, but in an area served by a state owned distribution system, the Corporacion Regional Autonoma del Cauca (CVC), not far from the city of Cali. Geographically, the users, non-adopters, inaccessibles and alternate users are more interspersed among each other given the different nature of the area and different arrangement of the distribution lines (See Figure 2).

Survey Schedules

The survey schedule used in Costa Rica and modified for use in Colombia was developed between June and August, 1972. Saunders and Davis discussed at length what types of information were to be gathered and the process by which we would most effectively be able to reach our goals. For the preparation of the sociological portion of the survey schedule we relied on the results of both extensive library research and our combined personal knowledge of rural electrification, Costa Rica, and sociological methodology.

We decided that the desired data could be gathered most expediently through the use of survey research. Accordingly, we roughed out broad areas of interest in which we wished to collect data. Davis then produced a tentative first draft of the proposed survey schedule.

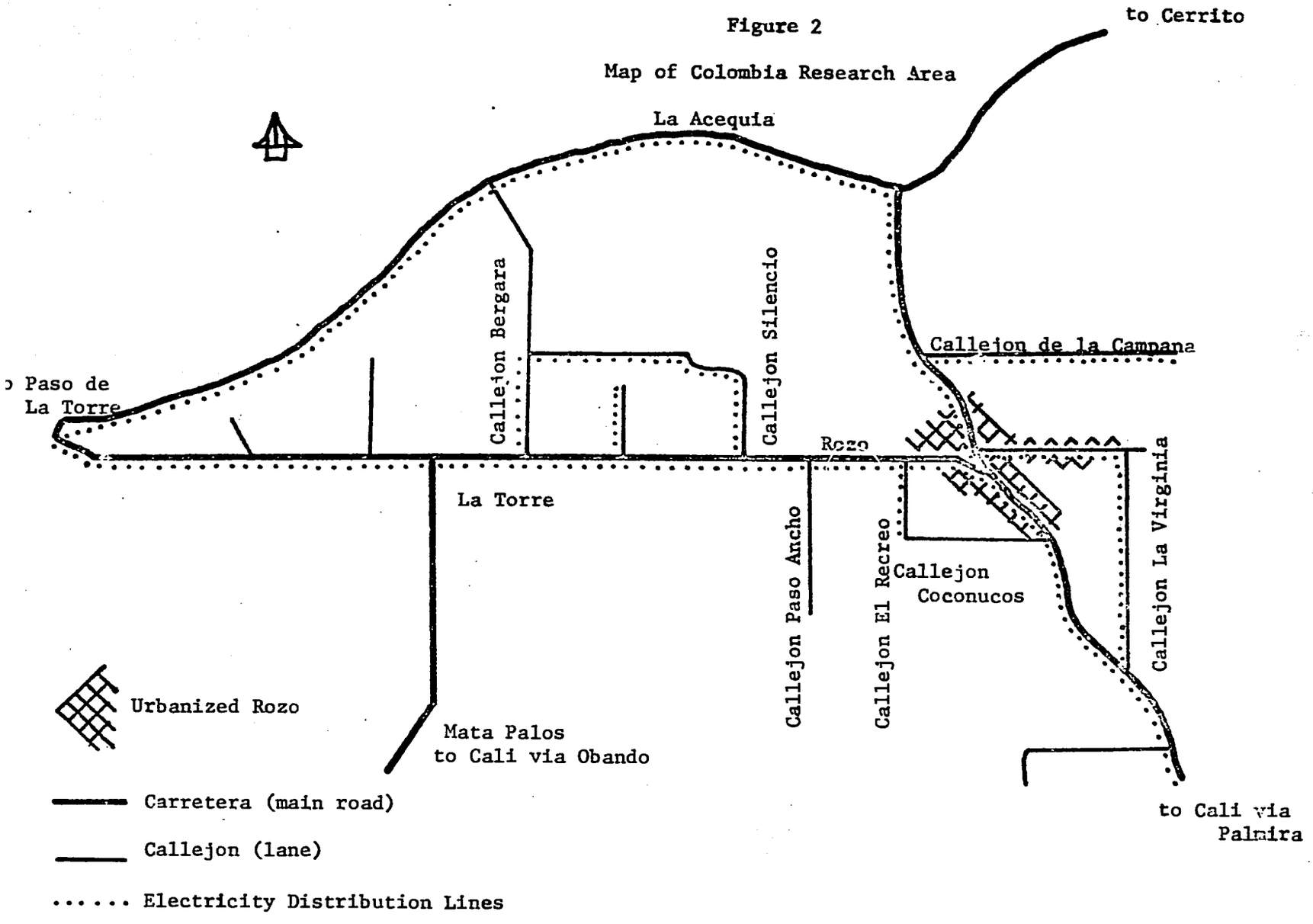
There then followed a series of re-writings of the documents which incorporated ideas and corrections supplied by both Saunders and Moses, a trained agricultural economist. Although we all tempered and modified the contributions made by each other, Saunders and Davis are largely responsible for the basic format of the instrument and those questions which deal with social aspects; Moses' input is clearly seen in the questions dealing with economic matters and in the agricultural section.

Davis and Saunders translated the instrument into Spanish and prepared what we had anticipated would approximate the final form. This draft was taken to Costa Rica where it was modified substantially for the field pre-test and further changed before a final draft was produced. The major revision of the schedule was made by Davis, Saunders and Moses in collaboration with Victor Hugo Cespedes and Alvaro Vargas of the University of Costa Rica during three days of intensive work. It was changed to conform to local terminology and to improve the wording of questions and the internal structure.

The input of both Costa Ricans was invaluable. Both were trained in conducting survey research. Vargas had had consummate experience in other endeavors similar to ours. Of special importance was their comprehension of the need to make our questions intelligible to rural Costa Ricans, especially to those living in rural San Carlos. The Spanish spoken in Costa Rica, as is the case in other Spanish speaking Latin American countries, varies not only from region to region but also from urban to rural areas. Cespedes, who is a native of the study area, gave us major assistance in insuring that our questions were phrased in the common language as spoken in San Carlos.

Figure 2

Map of Colombia Research Area



JHD

The final version was typed and mimeographed by secretaries of ICE. Their assistance was obtained by a major collaborator in this study, Senor Oscar Benavides, director of economic studies of ICE.

A copy of the survey schedule, Costa Rica version, is enclosed as Appendix A and of the Colombia version as Appendix B. Before discussing the actual contents of the document, we feel that it is pertinent to present some of the considerations which were taken into account which strongly influenced both the style and content of the instrument. This exposition serves as an explanation of why the actual finished product emerged as it did and why various segments were included while other facets where necessarily excluded.

The fact that the schedules were to be returned to the United States to be coded exerted a strong influence on their construction. Once the actual process of data collection was complete, it would be impossible to return to resolve any problems which might arise in conjunction with any aspect of the interviewing process. On the other hand, problems of coding and analysis could be worked out in the United States. As a result, when doubt arose as to the form of any portion of the schedules, considerations which might help to clarify a point either for the interviewer or the respondent took precedence over ease of analysis. A casualty of this consideration was pre-coding of the schedule. It was decided that the configurations needed for pre-coding purposes would confuse the interviewers. Consequently, they were eliminated from the final form of the survey schedule.

The survey schedules were designed so that theoretically they would take approximately one hour to administer.[1] This time limitation dictated certain restrictions on both the type and number of specific questions which could be included. For example, it would have been of interest to have gathered data on household expenditures. This, however, would have entailed adding a large number of questions including a series of time consuming queries about precise disbursements for groceries, medical services, clothing, etc. This clearly was impractical. Furthermore, experience has shown that respondent fatigue often sets in after about 45 minutes affecting the quality of the data obtained.

In order to shorten the length of the interviews, the survey schedules included a variety of filter questions, enabling the interviewer to bypass certain subsequent questions. For example, if a head of a household indicated that he had always lived in the same house, there was no need to ask the individual about his previous housing (See Appendix A, page 3). The bypass responses were signalled by arrows pointing to the number of the question to which the interviewer should proceed (See Appendix A, page 26).

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1. The actual length of the interviews varied between 25 minutes and 2 hours. The average time was approximately 40 minutes.

To facilitate the work of the interviewers, a single schedule was developed for use in all of the interviews. The result was that no one individual was asked all of the questions included in the schedule. As an example, those who used electricity were not asked to respond to queries dealing with the non-use of electricity. Also, merchants who owned no land were not questioned about agricultural production. (See Appendix A, page 6-24). Concise directions were given to the interviewers during their training and were included in each of the schedules concerning the characteristics of the respondents which governed the particular series of questions to either be asked or omitted.

As indicated by the term "survey schedule," forms were filled out by trained interviewers rather than by the respondents. The printed questions were asked by interviewers who also wrote down the answers. Few of the respondents ever saw the printed questions. The decision to conduct the interviews in this manner was made basically for three reasons. It had been expected that many of the heads of households would be functional illiterates. Therefore, they would be unable to read the questions and write in the answers. Secondly, it was felt that respondent filled-in questionnnaires would be both more incomplete and less legible. Finally, and perhaps most importantly, by utilizing trained workers a greater uniformity of response was obtained. The interviewers were cognizant of abnormal or incomplete responses and were able, by probing, to direct the questionning, if needed, to assure the compilation of the data requested. This process insured the receipt of uniform compatible data without affecting its quality.

One of the primary means of attaining the stated ease of interviewing objective was to so structure the sequential arrangement of the questions so that there would be a smooth transition from one series of questions to the next. Simple statements were used to introduce each section so as to facilitate the transition from one topic to another. Within each separate segment, the first questions elicited concrete information which the respondent could readily divulge. The more thought provoking queries were nestled safely towards the end of each section. For example, in the section dealing with exposure to mass media, the first question merely inquired if the respondent possessed a radio. Towards the end of the section the respondent was asked the names of television programs which he considered to be useful (See Appendix A, pages 5 & 6).

The composition of the survey schedule was not only influenced by the considerations mentioned above but also by the specific types of data which were sought. The discussion will now turn to identifying and examining the questions included to elicit information on specific subjects. While most of the data refer to the head of the household, some also pertain to other members of the household.

In spite of the degree of excellence of the personnel and of the training, an extraneous variable which affects any survey research project is what Benney & Hughes (1970) refer to as the "interviewer effect." Questions designed to gather information concerning the influence of the interviewer on the interview encounter were placed in the survey. It is hoped that in the future these data can be utilized for a methodological evaluation of the interviewer effect in this study.

The interviewer is generally best qualified to evaluate each encounter with respondents. Questions were included which enabled the workers to comment on each interview, especially with regard to the degree of cooperation, precision of answers, and their opinion of the degree of rapport between themselves and the person they talked to. During training it was stressed that this information was not intended to evaluate the work of the interviewers.

So that in a future re-survey respondents who were interviewed in 1972 might be identified, the name of the head of the household and the location of his residence were recorded. Basic demographic data were obtained for members of the household defined to include all persons, regardless of relationship to the head, living under the same roof. These were: age, sex, last year of school completed, occupation and relationship to the head. The same information plus place of residence was obtained for children living away from home. Data on the number of deceased children and their age at the time of death were also gathered.

Additional demographic data for the head of the household was sought. Questions which included place of birth, location of his last place of residence, length of time he had lived in the present dwelling, and his plans for moving in the future. Probes were also made to elicit more information about the employment of the head of the household. Questions dealing with both a self-definition of his employment and his sources of income were included.

In order to assess the influence of electricity, especially electric lighting, on the use of time, questions were asked about pastimes and the length of the work day. Mass media exposure has been found to be correlated with the adoption of the use of technological innovations (Rogers and Schoemaker, 1971, and Ryan 1969). In order to examine the relationship between exposure to the mass media and the adoption and use of electricity, data on the intensity and length of exposure to different types of mass media were obtained. Questions were included on the frequency of listening to radios and watching television. Inquiries were also made about programs which were considered to be of value and about the number and types of newspapers and magazines read.

Although the area studied is primarily devoted to agricultural and pastoral activities, it was of interest to learn about the types of businesses which furnished services to the residents. Accordingly, we endeavored to obtain data about businesses in the area.

As has been noted, one of the few concrete findings correlates rural utilization of electricity with both type and size of farm (Davis, 1956). We were anxious to focus on these relationships and seek to further the analysis of the co-variance of these phenomena. Consequently, a lengthy section was constructed and designed to produce a large quantity of data dealing with agricultural and pastoral enterprises.

The emphasis of the agricultural segment of the survey was to provide information useful for the study of the complex institutionalized relationships between man and the land. This encompasses, for the present purposes, land tenure; size of farms and farm-like entities, including land both owned and used under a variety of contractual and informal arrangements; types of farming; and systems of agriculture. Secondary importance was given to gathering information about the use of farm labor and the quantity of constructions and equipment used on the farm.

To discuss cogently the impact of electrification, it is essential to establish the parameters of actual use. The specific empirical aspects of this use deemed most important for the present research project were the following: length of use, supplier of the current, alternate sources of electricity, quantity and type of fixtures used for illumination and quantity and type of apparatus. In addition, an attempt was made to determine what was viewed by the respondents as being the most important use of electricity, opinions on what can be done with electricity which could not be done in its absence, and speculation on the problems which would be caused by a cessation of electric service.

Electricity is but one of the sources of power which can be used for domestic purposes. The value of electric current can be measured as a replacement for some other source of power. We, therefore, wished to assess the cost of all energy sources used in the household. This information was requested from both users and non-users of electricity. It is posited that a comparison of the expenses for energy incurred by those in these two groups would shed light on the economic value of the utilization of electricity.

Several questions were included to evaluate the non-utilization of electricity. An attempt was made to determine why some households were not electrified. Included in this section were queries concerning previous use of electricity, perceived importance of this source of power, readiness to install electric lines, and the perceived advantages associated with electricity vis-a-vis alternate sources of power; these questions are of course moot for those living beyond the physical reach of power lines.

The impact of the use of electricity was a priori viewed as being social as well as economic. The sense of social well-being or social contentment may be measured by examining one's satisfaction with life and by learning how a person would alter his life if given either the opportunity or the financial resources to do so. Six questions were included in the survey schedule for use in evaluating satisfaction with life situation.

Participation in organizations is an element which generally exists when people form a community. This phenomenon termed social participation, was of interest for three reasons. First, an objective of the study was to evaluate the awareness of the cooperative as a form for the distribution of electricity and participation in its affairs. Accordingly, an effort was made to gather information relating to knowledge of the functioning of cooperatives, and especially of COOPELESCA. Secondly, those who paid for electricity supplied by COOPELESCA were *ipso facto* members of that cooperative. One of the stated goals of cooperatives is to disseminate knowledge of cooperatives and to strive to create more cooperative efforts. It was of interest to see if this had transpired in San Carlos. And lastly, comprehension of the types and strengths of the various organizations, groups, and associations in a given community aid in understanding it.

The analysis of socio-economic characteristics is a useful device for dividing the members of a community into workable categories of those sharing similar traits. The accurate classification of the socio-economic characteristics of the members of a society is, in reality, sufficient work for a large research project. Nevertheless, the need for this information dictated that appropriate data be compiled. A level of living scale was incorporated in the survey schedule as a measure of socio-economic status. The scale, patterned after the work by Belcher (1972), examined the way in which fourteen basic household functions were performed.

The survey schedule utilized in Colombia was essentially similar to the one used in Costa Rica. Wording was adopted to conform to local usage, and one or two non-applicable questions were omitted. The only important change consisted of the expansion of the section on migration which was done at the request of the CVC.

Data Collection Procedures

The main body of data utilized was collected through intensive field interviews during August of 1972 in Costa Rica and January, 1973 in Colombia. Complementary data were drawn from official government publications and from various studies dealing with each country.

The Costa Rican survey research data were collected by a group of trained Costa Rican interviewers. Interviewing was conducted under a contract between the University of Florida and the *Instituto de Investigaciones Economicas* of the University of Costa Rica. Mr. Victor Hugo Cespedes, Acting Director of the Institute was responsible for hiring, interviewer training and administration of various matters regarding field work. Mr. Cespedes contracted with Mr. Alvaro Vargas to supervise the field work and also aid in interviewer training. Both Mr. Cespedes and Mr. Vargas, who has his licentiate in economics, have had previous experience in research projects such as this.

The interviewers received three days of intensive training. Alvaro Vargas conducted most of the training sessions which consisted of explaining the intricacies of the survey schedule, the goals of the research project, and the manner in which the interviewers were to conduct themselves in the field. Emphasis was placed on establishing rapport with respondents, on insuring that the interviewees would understand the various questions, on seeing that all effort was to be made to prevent the premature termination of interviews, and on making certain that all respondents were satisfied at the end of their research experience. The training took into account the fact that the respondents would not be experienced in granting interviews. The interviewers were to help them through what would be a learning situation. Because the people of San Carlos would be assisting us by granting us the opportunity to obtain information from them, we sought to insure that they would understand that we appreciated their cooperation. Secondly, while the interviewers would be leaving the research area to sleep elsewhere, the respondents would stay and communicate with others in their respective communities. If a respondent was dissatisfied with his interview experience, he could, by voicing his unhappiness with friends and neighbors, prejudice our efforts on successive days. The interviewers were taught that their actions in an interview situation could have severe repercussions for contacts with future respondents.

During the training period the interviewers were given every opportunity to suggest changes in the survey instrument. This training constituted, therefore, an initial pre-test of the survey schedule.

The interviewers field pre-tested the instrument in the Canton of Cartago. After a great deal of deliberation, it was decided to conduct the pre-test in an area other than San Carlos. Although it would have been beneficial to have introduced the workers to the actual research area, it was feared that a premature entrance into the area would contaminate future responses. Consequently, a different rural area was chosen. During the field pre-test, each interviewer, under the supervision of both Alvaro Vargas and John Saunders, completed at least one interview.

The day after the field test of the instrument, a final training session was conducted. During this time, the interviewers were debriefed on their experiences and the completed schedules were closely examined. Some modifications were made in the instrument as a result of points elaborated during the final training session.

On Wednesday, August 16, 1972 the interviewing team left San Jose for Ciudad Quesada. Part of the interviewers went by public transportation with the rest crowded into a jeep which was furnished by ICE for the duration of the field work. Through previous arrangements, COOPELESCA provided a second jeep which we were able to use for most of the time we remained in San Carlos.

Along with thorough supervision in the field the interviewers received periodic training sessions. Each interviewer was required to revise his work before turning it in. Inevitably errors went undetected in this process. The field supervisor and Mr. Davis would then review the schedules. They would talk with the interviewers sometimes with the entire group present, to discuss mistakes and to avoid them in the future. It was not always possible, in spite of repeated return visits, to locate the head of the household. In these instances someone other than the head of the household was interviewed, usually the spouse.

The diligence of Alvaro Vargas resulted in there being only two refusals out of 486 attempts. One case was that of a cook who although she fixed a meal for several of us, refused to answer questions in an interview. The second case was more dramatic; a man answered the door with a shotgun in his hands. He told the interviewer to leave and not return. The interviewer readily complied.

Besides administering survey schedules to 484 respondents, re-interviews were conducted in 46 of the same households. The re-interviews were obtained in an attempt to compile data which could be used to evaluate the reliability of the information gathered. The second interviews were deliberately carried out by a worker other than the one who had originally interviewed the respondent. By a careful comparison of the re-interviews with the original interviews, 32 were identified as having been answered by the same person on both occasions. An analysis of the findings indicates that the reliability index of the data is high, especially when compared to other studies. These findings are discussed below.

Essentially similar procedures were followed in Colombia except that in the absence of an organization such as the Instituto de Investigaciones Economicas with which to contract for the field work, it was necessary to hire interviewers and supervisors directly. The CVC was helpful in providing consulting services during the planning phase and transportation in the field. Mr. Alfredo Roa, in particular, aided with his advice and counsel and placed vehicles at the disposition of the interviewing group.

Reliability and Validity of Data

A survey is a very complicated operation and the researcher must take many precautions if he wants the results to reflect the reality of the situation he is studying. Among the many properties the answers gathered in interviews must have, validity and reliability are of fundamental importance. A measurement instrument is valid if it produces relevant information about the object being measured (that is, it measures what it is supposed to measure), and it is reliable if repeated measurements by the same procedure give similar results (Jahoda et. al., 1951:93). Great care must be exercised that the questions in the schedule have the same meaning for different interviewers

(Blalock, 1968:12). There are three main methods of measuring reliability: "test-retest," "simultaneous rating" and "split-half." For technical reasons, the best technique for surveys of this kind is the "test-retest," which consists in re-interviewing a subsample of the original sample using the same schedule, within a relatively short time after the first interview (Young, 1956:351).

The index of reliability can be very simple like the one used in this study and defined below, or it can be based on very sophisticated mathematical models like the one used by the United States Bureau of Census (Bailor, 1968) or in complicated opinion surveys (Hochstin and Renne, 1971). The theory behind the index was developed at the beginning of this century by Spearman, Guttman and others and it has been empirically tested in many psychological experiments. The time and cost involved in the reliability testing of a survey are amply compensated by knowledge of the confidence that can be had in the data.

Studies have shown that the reliability of answers in interviews depends on many factors such as age, sex, education and other qualities of the respondents (Hochstin and Renne, 1971). A very important factor is the content of the questions (Lehnen) and whether the questions are open or closed. Surprisingly, surveys are rarely tested for reliability and the results obtained, if published, have been not too encouraging (Alers, 1970). The decision to re-interview in Costa Rica proved to be very rewarding, as will be clear from the following analysis.

Analysis

To test the reliability of the answers, 46 re-interviews were made, 32 of which were answered by the same person. These 32 re-interviews were compared with the original interviews and each question was marked as a "match" or "non-match," according to criteria that will be explained when each section of the schedule is analyzed separately. Each re-interview was made by a different interviewer than the original interview. The coefficient of reliability is defined as the number of questions that are comparable over the number of "matched" questions. A question is operationally defined as comparable if it was answered in both interviews. The index of reliability for the whole schedule is r = .85.

The schedules were divided into 11 sections and a coefficient of reliability, using the same definitions and criteria, was calculated for each section. The results are presented in the following table:

I.	-The respondent and his family	.91	II.	-Mass media exposure	.83
III.	-Occupation	.90	IV.	-Agricultural information	.78
V.	-Use of electricity: general	.84	VI.	-Farm use of electricity	.--1

VII.	-Non-Use of electricity	.83	VIII.	-Satisfaction with life situation	.75
IX.	-Social participation	.87	X.	-Propensity to migrate	.83
XI.	-Level of living	.95			

[1]None of those interviewed for the second time used electricity on the farm.

The sections with the highest coefficients of reliability, I and XI, contain mostly factual information in the first case (I) and information gathered partially by observation of the interviewer himself in the second case (XI). The section with the lowest coefficient (VIII) was composed of attitudinal questions about the respondent's perception of his life situation. The section on agricultural information also has a relatively low coefficient of reliability. In analyzing each section, a factor that must be considered is the effect of the first interview. The hypothesis is that the first interview will have a sensitizing effect producing greater completeness and/or specificity in the re-interview.

Section I, The Respondent and His Family

The section has two kinds of questions: factual - place of birth, length of time lived in the house, location former residence, etc., - and questions about pastimes (pasatiempos). In the first category, surprisingly, a few persons did not remember where they were born (Gave different answers in the re-interview) and seven persons gave different answers to the question "How long have you lived in this house?" In the re-interview five persons gave more years than in the interview and two gave less. Examples: from 7 to 25 years, from 1 to 6 years, from 12 to 4 years.

Questions 10, 11 and 12 asked about pastimes of the head of the household, the wife and the children. If we consider that there was a re-interview effect in cases where the first answer was "none" or "to rest" and the second time the answer was more specific, there were 13 cases that confirmed the hypothesis and four cases that disproved it.

Section II, Mass Media Exposure

The following questions were considered to test the re-interview effect hypothesis: Do you watch television? How frequently do you watch? Do you watch programs that you consider useful? Do you listen to the radio? How frequently? Useful programs? Are there newspapers in the house? Do you read magazines? The influence was considered positive when the answers changed from "no" to "yes," and from "rarely" and/or "sometimes" to "sometimes" and/or "everyday." There were 23 instances of positive effect and 10 cases of negative effect. The question that had the highest number of positive changes was: Do you listen to any programs you consider useful?

III. Employment

In the question: "Como gana usted la mayor parte de su dinero," (How do you earn most of your money?) one would assume that people would tend to upgrade themselves in the occupational classification, but in all the instances of discrepancies observed between the interview and the re-interview, the respondents switched from "agricultor" to "jornalero" or, from farmer (agriculturist) to laborer. For the question: Besides doing housework does your wife help you in your work? Three respondents switched from "no" to "yes." For the question: Do you have any other source of income? Two persons switched from "yes" to "no" and two the other way around.

IV. Agricultural Information

This section, composed exclusively of factual questions, showed a surprisingly large number of discrepancies. Seven persons reported a different number of "manzanas" they owned, with discrepancies as large as 15 to 2 or 5 to 18 (interview to re-interview). The cost of the "manzana" was differently reported by 12 persons with differences as big as $2,000 to $4,000 colones or $5,000 to $3,000 colones. Three persons cited a higher price the second time, four gave a lower price and the rest said "do not know" the first time and gave a price the second time. The questions about cattle owned contained more surprises. Some examples of discrepancies: from 17 to 43, from 39 to 0 from 24 to 68. Altogether, 10 persons gave different answers to this question. There were five discrepancies for the question about farm machines owned, and five for the question about farm installations, and nine persons gave different answers to the question: What are your three main crops? As indicated in the table, this section showed the second lowest index of reliability.

V. Use of electricity: General

This section was answered in both cases by only 20 persons, as 11 persons of the sample did not use electricity and in one case the section was not answered in the re-interview due to interviewer error. There were discrepancies in the following questions: What can you do with electricity that you could not do without it (nine discrepancies), What would be the main problem if you were without electricity for a month (four) What is the most important use of electricity for you (seven), and cost of the installation of the electricity (three). In the last question, two of the answers were "do not know" in one instance and a price in the other.

VI. Non-use of Electricity

Eleven persons answered this section and two questions showed support for the re-interview hypothesis: Do you think that to have electricity is advantageous or disadvantageous - showed three cases where the answers were switched from disadvantageous to advantageous. In the question: What could you do with electricity that you cannot do now, three persons switched from "do not know" to explicit answers.

VII. Satisfaction With Life Situation

This section, composed of attitudinal questions, had the lowest coefficient of reliability, which even so was relatively high (.75). People were asked to answer questions like: Is your present situation in life worse, better or equal to what it was five years ago, according to a five value scale: much better, better, same, worse and much worse. An answer was considered a "non-match" if they differed more than one position in the scale. There were 23 changes in the negative direction of the scale and 13 changes in the positive direction of the scale. The question that had the highest number of negative changes was the one that compared the present situation with the situation of the father.

A question by question analysis of this section revealed that the questions dealing with the present and future were the most stable and that those dealing with the past were the least stable.

VIII. Level of Living

This section had the highest coefficient of reliability. The questions that showed the highest number of discrepancies were: What facilities do you have for cooking (seven discrepancies) and What means of transportation do you have (four). In the first instance, there seems to be a systematic error: confusion between the answers "fogon" and "cocina de hierro." In the second. there was a problem in interpretation: many persons understood "means of transportation" as mechanical and did not think of horses and carriages as means of transportation. For these reasons, these two questions were not considered for the calculations of the coefficient of reliability of this section.

It should be noted, however, that since responses are generally grouped for analytical purposes, response errors are minimized.

Discussion

As compared with other studies of reliability (Hochstin, Lehnen) and especially with the study made by Alers among Indians in the highland Peruvian estate of Vicos, the index of reliability of the present study is very high, which is an indication of the good quality of the data. This study confirms the results found in many other studies that the re-interview effect is an important factor that influences the answers. It also confirms the empirical findings that factual questions have a higher reliability than attitudinal questions. The high coefficient of reliability can be also taken as a confirmation of Alers' conclusion that for developing countries, closed questions have a much higher reliability than open-ended questions, due to cultural differences and the relatively low level of education of rural populations.

The sample is too small to make an analysis of variables such as age, sex, and education of the respondents. The importance of this kind of analysis, however, is insignificant in the present case due to the excellent reliability of the different sections of the schedule. A surprising finding is the relatively low reliability of the agricultural section. This seems to indicate that there are local conditions affecting the responses. For future similar studies, it would be desirable to conduct a previous pilot study, in order to assess these conditions and their influences on the answers. This could be an important methodological finding for future research in the area of socio-economic surveys in developing countries.

Constructed Variables and Indexes

A major task of social science research is the necessity to categorize and classify data which are to be analyzed. In order to strive for the fulfillment of this requirement and to facilitate the comprehension of the presentation of results, several indexes and scales have been constructed. These variables are built by incorporating the data garnished from various questions asked in the survey schedule. In most cases a wide array of data has been compressed into a small number of categories.

Level of Living

Rural sociologists have long chosen as one of their areas of interest the investigation of the economic well-being of rural residents. In order to evaluate this characteristic it is necessary to have instruments that differentiate between levels of material well-being. Level of living scales have a long history in the social sciences. William H. Sewell in the 1930's developed a widely used level of living scale for Oklahoma farm families. Such scales have been found useful for the measurement of differences in the level of consumption of goods and services. The primary advantage of this technique is that it incorporates valid data which can easily be gathered through the use of survey research.

However, until recently, level of living scales were both time-bound and culture-bound, in that they were mainly based on the possession of consumer goods. Thus, for example, whereas ownership of a radio in 1920 in the United States had discriminatory value, currently, since ownership of this item is almost universal, it no longer does. Likewise, radio ownership would be inappropriate to use in a level of living scale comparing, for instance, Oklahoma farm families with Amish families because of the prohibition among the later, for religious reasons, of possession of the item. Still other items such as coffee grinders, for example, largely disappear from use cancelling their value as meaningful components of a level of living scale.

John C. Belcher has developed a level of living scale based on the performance of household functions rather than possession of material goods (1972). He noted when commenting on his newly developed approach to the construction of his scale:

> The approach developed...was to list a number of functions that are customarily satisfied in the household in all societies and that require material items for the effective performance of the function" (1972:10).

The most important point in the definition is that relating to functions. The Belcher scale measures level of living by assigning values to the manner in which basic functions related to a household and its occupants are performed, for instance, shelter, human waste disposal, cleaning, lighting. Since these are functions which are performed to some degree in all households at all times, the scale does not suffer from the limitations mentioned above and is the best available technique for assessing levels of living between disparate social and national groups. Furthermore, real rather than the symbolic performance is stressed.

The level of living scale incorporated in this study is patterned on that developed by Belcher and contains fourteen questions (See Appendix A, pages 28-33). These questions deal with both the materials used in the construction of various portions of the dwelling and with the manner in which basic functions are performed within the household. There were six possible responses to each question. Five of these were rank ordered ranging from low, indicating an absence or minimal means of fulfilling the function, (assigned a value of one) to high for the most advanced method of satisfying the particular function (assigned a value of 5). The sixth response was a residual category in which answers that did not fit neatly into the other responses could be placed. These were later re-coded to conform to the five-point classification. A zero was added as a sixth code. This was reserved for those cases when a particular function such as cooking, for example, was not performed in or near the house of the respondent.

The combined score of the responses to the fourteen questions resulted in a total point spread ranging from a hypothetical low of zero to a possible high of seventy (14 x 5). After an analysis of the data, a level of living scale (LEVEL) was constructed. The six categories which comprise LEVEL are defined as follows: category one, less than 30 points; category two from 30 to 34; category three from 35 to 39; category four from 40 to 44; category five from 45 to 49; and the highest group, category six, 50 or more.

It should be noted, however, that five of the items included in the Belcher scale refer to household functions that, at their highest level, are performed with electrical equipment, for instance, dishwashing. Consequently, only electrified households could obtain the highest LEVEL scores. In order to eliminate this source of bias and assure comparability of results the electricity related items (See Table 1) were discarded and an electricity-free level of living index (LEVELNOE) was constructed with the remaining nine items which yielded a possible range

of scores from 0 to 45. Once the data had been analyzed LEVELNOE was constructed with five categories defined as follows: category one, less than 20; category two, from 20 to 24; category three, 25 to 29; category four, 30 to 34; category five, 35 or more.

Table 1

Questions Used in Level of Living Scale (LEVEL) Which Are Eliminated From Electricity-free Level of Living Scale (LEVELNOE).

How do you conserve perishable food?

1. None
2. Maintain food in a cool place
3. In jars or boxes
4. Icebox
5. Refrigerator

What do you use to clean your floor?

1. None
2. Broom made at home
3. Factory made broom
4. Electric broom
5. Vacuum cleaner

What facilities do you have for washing clothes?

1. In the river
2. Washboard
3. Wash tub
4. Hand washing machine
5. Electric washing machine

What system of lighting do you use?

1. Candles, kerosene lamp
2. Fuel oil lantern
3. Gas or kerosene lantern
4. Electric lightbulbs or fluorescent tubes
5. Electric lamps

Facilities for washing dishes

1. None, wash in the stream, river or creek
2. Tub which has various uses
3. Tub used exclusively for dishwashing
4. Sink with drainage
5. Electric dishwasher

Satisfaction With Life Situation

A satisfaction with life situation index was constructed for use in this study. Respondents were asked to compare their present life situation with that of their fathers, with their own five years earlier, and with that of their neighbors. Additionally they were asked to express an opinion with regard to what their life situation would be five years into the future and with regard to the future life situation of children when they reached maturity. Responses were recorded on a five point Likert type scale ranging from "much worse" to "much better," with "same" as a neutral response. La situacion is a term widely used and understood in Latin America to refer to the set of circumstances surrounding one's own condition in life. In the interviews, therfore, the referent was the respondent himself and the questions were easily comprehended and responded to.

The five questions included in this portion of the interview schedule (for the exact wording see Appendix A, page 25), permitted the calculation of four indexes. The present satisfaction with life situation index (SIT PRES) is based on the comparison with neighbors. The past satisfaction with life situation index (SIT PAST) is based on the mean of the scores to the two questions referring to the past, and the future satisfaction with life situation index (SIT FUT) on the mean of the scores of the two questions referring to the future. Finally, the total satisfaction with life situation index (SIT TOT) is based on answers to all five questions.

In each instance, of course, the responses given by interviewees are subjective evaluations. It should be noted however, that when referring to the past and to the present these evaluations have real referents to the extent that the respondent is aware of the life situations of his neighbors, of his father and of his own life five years earlier. Future life situation is, of course, much more speculative and is, no doubt, influenced by subjective optimism or pessimism as well as by an objective evaluation of future chances.

Mass Media Exposure

It has been shown that the various components of mass media are useful as a means of disseminating information about innovations, particularly technological developments (Rogers and Schoemaker, 1971 and Ryan, 1969). It was of interest to examine the relationship between exposure to the mass media and the use of electricity. Also, in an attempt to partially explain some of the characteristics which differentiate users of electricity from non-users, emphasis was placed on evaluating the influence of mass media.

The means chosen for quantifying the influence of mass media was to determine the amount of exposure to several types of mass media. The constructed mass media exposure index (MMEI) reflects the types of exposure, the intensity of exposure, and the evaluation of the importance of the exposure. Data were collected on four types of mass communications: radio, television, newspapers, and magazines.

The MMEI was constructed based on responses to twelve questions. Queries were made concerning the frequency of listening to the radio and of watching television. Those who answered that they "seldom" or "never" listened to the radio were given an index value of "0"; the same procedure was followed with regard to the frequency of watching television. Those who had the radio turned on "from time to time" or "every day" received an index weight of "1"; the same was done with respect to watching televised broadcasts. Respondents who stated that they listened to radio programs which they considered to be of value received one point. The same was done for television. No attempt was made to appraise the intrinsic value of the programs.

The respondent was given an index value of "1" if he reported that he read newspapers. He also received an equal value if he said that he had magazines in the house. No attempt was made to differentiate between either newspapers or magazines of varying quality.

The MMEI was constructed with a range of from zero to six, with the lower figure indicating an absence of exposure. After preliminary appraisal, the seven point index was reduced to one having four categories, by combining categories zero and one and categories four through six. This was done because of two considerations. The extremes of the range contained only a few cases. No one admitted to no exposure; only twenty-one respondents qualified for inclusion in the groups five and six. Secondly, the original index contained a bias which was eliminated in the shorter version. To be placed in category five or six, the respondent had to indicate that he viewed television. Since there are no television sets in the area not serviced by COOPELESCA, the inhabitants of that zone were discriminated against. In the shortened index, a respondent could qualify for inclusion in the maximum category without being exposed to one of the four types of media, including television. The index was adopted for use because it is more applicable to the desired analytic purposes.

Size of Farm

The size of farms and farm-like entities, may be defined as referring to the size of land areas used primarily for pastoral or agricultural activities which are held as definable units under various forms of ownership.

The basic unit of land studied in Costa Rica is the finca which may be translated as farm or sub-farm. The term finca is more exactly defined in the 1963 Costa Rican Censo Agropecuario (Census of Agriculture) as follows:

> a) A farm, for the purposes of the census, is an extension of land, of one or more manzanas(1) dedicated either partially or totally to agricultural or pastoral production, the labor for which is executed, directed, or directly administered either by a person alone or by one receiving help from others.

b) A farm may consist of one or more parcels either owned or belonging to someone else, not necessarily adjacent, but located either in one canton (county-like entity) or in neighboring cantones, as long as they form part of the same economic and technical unit (Costa Rica, Direccion General de Estadistica y Censos, 1965:21).

The Costa Rican census definition of finca explicitly excludes all tracts of land of less than one manzana from consideration as farms. Although these tracts of land do not qualify to be termed farms, they are nevertheless plots, or lotes as they are referred to in Costa Rica, on which active agricultural and pastoral production is pursued. Similar places were detected by Davis in his study of man-land relations of Norte de Santander, Colombia and referred to as conucos. These plots were described as follows:

> These small parcels of land are ones upon which crops are grown to supplement the income of the cultivator rather than to serve as a major source of his income. Since under the prevailing circumstances the conuco cannot be made to produce enough to provide even a subsistence level of existence for the agriculturalist and his family, it cannot be regarded as a farm. Rather, as a tract of land used merely to supplement income derived from other sources the conuco must be considered separately from the other explotaciones which are viewed as farms. The conuco must be viewed as a 'farm-like' or 'sub'farm' unit (1971:24-5).

The category of lotes is one of five classifications of the size of farms (SIZE FARM) used in this study. Considered as lotes are all of those agricultural-pastoral units of less than two manzanas. Since this limit is consistent with neither Costa Rican census classifications nor with those used by Upham (1969) in his pioneering work on the study of man-land relations in Central America, the reasons for selecting this figure should be given. Both the census and Upham consider as sub-farms those tracts of less than one manzana. This limit appears to be artificially low, especially in San Carlos where, because it has been recently inhabited, the land is not as thoroughly devoted to production as in other parts of the country. Because of the coding procedures used, it is impossible to discriminate between different sizes of plots each having less than one manzana. This became crucial when land owned and that used under some contractual arrangement were totalled as comprising one unit. Error would have been introduced had two or more plots of land been added without assuming that they would total more than one manzana. Thus since the upper limit of this category could not statistically be kept at one manzana, it was raised to 1.9 manzanas.

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1. One manzana (mz.) = 0.7 hectares (ha.) = 1.7 acres (a.).

Once the upper limit of the category of sub-farms was determined, the remainder of the process of classification followed closely established systems of categorizing the size of farms. The schema adopted here relies heavily on the work carried out by Smith (1953:297-324, 1967:7-80, and 1973:318-57), Upham (1969:53-162), and Davis (1971:17-48).

The second category of the size of holdings includes those places which should properly be referred to as minifundia. These are the small subsistence farms which produce barely enough to enable the cultivator to sustain his family. Although most minifundistas (one who farms a minifundium) must augment their earnings elsewhere, their principal occupation is that of farmer. Minifundia are here defined as those entities having two but less than ten manzanas.

The third and fourth categories include those places of a size to be considered as family-sized farms. Smith notes of the term "family-sized farms" that

> Certainly it refers to the condition in which each farm family has sufficient land to occupy its members fully at agricultural pursuits, but not enough land to necessitate the steady employment of a great deal of supplementary labor (1953:301).[1]

This size of holding is considered by many to be the optimum size in that it causes the farmer to assume the roles of entrepreneur, worker, and administrator.

The family-sized farms are sub-divided into two groups in an attempt to more finely discriminate between holdings of different sizes. The third category of the schema of the landholdings contains the places which may be defined as genuine family farms. These have at least ten but less than fifty manzanas. The fourth category of the index encompasses those larger places which may be either family farms or small highly productive haciendas. Included in this class are those units having from fifty to less than one hundred manzanas.

The Censo Agropecuario lists eleven separate classes of farms which contain one hundred or more manzanas. The category of the largest size of holding includes those entities having at least 3,500 manzanas. In our schema of the size of farms, the fifth and final category includes all of those units having one hundred or more manzanas. Because the largest place enumerated contained only eight hundred manzanas, and because few large holdings were encountered, all places of more than one hundred manzanas were lumped together. These are considered as being haciendas.

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1. For more information on the subject of the family-sized farm see Taylor, et al (1949), Nelson (1956), and Smith and Zopf (1970).

To recapitulate the classification of SIZE FARM: category one contains the lotes of less than two manzanas, category two the minifundia with from two to less than ten manzanas, category three the genuine family farms with at least ten but less than fifty manzanas, category four the larger family-sized farms having from fifty to less than one hundred manzanas, and the fifth category embracing those haciendas with one hundred or more manzanas.

Essentially the same analytical procedures were used for the classification of farm size in Colombia yielding three categories: less than 2 hectares, 2-99 and 100 or more. The first two categories include 94 percent of the farms located in the study area.

Type of Farm

A variety of pastoral and agricultural pursuits flourish in San Carlos. It was found, however, that most farms were devoted to either one or a few types of enterprises. The classification utilized is based on the proportion of the land in the farm devoted to crops or on the relative importance of livestock and pasture land versus area in crops. The following typology was developed:

1. Coffee (primarily)
2. Other crop (primarily)
3. Mixed crops and livestock
4. General livestock
5. Livestock and dairy

It should be emphasized that this schema was formulated as a result of examing the compiled Costa Rican survey research data. It is, therefore, a reflection of the types of farms found in the area studied. Virtually all of the farm units in the Colombian study area fall into the mixed crops category and are quite diversified. Therefore type of farm is not a meaningful variable for use in the analysis of the Colombian data.

Migration: Costa Rica

Two demographic phenomena must be taken into consideration when discussing the distribution of the inhabitants of Costa Rica. The country has a heartland, the Meseta Central (central plateau), which has traditionally been the site of the concentration of the majority of the citizens. Secondly, Costa Rica is a land of urban centers, most of which are located in the Meseta Central in close proximity to the nation's capital, San Jose. Both of these factors were taken into account in the categorization of the migration data.

A third consideration was included in the classification of migration data. The region studied is but one of several geographic portions of the Canton of San Carlos. It was of interest to view the migratory changes between the area studied and the other parts of San Carlos.

The following schema was devised for the classification of geographic locations in the analysis of migration:

1. San Carlos, Same district
2. San Carlos, Ciudad Quesada
3. San Carlos, Other
4. Meseta Central, Metropolitan San Jose
5. Meseta Central, Other
6. Other Costa Rica

The district is a minor civil division, part of a canton which is analogous to a county. The study area is located in the Canton San Carlos.

Migration: Colombia

A much smaller proportion of the Colombian survey population consisted of migrants than was the case in Costa Rica. Rozo is located in the Valley of the Cauca River, one of the major geographic and cultural regions of the country. Because of the small geographical diversity of the areas from which migrants come and because of their small number several classes which had, initially, been coded separately were grouped. The resulting classification has four categories:

1. Same vereda
2. Elsewhere in some municipio
3. Other Department of Valle
4. Other Colombia

The vereda is analogous to the district in Costa Rica and is a subdivision of a municipio which is analogous to the Costa Rican Canton and the United States county. The department is the major political subdivision of Colombia and corresponds to a state within the United States. The study area is located in the Department of Valle.

Other

Besides the constructed variables and indexes already presented, various other types of data are grouped and categorized in the analyses which follow. Included in these data are those pertaining to land tenure, occupation, age and education. The grouping of the data is conventional. As such it does not warrant further comment at this point.

Data Processing

Both computer analysis and well-established methods for the manipulation of data are employed. Only tried and tested conventional analyses are performed for the remainder of the data. The survey research data were analyzed utilizing an IBM System 370-165 of the Northeast Regional Data Center located at the University of Florida.

The data are recorded in three separate computer card decks. The first, entitled the "main deck," contains either in final or summary form all of the information taken from the survey schedules. The "family history deck" contains the demographic information for not only the head of the household but also for all those living together in the house and for children of the head of the household who are living elsewhere. The third deck is the electricity consumption deck, compiled by Galen Moses, which records information from both the survey schedules and the offices of COOPELESCA on the patterns of the consumption of electricity of those in the research area.

Davis prepared the code books for both the main deck and the family history deck. The process of coding embraced the first step in categorizing the wide range of data obtained, in that unstructured data must be aggregated into a fixed number of categories.

The data were coded and transferred to computer cards. Four cards were used for each respondent in the main deck; one card for each member of the household was used for each case in the family history deck.

Most of the computer analysis was performed utilizing the Statistical Package for the Social Sciences (SPSS). The work was mainly conducted by Oleh Wolowyna, applications programmer for the rural electrification project. Besides relying on the SPSS Crosstabs and Fastabs programs, frequency distributions, and index construction were provided through the process of computer analysis. In many instances, the computer was used to aggregate the data so that it could be more easily examined. The results of much of the analysis are presented graphically and in tabular form. This, it is felt, facilitates lucid presentation while enabling the reader to be exposed to the data.

A complete set of computer cards has been given to the Agency for International Development. The code books are to be found in an appendix to this report so that the analyses contained in it can be repeated and new analyses of the data performed.

CHAPTER III

COSTA RICA

Host Country Support

Several agencies in Costa Rica were actively interested in this project. The Instituto Costarricense de Electricidad (ICE) through its Department of Economic Studies not only provided secretarial services, liaison with the electric cooperative and a jeep for transportation in the field but also, through numerous consultations with Mr. Oscar Benavides valuable advice and guidance. The Department of Cooperatives of the Bank of Costa Rica through which the loan to the cooperative had been made also showed an interest in the study and several meetings were held with the bank group to discuss it. The cooperative, Cooperativa de Electrificacion Rural de San Carlos R. L. (COOPELESCA) itself, through its manager, Mr. Fredy Arroyo, was exceedingly helpful, providing one of the two jeeps used for the transportation of interviewers in the field, making an office available for the use of the study team in the cooperative's headquarters building and as an invaluable source of information about the area and its people. Mr. Arroyo was untiring in his efforts to aid the project. Finally, personnel of the Institute of Economic Studies of the University of Costa Rica with whom the interviewing was sub-contracted were extremely helpful.

Some Characteristics of the Study Area

The area being studied is situated in the Llanos of San Carlos. The llanos are nestled in a large flat valley created by the tributaries of the Rio Arenal, the Rio Penas Blancas, and the Rio San Carlos. The region to the West and South is bordered by the Cordilleras of Tilaran and Platanar, part of the mountain range which traverses Costa Rica. To the south and north are vast expanses of unoccupied virgin lowlands which extend to the Gulf of Mexico and to the international boundary with Nicaragua.

The area is relatively recently inhabited. Before World War II only breaks in the forest existed where new roads and farms now proliferate. The land is used for a variety of agricultural and pastoral enterprises. The region is polycultural when referring to types of farming. No one size of farm predominates in the zone; rather, farms of all sizes are to be found. In sum, this is an agricultural and pastoral area where a wide range of crops and animals are raised on farms which vary in size from the smallest to the very large.

Farming and stockraising are facilitated by topographic and climatic conditions. Flat and gently rolling land predominates in the Llanos. There are also hills and broken ground parallel to some of the major rivers. At the edge of the plains the configuration of the terrain becomes more mountainous. The change is not rapid; in fact, in the foothills numerous wide valleys and sloping rises are found.

The climate is moderate. The mean annual rainfall in the area is 3,602.6 mm. Temperature variations are slight with a mean of 25.7°C. These conditions impose few hardships on the people of the area. They are not obliged to either use heavy clothing or to insulate and heat their dwellings.

The precise area being studied is that between the villages of Florencia and La Fortuna, both of which are located in the Canton of San Carlos (See Figure 1). The research population includes those who reside along the roads which connect these hamlets. Because there are numerous villages, it is necessary to mention briefly their geographic location. The methods used for identifying the specific members of the research population are discussed later.

Florencia is located 11 kilometers to the northwest of Ciudad Quesada, the capital of the Canton of San Carlos. Florencia is on the paved road leading to Boca Arenal and is situated at the base of the mountains. The only land route into the research area passes through this urban village and across the bridge over the Rio Peje which is at the edge of the village. This bridge is one boundary of the region being examined.

Across the bridge from La Florencia the road leading to La Fortuna divides. The longer route passes through Villa Fatima de La Vieja (La Vieja) and the shorter one goes through Cuestillas before they join together at Santa Clara. There is but one route between Santa Clara and Jabillos (also written Javillos). At Jabillos the route once again divides with one branch passing through San Isidro del Rio Penas Blancas (also known as San Isidro de La Tigra or simply as San Isidro), Chachagua (La Colonia), and San Francisco (known locally as El Burrito) before arriving at La Fortuna. This distance between Florencia and La Fortuna is 35 kilometers. Before reaching San Isidro del Rio Penas Blancas, a branch road leads off to La Tigra and San Jose de La Tigra. The second route from Jabillos passes through La Vega, El Tanque, and Los Angeles before reaching La Fortuna.

Selection of the Study Area

One of the objectives of this study was to evaluate the rural electric cooperative as a suitable system for the distribution of electric energy. Consequently, it was determined that one of the areas to be studied should be served by this type of distribution system. Costa Rica is one of the few Latin American countries in which the cooperative

form of management is used for the distribution of electric energy. Of the four electric cooperatives in Costa Rica, the San Carlos Cooperative seemed most appropriate for the accomplishment of the objectives of this study given the diversity of agriculture in the area served by it, as opposed to the coffee and monoculture which prevail in the areas served by the other cooperatives. This consideration was especially important in relation to the use of electricity for productive farm use since the type of farming engaged in largely determines whether or not electric energy can be effectively used for productive agricultural purposes. Small banana farms, for example, have little use for electric energy, whereas the potential for the use of electricity on poultry or dairy farms is considerable (See Davis, 1956:10). Additionally, Davis (1956:10-11) reported that the size of farms is a determinant of both the decision to use and of the consumption of energy. Hence an area having a variety of sizes of farms was considered desirable, a criterion best met in the San Carlos area. Furthermore, if possible, the area should be homogeneous with regard to topography, soil and climate.

In addition to theoretical considerations, survey research inevitably must rely on practical considerations bearing upon the feasibility of conducting research in the area selected. In this instance, especially, the cooperation of a particular agency, the rural electric cooperative, was indispensable. Since the area was at a considerable distance from the usual places of residence of the interviewers, it was necessary that lodging be available for them. Accessibility by motor vehicle for the transportation of the interviewers was also indispensable.

For the selection of the precise area to be studied in the San Carlos zone we relied heavily on the advice of people knowledgeable about the area, particularly Mr. Fredy Arroyo, a native of the region, manager of COOPELESCA, and former congressional deputy from San Carlos. We informed Mr. Arroyo that we were seeking a rural area having the characteristics already mentioned, and which contained an approximately equal number of houses with access to COOPELESCA electricity and beyond the reach of distribution lines.

The discussion dealing with the selection of the specific area lasted over an hour. The conversation took place in front of a large, recent topographic map of the entire region of San Carlos. On the map were not only shown contour lines, rivers, roads, and buildings, but also the exact location of the COOPELESCA distribution lines. After eliminating, for a variety of reasons all of which dealt with the failure to meet our stated criteria, a number of possible areas, the area between Florencia and La Fortuna was selected. The decision to use this particular zone was finalized only after a reconnaissance of the actual area was made by the research team.

Selection of the Research Population

About half of the estimated 500 interviews to be completed were to be users of electricity and the remainder non-users.
To insure consistence of data collection, criteria had to be established governing the inclusion and exclusion of those to be interviewed. The criteria had to be such that they could be applied with impartiality to both users and non-users.

Originally the intent had been to draw a random sample of the heads of households. After careful consideration, however, it was decided to administer surveys to all of the heads of households included in the designated zone, interviewing, therefore, the entire universe rather than a sample.

A methodological digression is in order here. The decision to interview the entire universe, or all of the households in the study area, rather than every nth household proved to be economical in terms of time and expenditures. It meant that, generally, interviewers were able to walk from one interview to the next rather than be transported. Additionally, the very real possibility, particularly in a rural area, of interviews being conducted in houses not included in a sample was avoided. Furthermore, problems of sampling error and chance distributions of data were avoided. The decision was justified because the purpose of the survey was to compare characteristics of users and non-users of electrical energy rather than to obtain data which were generalizable to a large universe.

Because the users of COOPELESCA supplied electricity were easily identifiable, the parameters of the population of users of this central source was drawn first. The same criteria were then applied to the population of non-users.

All users of COOPELESCA electricity have lines connected to their homes or business establishments which radiate from a pole. This may be either from a distribution line pole or from a small branch line which is connected to the distribution line. If a building was connected to a COOPELESCA distribution line the occupant was classified as a user of COOPELESCA supplied energy. If a house was accessible to COOPELESCA lines, but the occupant had not connected he was classified as a non-adopter of COOPELESCA electricity. If a house had lines from a source other than COOPELESCA attached to it, the occupant was classified as a user of electricity supplied by an alternate source. The occupants of all other buildings beyond the reach of any source of electric power were classified as inaccessibles.

In the study area, all of the COOPELESCA distribution lines parallel principal roads. It should be noted that the houses in the area were situated in close proximity to the principal roads before the distribution lines were constructed, so that the established pattern of constructing residences along the roads facilitated the distribution of electricity. Because houses are clustered along the roadside, it is possible to see virtually all of the buildings which have been wired for electricity by driving along the main roads. Consequently, it was decided that visibility of a building, that is to say of a house, business, commercial establishment, school, or church, from the road was a logical criterion for selecting the population of heads of households.

The validity of this criterion should be evaluated with regard to the possible bias which it might introduce. The following objections may be raised: 1) it does not take into account geographic variations which may influence the distance included in the line of sight, and 2) it does not take into account topographic features which may either facilitate or make more difficult the sighting of buildings.

Were the area being studied one of extreme geographic variations, the first objection would, to a large degree, be valid. However, the area is geographically rather homogenous. With the exception of the La Tigra and San Jose de La Tigra portion, the area is either in the llanos (level lowlands) or on level land at the edge of the mountain range along the fringe of the llanos. The La Tigra and San Jose de La Tigra portion of the area consist of two small valleys in the lower foothills. The geographic variations did not appreciably affect the line of sight from the roads. These observations were supported by an examination of maps of the area.

It might be argued that topographical variations would significantly affect the selection of the research population. In only a few instances were houses which front a road in the area being studied blocked from view from the road by such things as trees or other buildings. In almost all cases, at least a portion, such as a part of a roof, of the building was visible from the road. Virtually all of the houses in the area have a trail or a path from the road to the house. In those few cases when there were indications that a house was blocked from sight from the road, the interviewers were instructed to follow the trails or paths for a reasonable distance to ascertain if there was in effect a house hidden from sight.

An elaborate procedure undertaken to enumerate all of the houses in the area uncovered only seven houses which were included in the survey research but which could not be seen at least partially from the road. Two of these were less than 100 yards from the road but were blocked from view by a thick planting of coffee trees. They clearly were situated in close proximity to the road and consequently were included. The remaining five houses were clustered together near a road but were obscured by a high bank. Since the buildings were clearly visible from the top of the bank, they were included as houses where surveys were to be conducted.

Another criterion was also used for determining those to be included in the survey population. If they were within the zone of influence of a major alternate source of electricity they were excluded from the survey portion of this study. On the basis of this criterion the areas serviced by the generating plant in the hacienda Chachaguas and the area provided with electricity by the small plant in La Fortuna were eliminated. The inclusion of major alternate sources of electricity, it was felt, would obscure the focus of this study.

The final criterion used was that the buildings had to be occupied in order to be included in the survey. The reasons for using this standard are obvious. Approximately ten percent of the houses in the area are unoccupied. Many people constructed new dwellings adjacent to their former homes and abandoned the old building. Also, it appeared that several of the structures were commonly used by seasonal farm laborers and were unoccupied at the time.

It should be restated that the criteria used for the selection of specific buildings where the heads of households were to be interviewed were uniformly applied to all areas being studied. That is to say, that the same criteria were applied to both the electrical users and non-users. Consequently, it can be assumed that any bias resulting from the selection and application of these criteria were evenly distributed. Therefore, the primary characteristic being studied, for the selection of the research population.

Demographic Characteristics

A total of 452 households are included in the survey research portion of the study in Costa Rica. For our purposes a household is all persons living together in one dwelling, regardless of blood or marital relationships. For these people an attempt was made to gather the following information: name, relationship to head of the household, sex, age, marital status, last year of school completed, principal occupation, and current school attendance. For children who live away from home, data on their location was secured. Only name, sex, and age at death data were compiled for deceased children. Additional information dealing with the migration history of the heads of the household was obtained.

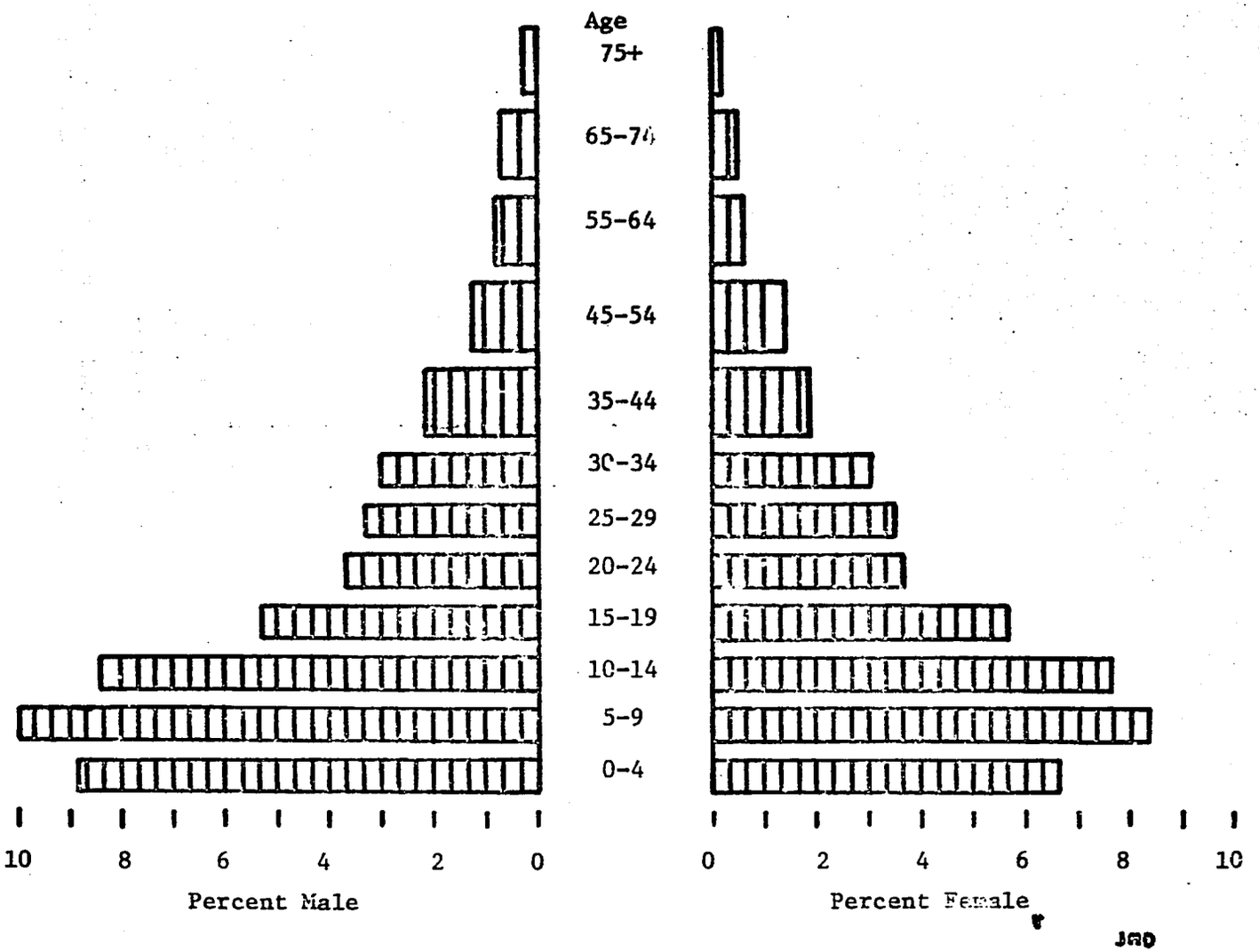
The population surveyed numbers 3,510 belonging to 452 households. Included in this number are 252 dead sons and daughters of the head of the household and 532 living children who reside elsewhere. Both of these groups are separated for special analysis. Thus, the total resident population to be discussed numbers 2,726. In certain instances which follow, the number of respondents varies because of incomplete answers or the elimination of faulty data.

Age and Sex

One of the most valuable methods for examining the age of a population is to sub-divide it into major age categories: under 15 years, between 15 and 64 years, and 65 years of age and older. Nearly one-half, 49.8 percent, of the resident population is under 15 years of age. Only 3.1 percent is over 65 years of age. The remaining 47.1 percent are in the "productive" years of life between 15 and 64 years of age. This is a young population with an exceptionally large proportion of the people under 15 years of age. However, this proportion is only slightly higher than that for Costa Rica as a whole in 1972 which was 48 percent. Additional data is provided in the age-sex pyramid (Figure 3). Both a preponderance of the young and a small fraction of the aged are evident. Of special interest, however, is the fact that children under five years of both

Figure 3

Age-Sex Pyramid of the Resident Research Population, Costa Rica



sexes are less numerous than children five to nine years old. It is probable that this is a reflection of the dramatic drop in the birth rate that occurred during the previous five years in Costa Rica. This decrease is partially due to the increased use of effective birth control methods. With the exception of the youngest age group, the size of the age cohorts for both males and females steadily decreases as age increases. This is the result particularly of high birth rates in the past but also of high death rates. Coupled with this there has, apparently, been a high incidence of migration into the area of families headed by relatively young adults.

One of the most common means of analyzing demographic data is through the use of the sex ratio. The sex ratio is defined as the number of males of a given age or age group in a population divided by the number of females of the same age and the result multiplied by 100 in order to have whole numbers. A ratio of 100.0 consequently signifies numerical equality between males and females.

The sex ratios of the various age groups in the population being studied is shown in Figure 4. The total population contains 1,435 males and 1,275 females yielding a sex ratio of 112.5 men per 100 women. As is shown in Figure 4 males predominate in the younger age groups and in the older ones; the sex ratio of the population under five years old is 135.4, for ages five to nine, 118.9, for ages 55 to 59, it is 141.4 and for persons 65 years of age and older it is 129.7. Although every effort was made to insure accurate data collection procedures, either males are over-reported or females under-reported (probably the latter) among youngest members of the population. The high sex ratios of the older age groups, which might have been influenced by the small number of cases in them are, most probably, the result of migration into the area. These older people are generally heads of households. Many of them were single when they moved to the area when it was originally being settled. The consequence of this phenomenon is still reflected by the high sex ratio.

The ratios for ages 15 to 34 are of interest. With the exception of the 20-24 age group, females are under-represented. This probably is partly because of greater out migration of males than of females and partly due to incorrect age reporting. For instance, it appears that women 20-24 sometimes were reported as being 15-19, while men 15-19 were reported as being 20-24. The dramatic variations between the age groups of 35 to 44 and 45 to 54 is principally the result of the small numbers in the groups.

Data on the age of the heads of households were collected from 413 respondents. These data are presented in condensed form in Table 2. The modal age group of the heads of households is 30 to 39 years. Nearly one-third, 31.7 percent, of the family heads are in it. Next in importance are the age groups 40 to 49 years and less than 30 years, respectively. The youthfulness of this population encompasses the heads of households as well as their offspring. Over one-half of these adults are under 40 years of age and nearly three-fourths of them are under 50 years old.

Figure 4

Sex Ratios by Age of the Resident Research Population, Costa Rica

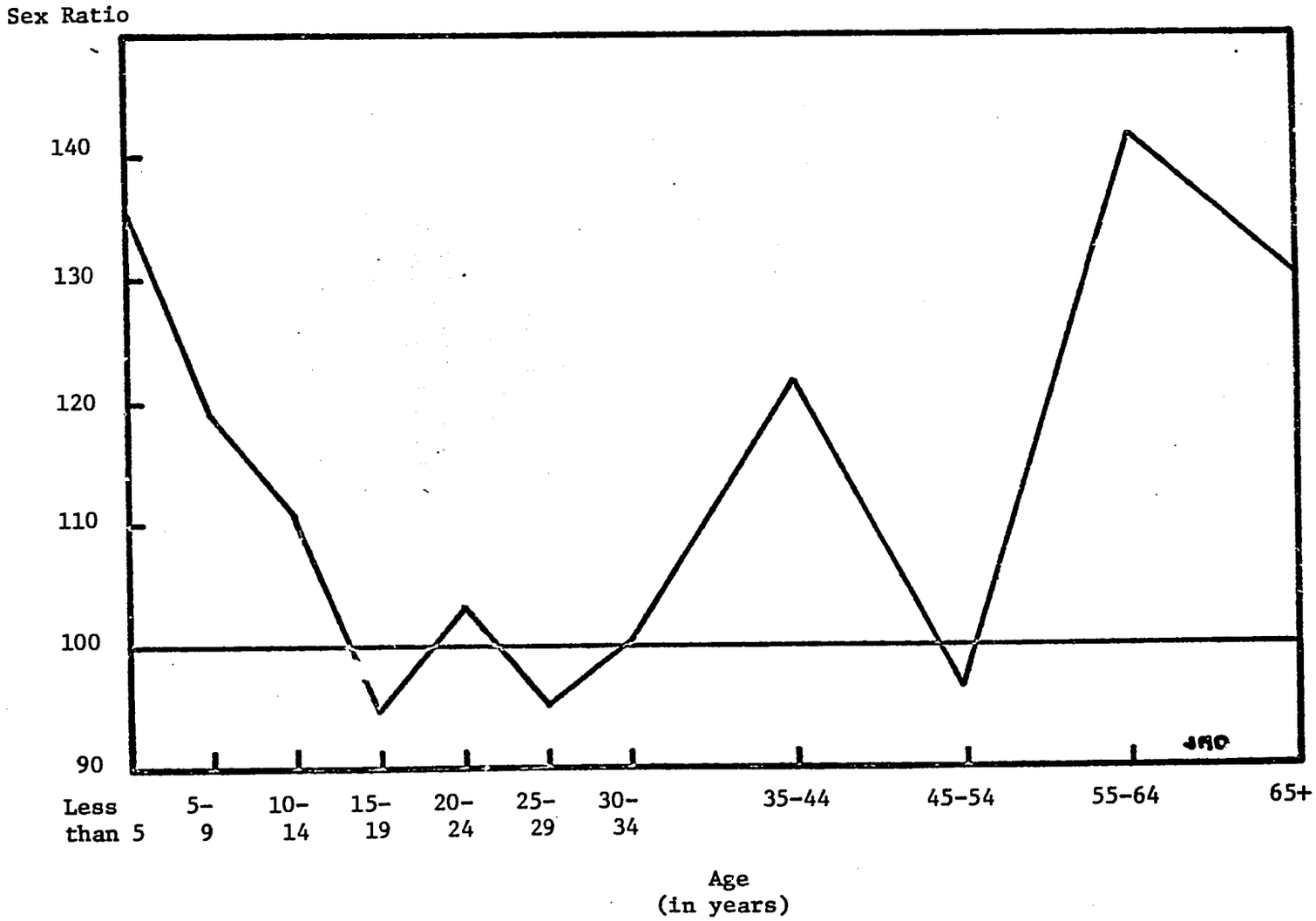


Table 2

Percentages and Numbers of Respondents in Categories of Age of the Head of the Household (AGE HEAD) and Median Age by Users Variable, Costa Rica

Users Categories	AGE HEAD Categories (Age in Years) 1 (less than 30)	2 (30-39)	3 (40-49)	4 (50-59)	5 (60+)	TOTAL	Median Age
USERS	22.1 (37)	32.3 (54)	20.4 (34)	16.2 (27)	9.0 (15)	100.0 (167)	38.6
INACCESSIBLES	20.9 (33)	29.8 (47)	25.9 (41)	15.2 (24)	8.2 (13)	100.0 (158)	39.8
NON-ADOPTERS	15.9 (14)	34.1 (30)	25.0 (22)	19.3 (17)	5.7 (5)	100.0 (88)	40.0
TOTAL	20.3 (84)	31.7 (131)	23.5 (97)	16.5 (68)	8.0 (33)	100.0 (413)*	39.3

* Because some respondents did not report their age, this figure is smaller than the grand total found in most of the tables.

The age of heads of households (AGE HEAD) was cross-tabulated with the users variable (Table 2). No important differences were revealed. Further analysis was performed by calculating the median age of those in the three users categories. The median separates the group into two equal parts, so that one-half of the cases are below the median and one-half above it. The USERS as a group are slightly, although not significantly, younger than the INACCESSIBLES. The NON-ADOPTERS constitute the oldest grouping. Because of the slight variation, inaccuracy in age reporting and because of the 39 missing cases, these findings are not meaningful. It is reasonable to state that the heads of households falling into several user categories are essentially similar with regard to age.

Education

Major advances have been made in Costa Rica in providing a primary education to all segments of the population. The results of governmental policies designed to make schooling available to all are clearly seen in the San Carlos area. Without exception, every small community in the area has a school with at least one teacher who taught grades one through six. In Ciudad Quesada there are three secondary schools and in Santa Clara there are vocational and technical agricultural schools.

Data on the last year of school completed were collected for 3,164 members of the research population. Of these 626 reported that they had had no education. Another 285 were pre-schoolers. Thus nearly one-fifth, 19.8 percent, of the population over 4 years of age was reported as having no schooling and 9.0 percent as being too young to enter school.

Of those who have received some education, only 5.2 percent have had more than a primary schooling. Less than one percent, (0.8) of the educated population has received more than a secondary education. Of those who have completed at least one year of schooling, the largest proportions have completed three or six years, 19.6 percent and 19.5 percent respectively.

The data on educational attainment include both persons who have terminated their education and those who are still in school. Because of the large number of children of primary school age, it is to be expected that data on the last year of school completed would be heaped in the lower rungs of the educational ladder. The predominance of the number of those who have completed three and six years of education is, therefore, worthy of note. These figures include many adults who have completed their education.

Information on the educational attainment of the heads of households is presented in Table 3. Those who reported having had no education are grouped with those who gave no information on this subject. Analysis revealed that most of those who did not respond to the question on schooling most probably did so because they were attempting to mask the fact that they were illiterate. Consequently, only a small error

was introduced by the grouping procedure used. This error is conservative in that the amount of schooling is viewed as being under-reported rather than as exaggerated. Because of the small number of those who have more than a primary education, all of those with seven or more years of school have been grouped together.

Nearly one-third, 31.0 percent or 140, of the heads of households either reported no formal education or did not respond to the question. Another 23.7 percent of them may be viewed as either functionally illiterate or barely literate in that they reportedly have completed only the first or second year of primary school. Thus, approximately one-half of these heads of households are either completely or nearly illiterate. Less than one out of twenty, 4.6 percent, have gone beyond primary school.

Table 3 also presents the data on education of household head cross-tabulated with electricity use categories. The distribution of persons in the three categories of the users variable clearly varies according to educational attainment.

Table 3

Percentages and Numbers of Respondents in Categories of Education of the Head of the Household (ED HEAD) by Users Variable and Median Year of Schooling, Costa Rica

	ED HEAD Categories (Years of Education)						
Users Categories	1 (none, no information)	2 (1-2)	3 (3-4)	4 (5-6)	5 (7+)	TOTAL	Median (Year of schooling)
USERS	31.4 (44)	32.7 (35)	46.4 (57)	59.0 (36)	61.9 (13)	40.9 (185)	3.47
INACCESSIBLES	41.2 (58)	43.9 (47)	33.3 (41)	27.9 (17)	28.6 (6)	37.4 (169)	1.88
NON-ADOPTERS	27.2 (38)	23.4 (25)	20.3 (25)	13.1 (8)	9.5 (2)	21.7 (98)	2.13
TOTAL	100.0 (140)	100.0 (107)	100.0 (123)	100.0 (61)	100.0 (21)	100.0 (452)	2.33

The modal number of years of schooling for the USERS is three to four. The corresponding datum for INACCESSIBLES and NON-ADOPTERS, on the other hand, is zero. The USERS appear in proportionately smaller numbers among the lesser educated than do those in the two categories of non-users. The USERS also are relatively more numerous among the better educated than are those in either of the two categories of non-users. Over one-half, 57.3 percent, of the USERS have had three or more years of education. Only 37.9 percent of the INACCESSIBLES and 35.7 percent of the NON-ADOPTERS have had as many years of schooling.

The differences between the three categories of the users variable are more succinctly revealed by the median. The median number of years of schooling completed for the total is 2.53, for USERS it is 3.47, for INACCESSIBLES 2.13, and for NON-ADOPTERS 1.88. Therefore, USERS are better educated than are the non-users of electricity.

It can, then, be stated that in the Costa Rican research population there is a positive correlation between use of electricity and educational attainment. No causality is assumed. It does appear, however, that given the limited length of time that electricity has been available in the area it is the better educated who are the first to adopt the use of electricity. Because of the complex inter-relationships which exist between education and age, level of living, and economic status, it is not possible with the resources at hand to isolate the degree to which education by itself is independent in its relationship to the adoption of the use of electricity.

Occupation

The portion of San Carlos studied is a rural agricultural and stockraising area. This is dramatically shown by the occupations of the heads of households. More than three-quarters of them, 75.4 percent, are either farm laborers, farm operators, or farm administrators, as shown in Table 4. Also shown in the same table are those employed in other categories. The unemployed, teachers and merchants comprise 16.1 percent of the total. The remaining 38 individuals or 8.5 percent are engaged in 17 different types of employment, ranging from a guard in a school to the manager of an agricultural production marketing cooperative, and are placed in a single residual category. There is a positive association between electricity use and farm operator status and a negative association between electricity use and farm laborer status when comparing USERS and NON-ADOPTERS. There is almost no disparity in the relative importance of these two groups among the INACCESSIBLES. More than three-quarters, 78.7 percent, of the farm operators living within reach of COOPELESCA lines are electrified whereas only 51.0 percent of the farm laborers in the same area are electrified.

Table 4

Percentages and Numbers of Respondents in Occupational Categories by Users Variable
Costa Rica

Users Categories	Occupational Categories							
	Farm Laborers	Farm Operators	Farm Administrators	Teachers	Merchants	Unemployed	Other	Total
USERS	26.5 (49)	37.8 (70)	2.7 (5)	6.5 (12)	11.9 (22)	4.9 (9)	9.7 (18)	100.0 (185)
INACCESSIBLES	42.6 (72)	40.2 (68)	3.5 (6)	1.2 (2)	3.5 (6)	3.0 (5)	6.0 (10)	100.0 (169)
NON-ADOPTERS	48.0 (47)	19.4 (19)	5.1 (5)	0.0 (0)	1.0 (1)	16.3 (16)	10.2 (10)	100.0 (98)
TOTAL	37.2 (168)	34.7 (157)	3.5 (16)	3.1 (14)	6.4 (29)	6.6 (30)	8.5 (38)	100.0 (452)

All of the teachers who have been able to, do have electricity in their homes. One of these when asked what was the major importance of electricity for her replied that it enabled her to grade papers at night. The teachers in the INACCESSIBLE group appear to be under-enumerated. It is probable that the teachers who work in this zone live in the urban community of La Fortuna, which was excluded from the study, and commute daily to work. Teachers are both the best educated and very likely the most urban oriented members of the research population.

Of the 23 merchants, including those having commercial establishments ranging in size from the small pulperia (convenience store) to the almacen (general store), who live within the reach of COOPELESCA's electrical distribution lines, only one did not utilize electricity. In addition to the six merchants interviewed in the non-electrified area four others were identified. Of these ten merchants four had procured an alternate source of electricity. It is probable that the remaining

six were beyond the reach of any source of electricity or could not afford a private generating plant, for 22 of the 23 merchants in the electrified area had become consumers of COOPELESCA power. Well over half of the 25 unemployed household heads in the COOPELESCA area are NON-ADOPTERS. Most of them are retired farm laborers who live on gratuities received from relatives and neighbors.

The highest adoption rates are found among teachers and merchants. Teachers are urban oriented, accustomed to the use of electricity and have working hours that include the hours of darkness. Merchants can profit most immediately from the use of electric current. (For instance in a hot climate cold drinks sell better than drinks that are at room temperature. Their working hours also include nighttime. Next come farm operators, followed by farm laborers, and lastly the unemployed (Table 5).

Table 5

Percentage of Users of Electricity by Occupational Categories, Costa Rica

Occupation	Percent Adopting
Teachers	100.0
Merchants	95.7
Farm Operators	78.7
Farm Laborers	51.0
Unemployed	36.0

Based on data in Table 4 for USERS and NON-ADOPTERS.

It is evident, therefore, that the use of electricity is closely related to occupation. In general, the higher the occupational status the greater the adoption rate for electricity. Also, the greater the utility of electricity for the achievement of occupational ends the greater the adoption rate.

It is also possible that the availability of electricity has an equalizing effect, particularly among merchants. In the absence of central source electricity the more prosperous merchants can further enhance their economic advantage by installing private diesel or gasoline powered plants placing their poorer competitors at an even greater disadvantage. The cost of connecting to a power distribution line is more equally accessible to all as indicated by the fact that all but one of the 23 merchants who had this opportunity availed themselves of it. Thus the potential commercial advantages of electricity can be equally distributed.

Size of Household

A total of 2,726 persons live in the 452 households enumerated. The persons residing in them have a variety of marital and blood relationships and include unrelated individuals. The normal family consists of a married couple and their offspring. In addition, however, there are many instances of three generation families. Not infrequently blood relatives such as brothers or sisters, uncles or aunts, and nephews and nieces of either the head of the household or his spouse also live in the parentela. In some cases, farm laborers, servants, or friends also reside in the households. Because of the tendency to have a wide range of relatives and un-related persons living together, the size of the households in the San Carlos area is large.

As is shown in Table 6 the size of households ranges from single residents to sixteen people living together. The frequency of cases according to household size is fairly evenly distributed with sizeable numbers found in all the classifications up to and including twelve member households.

Most persons live in households which have between three and twelve members. Six-member households were the most common, closely followed by those having nine members. The mean size of household is 6.038. Three-fifths of the population live in households having seven or more members.

Table 6

Size of Households by Frequency of Occurrence and Number of People, Costa Rica

Size of Household	Number of Households	Persons		
		Number	Percent	Cumulative Percent
1	15	15	0.6	100.0
2	38	76	2.8	99.4
3	47	141	5.2	96.6
4	58	232	8.5	91.4
5	58	290	10.6	82.9
6	58	348	12.7	72.3
7	42	294	10.8	59.6
8	39	312	11.4	48.8
9	37	333	12.2	37.4
10	23	230	8.4	25.2
11	11	121	4.4	16.8
12	12	144	5.3	12.4
13	7	91	3.3	7.1
14	4	56	2.1	3.8
15	2	30	1.1	1.7
16	1	16	0.6	0.6
TOTAL	452	2,729		

The data were analyzed in an attempt to discover if there were significant differences between the three categories of the users variable according to the size of households. The variations found were slight. The patterns of the size of households found for each of the categories of the variable of the use or non-use of electricity were similar to those of the total group. The arithmetic means for each of the categories are as follows: 5.881 for USERS, 6.100 for INACCESSIBLES, and 6.224 for NON-ADOPTERS. The average household of USERS has less than six persons in it and is smaller than the mean size of families for either of the groups of non-users of electricity. Of the non-users, the NON-ADOPTERS have on an average the larger families living in one dwelling. The differences between the means of these groups are not significant. Because the area has been electrified for no more than four years, any possible relationships between the use of electricity and the size of households are not yet manifest.

In-Migration

The Meseta Central is the central plateau where metropolitan San Jose is located and where the major historical development of Costa Rica has occurred. Outlying areas such as San Carlos have until fairly recently been of minor importance. The rise in the relative importance of San Carlos has been occasioned by population growth. Although the natural increase of the population has been responsible for some of the population growth in the area, much of it has been caused by in-migration. In the following analysis of the migration patterns of the heads of the households two major trends are observed: the extent to which population pressure in the Meseta Central is relieved by people moving from there to San Carlos, and the importance of migration into the area in general.

If immigrants are defined as persons from outside of San Carlos, 69.1 percent of the respondents are so classified (Table 7). They were born, in nearly equal numbers, in the Meseta Central and in portions of the country other than the Meseta Central and San Carlos.

The respondents were overwhelmingly born in rural areas. Only 6.3 percent were born in the uncontestably urban centers of Ciudad Quesada and metropolitan San Jose. Although it is possible that some of the remaining 93.7 percent of the heads of households were born in urban areas, the large majority of them were, no doubt, born in rural areas.

There is little variation in the place of birth according to current use or non-use of electricity. However, more of the USERS were born in San Carlos than is the case with those in either of the two categories of non-users of electricity. The percentages of those born in San Carlos are as follows: USERS, 32.9; INACCESSIBLES, 28.8; and NON-ADOPTERS, 26.8. Since the USERS are more likely to be landowners, and perhaps owners of inherited land, and the NON-ADOPTERS more likely to be farm laborers, the differences are probably related to occupational status.

Table 7

Percentages and Numbers According to Place of Birth of Heads of Households by Users Variable, Costa Rica

Users Categories	Place of Birth						
	San Carlos			Meseta Central			TOTAL
	1 (Same District)	2 (Ciudad Quesada)	3 (Other)	4 (Metro-politan San Jose)	5 (Other)	6 Other Costa Rica	
USERS	12.8 (23)	5.0 (9)	15.1 (27)	2.8 (5)	36.9 (66)	27.4 (49)	100.0 (179)
INACCESSIBLES	12.6 (21)	2.4 (4)	13.8 (23)	1.2 (2)	27.5 (46)	42.5 (71)	100.0 (167)
NON-ADOPTERS	9.3 (9)	5.1 (5)	12.4 (12)	3.1 (3)	33.0 (32)	33.0 (32)	100.0 (97)
TOTAL	12.0 (53)	4.0 (18)	14.0 (62)	2.3 (10)	32.5 (144)	34.3 (152)	100.0 (443)

If, on the other hand, immigrants are defined as persons born in a district different from that in which they reside, then 88.0 percent of the population is classed as being immigrants. Again the proportions of migrants vary but little among user categories: 87.2 percent of USERS were migrants, the corresponding figures for INACCESSIBLES and NON-ADOPTERS are 87.4 and 90.7.

A disporportionally large number of INACCESSIBLES are in the "Other Costa Rica" category. Portions of the area inhabited by the INACCESSIBLES are in the Canton of San Ramon. This canton is not part of the Meseta Central. The imbalance found in this category is probably caused by an influx into the area of people born in or around the Canton of San Carlos.

Data were compiled on the previous place of residence of the heads of households (Table 8). The same variation between the USERS and both of the groups of non-users of electricity which was noted when discussing place of birth persists with regard to those who have moved to their present location from elsewhere in San Carlos. Once again, the INACCESSIBLES have been influenced by those who apparently have moved into the area from San Ramon.

Table 8

Row Percentages and Numbers According to Previous Place of Residence of Heads of Households by Users Variable, Costa Rica

Users Categories	Previous Place of Residence: San Carlos (Same District)	San Carlos (Ciudad Quesada)	San Carlos (Other)	Meseta Central (Metro-politan San Jose)	Meseta Central (Other)	Other (Other Costa Rica and Foreign)	TOTAL
USERS	59.0 (108)	4.4 (8)	13.1 (24)	3.2 (6)	11.5 (21)	8.8 (16)	100.0 (183)
INACCESSIBLES	54.3 (88)	1.2 (2)	19.2 (31)	1.8 (3)	6.2 (10)	17.3 (28)	100.0 (162)
NON-ADOPTERS	56.2 (54)	5.2 (5)	15.6 (15)	6.3 (6)	6.3 (6)	10.4 (10)	100.0 (96)
TOTAL	56.7 (250)	3.4 (15)	15.9 (70)	3.4 (15)	8.4 (37)	12.2 (54)	100.0 (441)

If immigrants are defined as persons whose previous place of residence was in a different district, then 43.3 percent of the population is classed as migrant. Once again there are but small differences in this percentage among the user categories. Forty-one percent of USERS, 45.7 percent of INACCESSIBLES and 43.8 percent of NON-ADOPTERS are immigrants. Approximately equal percentages of each user category, around 24, had had their previous place of residence outside of San Carlos.

Over one-half, 56.7 percent, were lifetime residents of the district in which they were enumerated or had had their previous residence in the same district. Included in this figure are only six individuals who had always lived in the same house. A total of 76.0 percent of the heads of households had previously lived either in the same district or some other part of San Carlos, including Ciudad Quesada. When these facts are compared with those already cited on the place of birth, some interesting conclusions can be drawn. The particular area being studied is populated by people born out of the region but who have lived elsewhere in the region before moving to their present location, so that there is major internal migration within San Carlos.

Only a few heads of households, 11.8 percent, had had their last place of residence in the Meseta Central. Only 12.2 percent had lived previously in areas of Costa Rica other than the Meseta Central or San Carlos.

The last category listed in Table 8 includes one person who had lived in a foreign country, Nicaragua. Only 30 of the 441 people for whom data were obtained had been urban dwellers, that is had lived in either metropolitan San Jose or in Ciudad Quesada. Undoubtedly, many of these are school teachers who were educated in urban centers.

As was the case with the analysis of the place of birth, no significant variations are seen when the categories of place of previous residence are sub-divided according to the categories of the users variable. Regardless of the use or non-use of electricity, most heads of the households had had their previous residence in San Carlos. The length of time that the family has occupied their present home provides some insight into the migration patterns of the population (Table 9). Two phenomena are immediately apparent: a substantial number of the respondents moved recently

Table 9

Length of Residence in Present House, Costa Rica

Number of Years	Frequency	Percentage
Less than 1	102	23.0
1 and 2	98	22.1
3 - 5	87	19.6
6 - 10	75	16.9
11 +	82	18.4
TOTAL	444	100.0

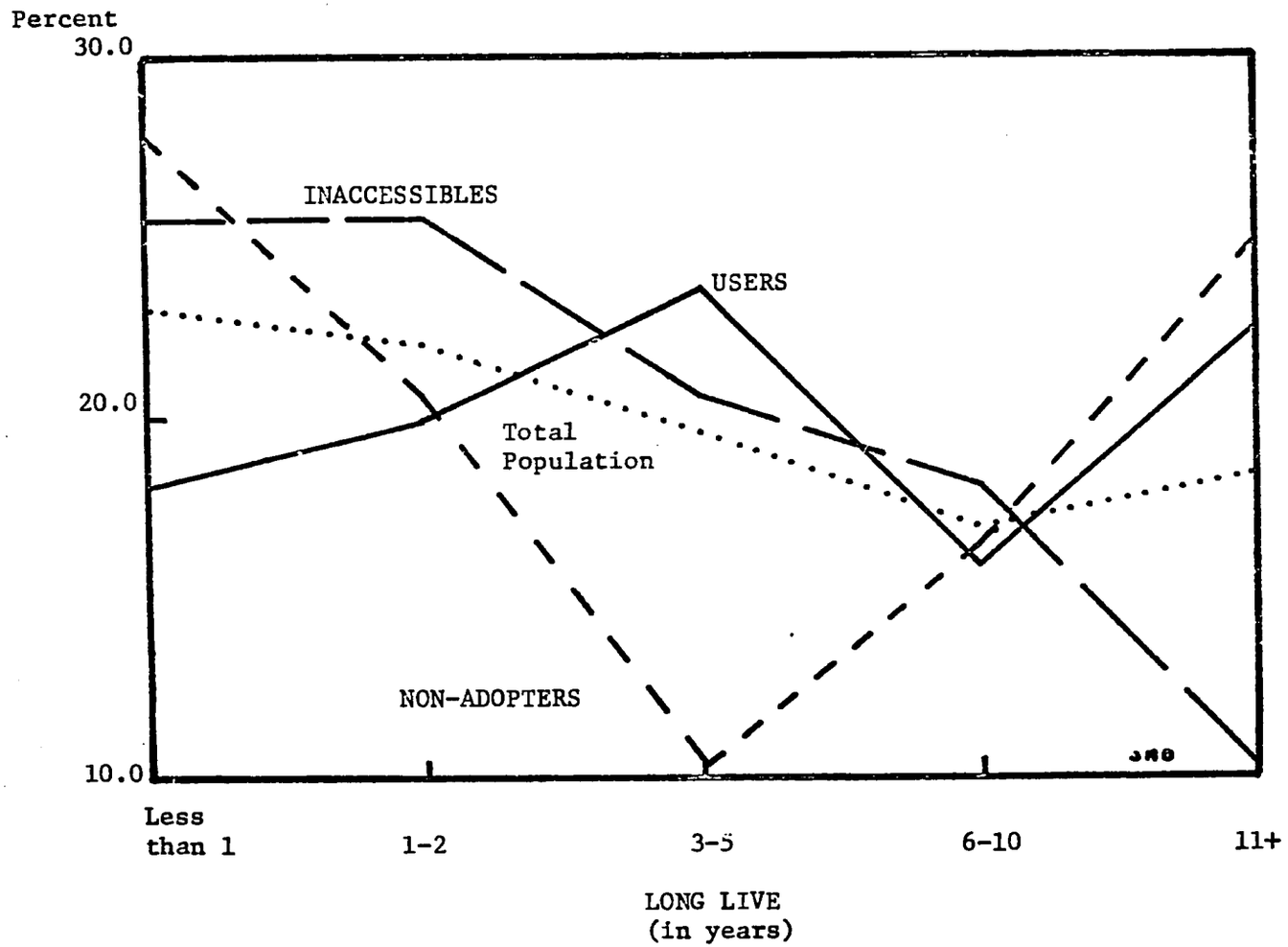
into their present house and a substantial number have lived in the same location for a long period of time. Nearly one-quarter, 23.0 percent, of the respondents had lived at their current address for less than one year. Another 22.1 percent had only lived in their present house for from one to three years. At the other extreme, 18.5 percent of the families had lived in the same place for eleven or more years. An additional 16.9 percent of the families had been in the same house for from six years to one decade.

The residential stability of the population in each of the user categories is not the same (Figure 5). The pattern of the INACCESSIBLES most nearly parallels that for the total population. Because persons who live beyond the reach of the COOPELESCA power lines live in an area which has been colonized more recently, fewer have lived in the area for more than a decade than is the case with the aggregated population.

The NON-ADOPTERS accentuate the distribution of the total population already commented upon: prevalence of both recent and long-term residents. More than one-fourth, 27.8 percent, of the NON-ADOPTERS have lived in their present dwelling for less than one year; nearly another quarter, 24.7

Figure 5

Percentage of Total Population, USERS, INACCESSIBLES and NON-ADOPTERS
by Length of Residence in Present House (LONG LIVE)
Costa Rica



percent, have remained in the same location for more than ten years. This pattern is apparently related to the relative importance of farm laborers among the NON-ADOPTERS. Many hired hands in the area are obviously transient; others, apparently either have worked on one farm for long periods of time or have worked at a variety of jobs over a long period of time.

The USERS tend to be more permanent residents than those in either of the categories of non-users of electricity. Fewer of those who use electricity have been in their present homes for less than three years than was found for those who do not use electricity. The majority of the USERS, 62.0 percent, have remained in the same house for at least the past three years. The drop among the USERS of those who have spent from six to ten years in the same residence is not explained at the present time.

Although migratory patterns are not one of the major concerns of this study, certain conclusions can be drawn. There is no demonstrable relationship between electricity use and migration as defined by place of birth or by place of previous residence among the Costa Rican respondents. Residential stability, however, is somewhat greater among users than among others, so that users comprise the most residentially stable group in the population surveyed.

Movement of Children

The 452 heads of households in this population have a total of 2,238 living children. Some 532, or 23.8 percent, of them live away from the parental home. In order to learn something more about the target population, and to present benchmark data which should be useful for future studies of the subject of rural electrification, it is of interest to note some of the characteristics of this special group. Because of missing data, the following discussion deals with 504 of the offspring.

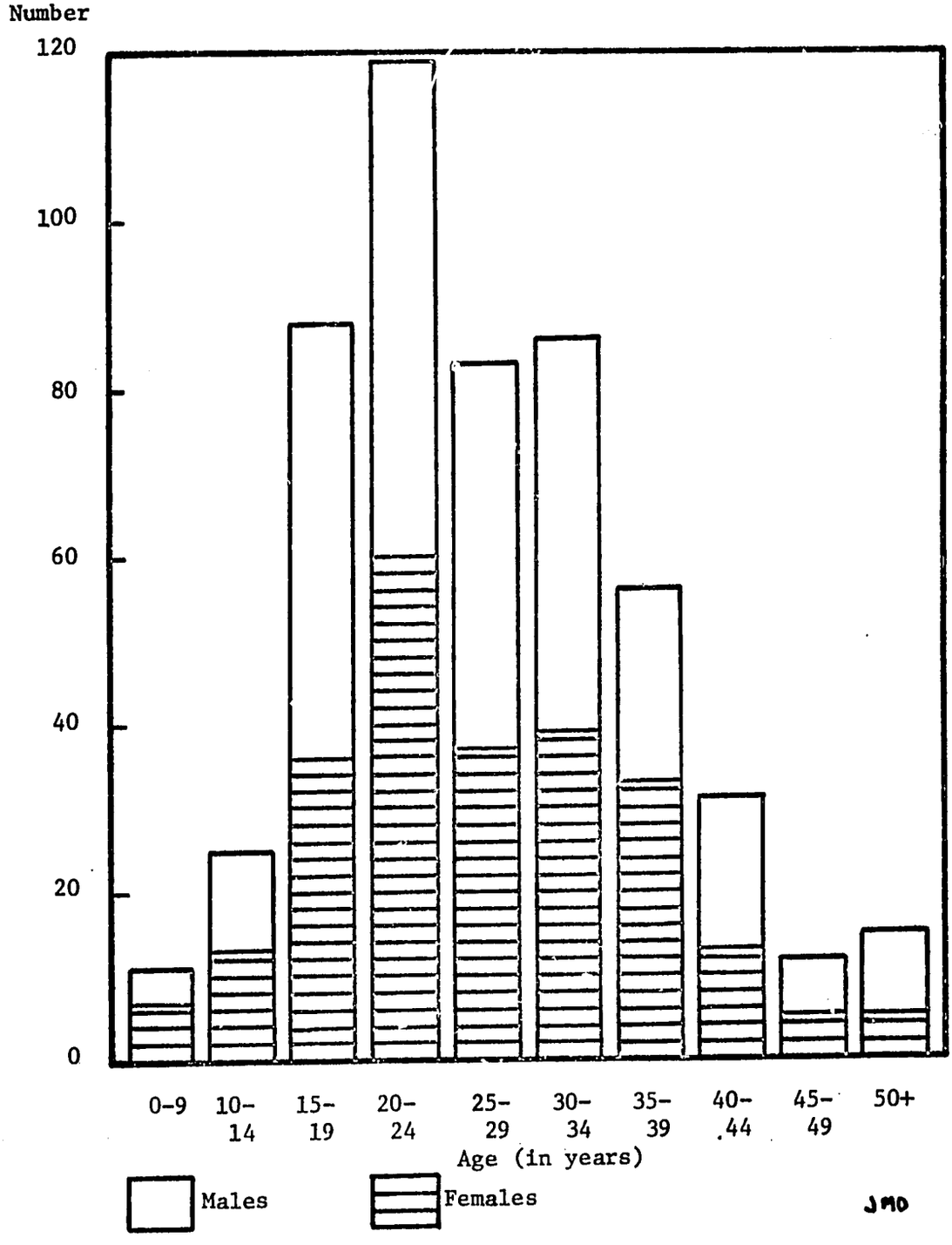
The age and sex of those living away from home is shown graphically in Figure 6. As expected the largest numbers are found in the ages 15 to 19 and 20 to 24. The sex ratios or number of males per 100 females, for these age groups are 88.8 and 98.3, respectively. Thus, youthful females living away from their parents outnumber their male counterparts. The low sex ratio persists for the entire aggregate, being 92.8, with 276 females versus 256 males living away from home.

It is of note that large numbers of older children are away from home. Nearly one-half of the children 15 years old or older are away from home. This is a reflection of the fact, pointed out earlier, that there is a substantial proportion of older heads of households in the region.

Some 468 of these sons and daughters are at least fifteen years of age. Data on whether they lived in rural or urban locations were compiled. Nearly one-third, 32.4 percent, reside in urban areas, while the remaining two-thirds, 67.6 percent, live in rural zones. These

Figure 6

Number of Children of Heads of Households Living
Away from Parental Homes by Age and Sex
Costa Rica



statistics vary according to whether the child is from a family of users or non-users of electricity. Eighty, 34.9 percent, of the children of USERS live in urban areas; while 65.1 percent or 149 live in rural areas. The percentages of the children of INACCESSIBLES and NON-ADOPTERS who live in urban areas is identical: 30.1. Conversely, 69.9 percent of each group live in rural areas.

The implication is that the sons and daughters of those who use electricity in their homes are somewhat more likely to move to urban areas than are the offspring of those who do not use electricity, regardless of whether they have or do not have access to electricity. In the population being studied the causes of this phenomenon are undoubtedly related to such things as education, income, size of family, and residential stability of their parents rather than to the use of electricity. The research question which at this point remains unanswered deals with the future effect of electricity on the differential migration of children from the parental homes. Will, for example, children who have grown up in homes which are electrified, seek homes of their own which are also electrified? Will the use of electricity enable children to be exposed to forces which will pull them into urban areas or make them wish to remain in rural areas? It can be assumed that electricity in rural areas may have some effect on the migration, not only of heads of household, but also of their offspring. It can also be assumed that its influence would be exerted differentially on different age groups. The strength and direction of these influences cannot be ascertained on the basis of the data collected in this study. These, however, are anticipated social consequences of rural electrification which should be examined.

Dead Children

In addition to data on living members of the research population, data were also collected on deceased children of the heads of households. The following analysis does not directly relate to the impact of rural electrification. Rather it deals with a facet of the demographic analysis of a population which reflects the degree of development of the society. Mortality, especially infant mortality, can be affected by technological developments. The ensuing discussion is relevant in that the increased use of technological innovations which rely on electrical energy may alter the high incidence of infant mortality found in this research population.

A total of 2,490 births to heads of households were reported. Of these 2,238 were still living at the time of the interviews, and 252 or 10.1 percent had died. The age at death ranged from days, or perhaps hours, to 48 years.

The majority of the deaths occurred in infancy. A total of 135 infants or 53.6 percent of the deceased, died before they reached their first birthday. Or to view the fact in more dramatic fashion, more than one out of every twenty, 5.4 percent, of the children died before their first birthday. Nearly twice as many males as females died during their first year of life as shown by a sex ratio of 181.3. Another 82 children died between their first and fifth birthday. The sex ratio of this age cohort is 121.4.

No information was obtained on the causes of death of these children. One can only wonder about how many of the deaths could have been prevented had complete medical assistance been available. It is hoped that the spread of rural electrification will enable members of the medical profession to utilize equipment in the rural areas which might aid in lowering the infant mortality rate.

Social and Economic Factors

In addition to the social factors already discussed under demographic characteristics the relationships between electricity use and four variables are examined in this section. These variables are level of living, satisfaction with life situation, mass media exposure and social participation. The construction of these variables is explained at length in Chapter II on methodology.

Level of Living

The number of cases in each level of living category is shown in Table 10. There is a fairly normal distribution according to categories of LEVEL for the total population. Category three is the modal one embracing 23.2 percent of the respondents. With the exception of category one, each of the groupings contains at least one-tenth of the households. The total mean score is 3.462. Table 10 also presents the level of living scale cross-tabulated with the electricity users variable. The Chi square test yields a significance of 0.01, which is to say that the probability of this distribution occurring by chance is less than one in one thousand. Therefore, there is virtually no probability that the patterns revealed are due to chance occurrence. These measures and an inspection of the table reveal a strong positive association between electricity use and the level of living. The distribution of each of the classes of users according to their level of living classification is shown graphically in Figure 7.

Figure 7

Percentages of USERS, INACCESSIBLES, and NON-ADOPTERS by Categories of Level of Living Scale (LEVEL), Costa Rica

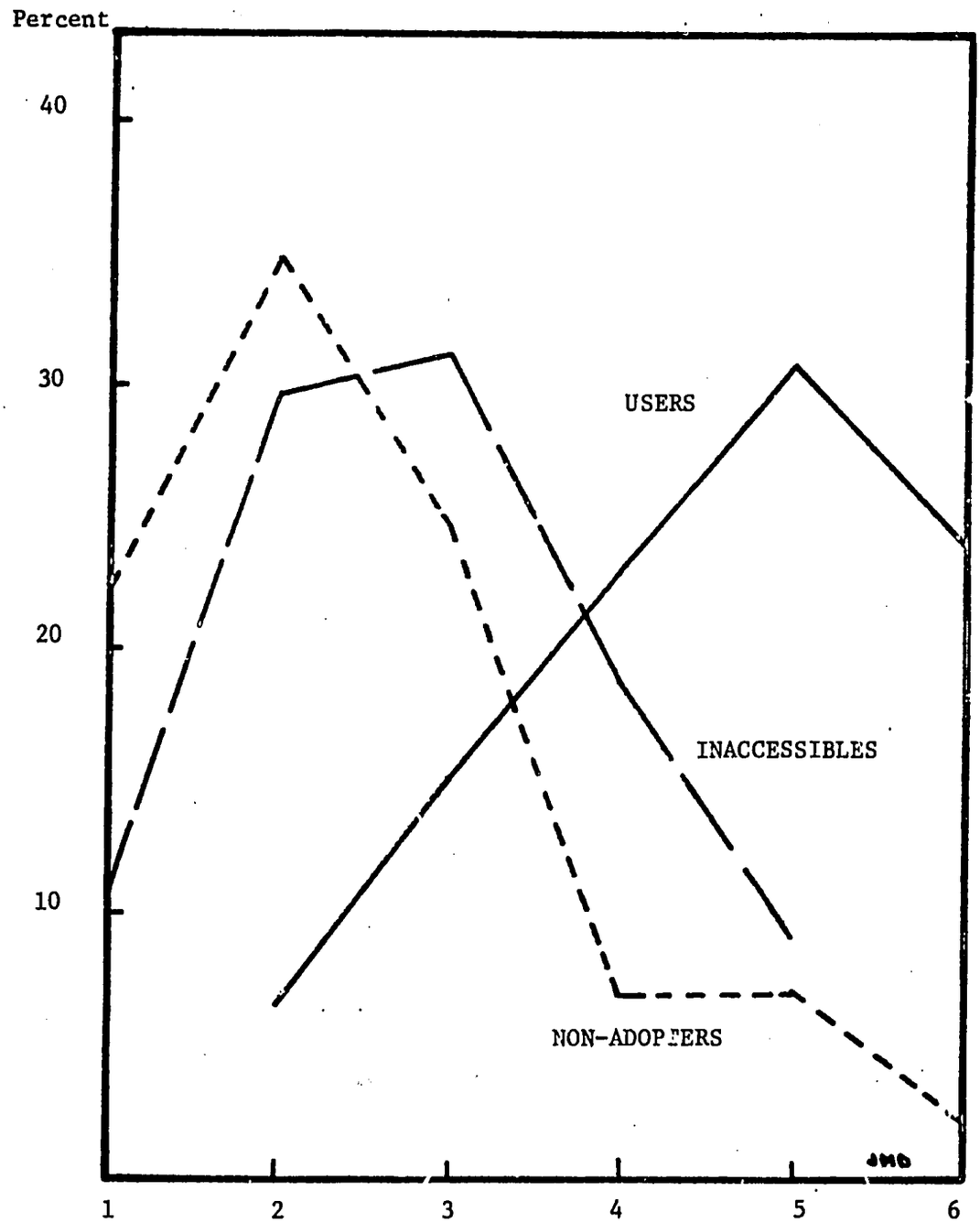


Table 10

Percentages and Numbers of Respondents in Level of Living Scale (LEVEL) Categories by Users Variable, Costa Rica

Users Categories	LEVEL Categories 1 (low)	2	3	4	5	6 (high)	TOTAL
USERS	0.0 (0)	12.5 (12)	26.7 (28)	52.5 (43)	72.1 (57)	91.8 (45)	41.0 (185)
INACCESSIBLES	46.3 (19)	52.1 (50)	50.5 (53)	39.0 (32)	19.0 (15)	0.0 (0)	37.4 (169)
NON-ADOPTERS	53.7 (22)	35.4 (34)	22.8 (24)	8.5 (7)	8.9 (7)	8.2 (4)	21.6 (98)
TOTAL	100.0 (41)	100.0 (96)	100.0 (105)	100.0 (82)	100.0 (79)	100.0 (49)	100.0 (452)

The proportion of USERS increases as level of living increases while the reverse is true for INACCESSIBLES and NON-ADOPTERS. Of the 185 USERS, only 40, or 21.6 percent, are not in the upper half of the LEVEL groupings. The INACCESSIBLES, those who are beyond the reach of the COOPELESCA distribution system, are distributed around the lower middle range of LEVEL. Only 21.8 percent of the INACCESSIBLES are grouped in the upper three categories of LEVEL. The NON-ADOPTERS, those who could but have not availed themselves of the opportunity of utilizing COOPELESCA electricity, disproportionally fall into the lower reaches of the level of living scale. Over half, 57.2 percent, of the NON-ADOPTERS occupy the lowest two categories of LEVEL.

It is apparent that the average USER has a higher level of living than the average INACCESSIBLE who in turn surpasses the average NON-ADOPTER. This is borne out by the arithmetic mean of each group. The mean of the USERS is 4.514, for the INACCESSIBLES the figure is 2.846, and the NON-ADOPTERS have a mean LEVEL score of 2.541. The test scores for the difference between those means and their level of significance are shown in Table 11.

Table 11

Scores of T Tests for Difference between Arithmetic Means and Levels of Significance for Categories and Combinations of Categories of Users Variable by Level of Living Scale (LEVEL) and Electricity-free Level of Living Scale (LEVELNOE) Costa Rica

Level of Living Scales	T Test Score	Level of Significance for Two-tailed Test
LEVEL		
USERS/NON-ADOPTERS	12.671	0.001
USERS/INACCESSIBLES	13.448	0.001
NON-ADOPTERS/INACCESSIBLES	1.992	0.050
USERS/NON-ADOPTERS and INACCESSIBLES	15.407	0.001
LEVELNOE		
USERS/NON-ADOPTERS	10.851	0.001
USERS/INACCESSIBLES	8.184	0.001
NON-ADOPTERS/INACCESSIBLES	4.490	0.001
USERS/ NON-ADOPTERS and INACCESSIBLES	10.946	0.001

Several conclusions can be drawn from both analyses of the LEVEL at this point. Those who use electricity have a significantly higher level of living than do non-users. The mean of the USERS, 4.514, indicates a moderately high average for all those in this group. While both groups of non-users have dramatically lower average levels of living than do the users, the mean of the INACCESSIBLES is higher than that of the NON-ADOPTERS. It also signifies that while the use of electricity is associated with a higher level of living, it is not necessarily the only factor. The non-use of electricity is apparently but one of the factors which is associated with a substantially lower level of living for NON-ADOPTERS.

In an attempt to examine more closely the disparity in LEVEL between the USERS and NON-ADOPTERS, a ratio between the total percentage of USERS by category of LEVEL and the same statistic for NON-ADOPTERS was prepared. This analysis is presented in Table 12. Although there is one fluctuation, the percentage of USERS increases with a concurrent rise in value of the category of LEVEL, and the reverse trend is apparent for the NON-ADOPTERS. The effects of these changes are reflected by the ratios which compare the percentages of USERS in each category of LEVEL with those of NON-ADOPTERS in the same categories. The value of the ratio varies directly with an increase in the classification of LEVEL.

The change is from 0.000 in the first category to 5.927 in the last one. As a result it can be stated that when comparing users of electricity with those who could but do not use electricity the proportion of users directly increases with a rise in the level of living and the reverse correlation is found for the non-users.

Table 12

Percentages of USERS and NON-ADOPTERS by Categories of Level of Living Scale (LEVEL) and Ratios of Percentages of USERS to NON-ADOPTERS, Costa Rica

	LEVEL Categories						
	1	2	3	4	5	6	TOTAL
USERS (percentages)	0.0	6.5	15.1	23.3	30.8	24.3	100.0
NON-ADOPTERS (percentages)	22.5	34.7	24.5	7.1	7.1	4.1	100.0
Ratio of percentages of USERS to NON-ADOPTERS	0.000	0.187	0.616	3.282	4.338	5.927	--

Because the LEVEL scores used above are partly based on the use of electrical appliances, an electricity-free level of living scale, LEVELNOE, was devised (See Chapter II). To avoid a possible bias in the cross-tabulations used in the remainder of this presentation, LEVELNOE is used instead of LEVEL. The number of respondents classified in each class of LEVELNOE by user categories is shown in Table 13. The same relationships found between electricity use and LEVEL persist between electricity use and LEVELNOE. The distribution of the total population according to LEVELNOE resembles a bell-shaped curve as it did with LEVEL. The middle category is modal containing nearly one-third, 33.0 percent, of the respondents. Only slightly smaller is category two with 30.1 percent of the cases. The mean score of all of the cases is 2.812. Once again, as was the case with the statistical manipulations between LEVEL and the users variable, the Chi Square tests show that the probability of the relationships between LEVELNOE and the users characteristic occurring by chance is no greater than 0.001.

Certain characteristics of the various types of users and non-users are apparent in Table 13. These, however, are more explicitly revealed in Figure 8. USERS predominate in the upper categories of LEVELNOE.

Some 36.2 percent of them are in the middle category; but another 31.9 percent of them are classified as being in category four. In comparison, the INACCESSIBLES are fairly evenly distributed between categories two and three. The former contains 38.5 percent of the INACCESSIBLES, while another 37.9 percent placed in the latter class. The NON-ADOPTERS are clustered around the lower end of LEVELNOE. The modal category of these non-users is the second classification where 42.9 percent of the NON-ADOPTERS are placed.

Table 13

Percentages and Numbers of Respondents in Electricity-free Level of Living Scale (LEVELNOE) Categories by Users Variable, Costa Rica

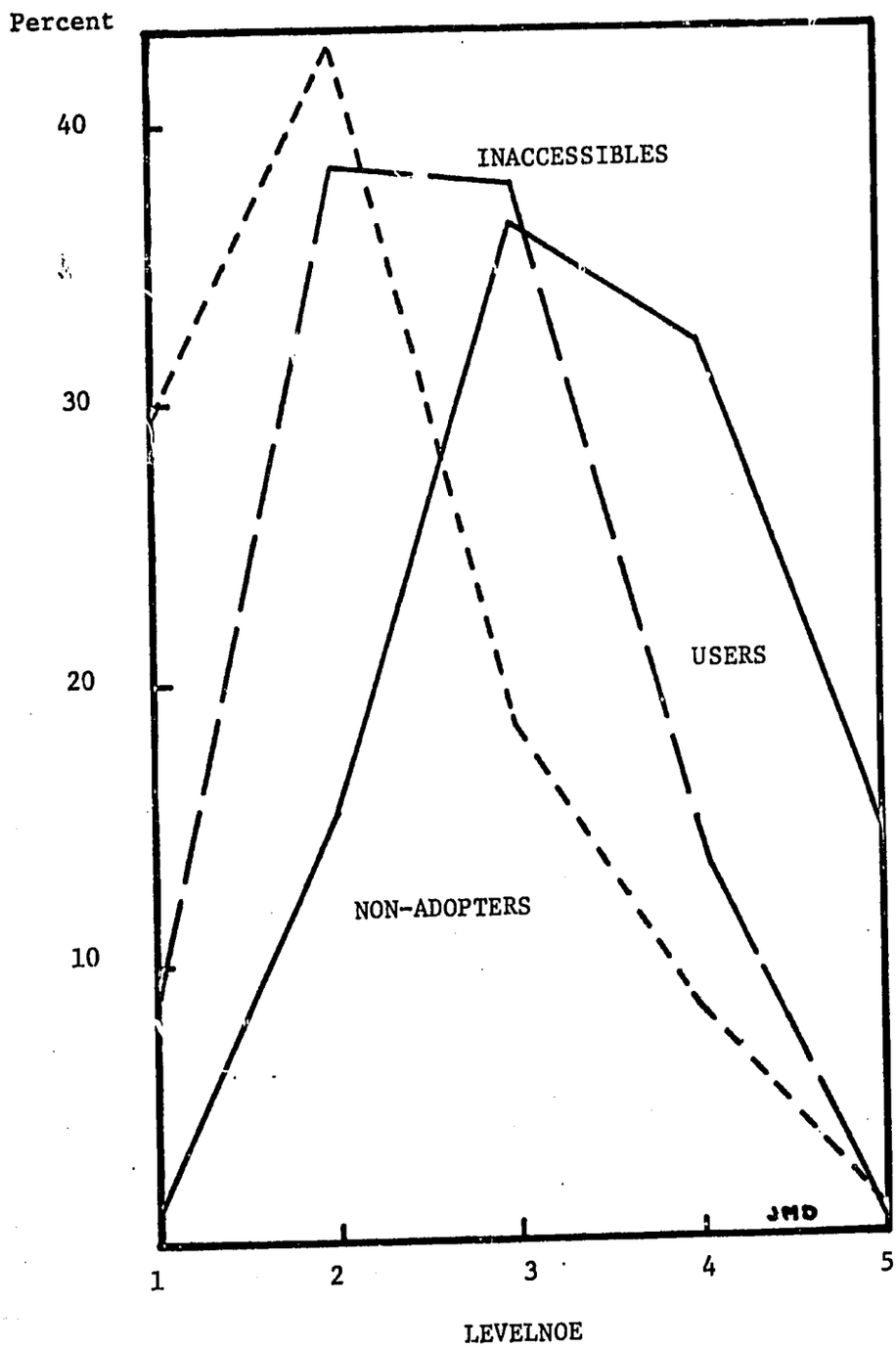
Users Categories	LEVELNOE Categories 1 (low)	2	3	4	5 (high)	TOTAL
USERS	8.3 (4)	21.3 (29)	44.9 (67)	64.8 (59)	92.8 (26)	41.0 (185
INACCESSIBLES	31.3 (15)	47.8 (65)	43.0 (64)	26.4 (24)	3.6 (1)	37.4 (169)
NON-ADOPTERS	60.4 (29)	30.9 (42)	12.1 (18)	8.8 (8)	3.6 (1)	21.6 (98)
TOTAL	100.0 (48)	100.0 (136)	100.0 (149)	100.0 (91)	100.0 (28)	100.0 (452)

The relationship between the categories of users is similar whether using LEVEL or LEVELNOE. Using LEVELNOE, the USERS have the highest level of living as shown by their mean score of 3.400. The INACCESSIBLES occupy the middle position with a mean score of 2.592. NON-ADOPTERS have on the average the lowest level of living as shown by their arithmetic mean of 2.082. The standing of the INACCESSIBLES is indicative of the fact that those who do not have access to electricity are intermediate, with regard to level of living, between users of electrical power and voluntary non-users of this source of energy.

The relationship between the use of electricity and level of living is dramatically shown when comparing the LEVELNOE scores of the USERS and NON-ADOPTERS (Table 14). The percentage of the USERS by category of LEVELNOE is presented. The same procedure for the NON-ADOPTERS is also shown. The figures for these USERS and NON-ADOPTERS are then compared in the form of a ratio. The importance of USERS vis-a-vis NON-ADOPTERS increases directly with rising values of LEVELNOE. The following conclusions can be drawn from this comparison. Although both users and non-users of electricity are found in all levels of the electricity-free level of living scale,

Figure 8

Percentages of USERS, INACCESSIBLES, and NON-ADOPTERS by Categories of Electricity-free Level of Living Scale (LEVELNOE), Costa Rica



the relative importance of the users varies in direct relationship with a positive change in the level of living. Concurrently, with an increase in value of level of living there is a decrease in the relative importance of non-users.

Table 14

Percentages of USERS and NON-ADOPTERS by Categories of Electricity-free Level of Living Scale (LEVELNOE) and Ratios of Percentages of USERS to NON-ADOPTERS, Costa Rica

	LEVELNOE Categories					
	1	2	3	4	5	TOTAL
USERS (percentages)	2.2	15.7	36.2	31.9	14.0	100.0
NON-ADOPTERS (percentages)	29.6	42.8	18.4	8.2	1.0	100.0
Ratio of percentages of USERS to NON-ADOPTERS	0.074	0.367	1.967	3.890	14.000	

In summary, evidence has been presented to support the contention that there are demonstrable relationships between the level of living and the use of electricity. Although both users and non-users of electricity are found in all of the categories of level of living, there is a strong positive correlation between the relative importance of users and increases in the values of the level of living category. The reverse trend is observable for non-users.

However, the existence of this association does not demonstrate causality. Greater economic resources as reflected in size of farm within a given type of agricultural activities may affect levels of living as may education, indirectly, through other variables such as superior farming methods. Size of household may also affect this relationship by influencing the allocation of resources. Age may also be related to level of living in various ways. For instance, the highest income may be earned during a certain portion of the adult life span, or older household heads may have had more time in which to make the improvements which would increase their level of living scores. Consequently, these variables are used as controls in the analysis which follows.

It could be expected that as the number of people living in a household increases, relatively more has to be spent on personal necessities resulting in smaller amounts being available for upgrading the fulfillment of household functions measured by LEVELNOE. The supposition then, is that LEVELNOE and size of household are inversely related. The data presented in Figure 9, however, do not support this contention, for there is no consistent trend. However, these data also demonstrate that USERS have higher scores on LEVELNOE than either INACCESSIBLES or

Figure 9

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Number of People per Household (PEOPLE), Costa Rica

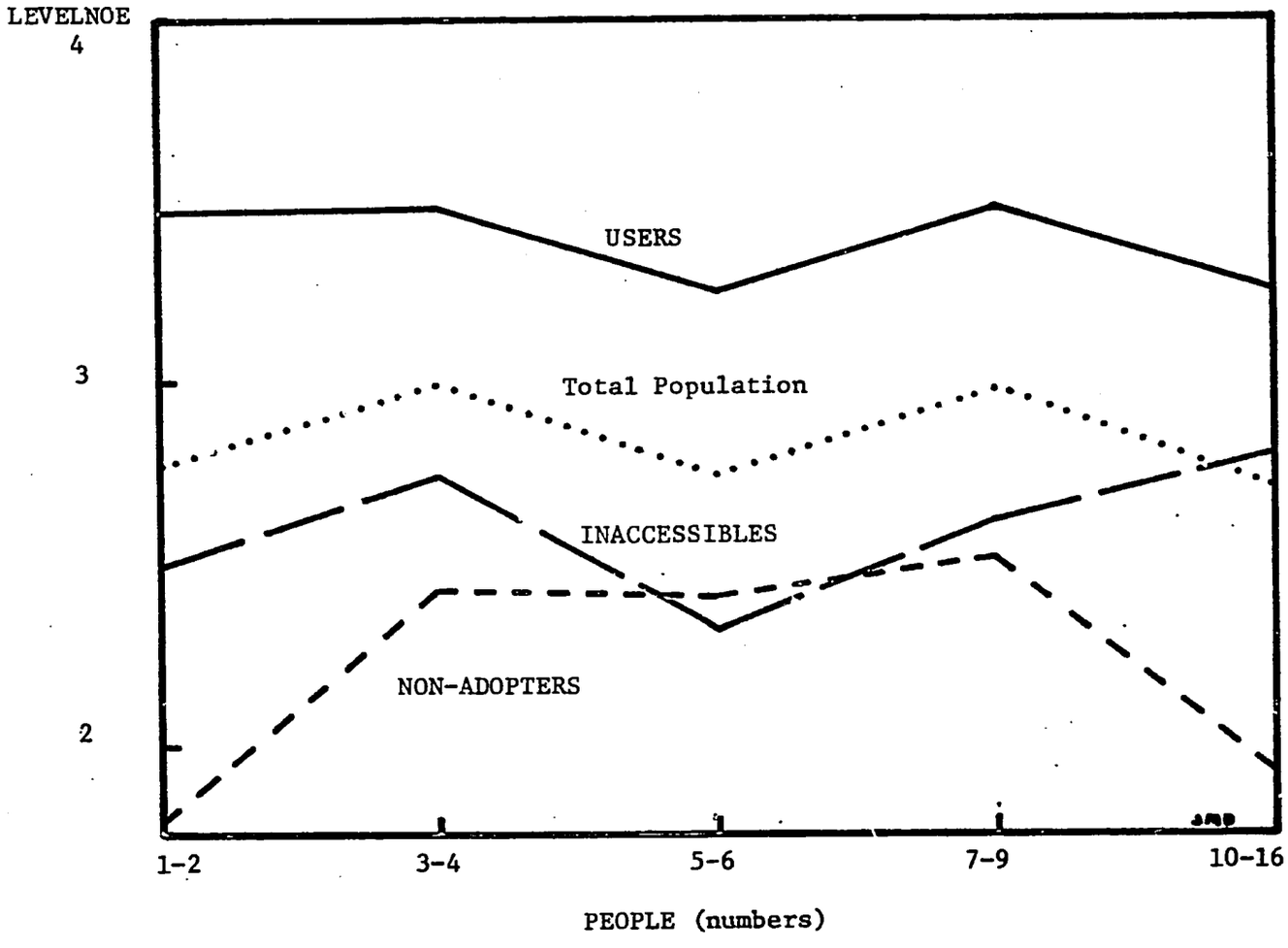
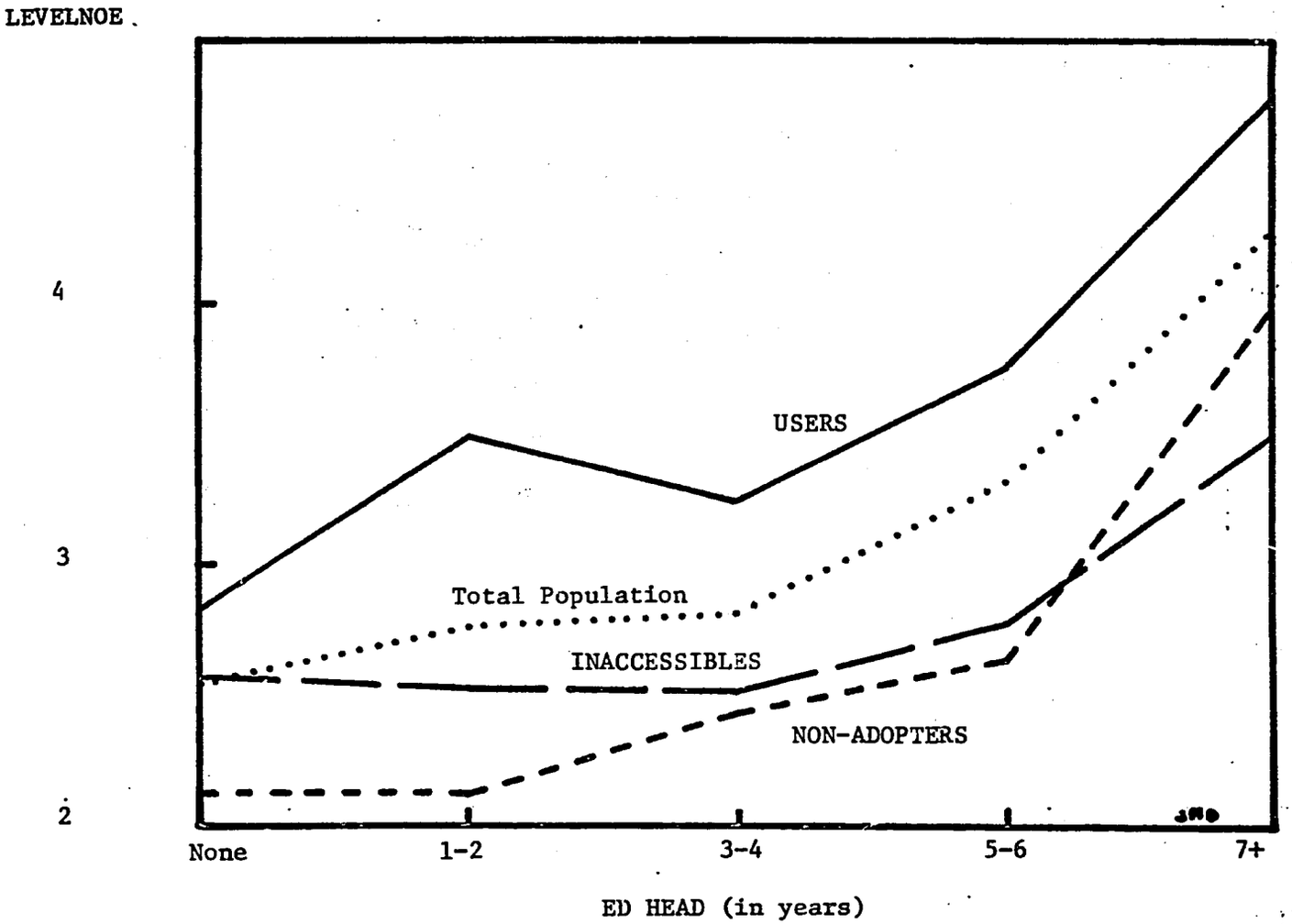


Figure 10

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population Years of Education of Heads of Households (ED HEAD), Costa Rica



NON-ADOPTERS regardless of the size of household. Furthermore, the differences for all sizes of household are substantial. Thus, for instance, the mean LEVELNOE score of households having three or four members is about 3.5 for USERS, 2.8 for INACCESSIBLES and 2.4 for NON-ADOPTERS. The higher LEVELNOE scores of USERS persist for every size of household category. It is thus apparent that size household does not appreciably affect the level of living of household heads in the several user categories and does not explain the higher scores on this measure obtained by USERS as compared to others.

Education has been found, in many studies done in a great variety of settings to be positively associated with socio-economic status, including income and level of living. The respondents interviewed in Costa Rica are no exception (Figure 10). The mean LEVELNOE scores for persons in each user category tend to increase with increases in the number of years of school completed. The effect of education is especially marked for persons having completed five or more years of school. It will be recalled (see demographic characteristics, above) that USERS completed a larger number of years of school than either INACCESSIBLES or NON-ADOPTERS. Yet when household heads having completed the same number of years of school are compared, those who are USERS score substantially higher on LEVELNOE than do either INACCESSIBLES or NON-ADOPTERS (Figure 10), so that education does not account for the differences in LEVELNOE found between persons in the several user categories. INACCESSIBLES, with one exception are intermediate between USERS and NON-ADOPTERS.

Another possible explanation of differences in LEVELNOE between the user categories is size of farm. Presumably income is related to the size of the farm owned or operated which in turn would permit higher levels of living for the operators of large farms regardless of electricity use. The positive relationship between the electricity-free level of living scores and size of farm is indeed supported by our data. Mean LEVELNOE scores tend to increase as size of farm increases (Figure 11). NON-ADOPTERS are only an apparent exception at the higher size of farm categories because of the small number of cases of NON-ADOPTERS owning farms of fifty or more manzanas. As shown elsewhere in this report USERS have larger farms than either INACCESSIBLES or NON-ADOPTERS. Yet, once again, even when farm size is held constant, USERS score higher on LEVELNOE by a substantial margin than INACCESSIBLES and NON-ADOPTERS, so that farm size does not explain the differential in level of living between USERS and others. It is also noteworthy that INACCESSIBLES score higher than NON-ADOPTERS, when farm size is controlled, once again occupying an intermediate position between USERS and NON-ADOPTERS.

Finally, the age of the head of the household was used as a control variable for the comparison of the LEVELNOE of the several user categories (Figure 12). Except for USERS whose mean LEVELNOE scores tend to drop slightly with advancing age there is no clear relationship between age and the electricity-free level of living. Even so, the decline in the LEVELNOE of users with advancing age is slight. The differential in LEVELNOE between USERS and others again persists, however, regardless of the age of the household head. Age, therefore does not explain the higher scores of USERS. INACCESSIBLES once more occupy an intermediate position between USERS and NON-ADOPTERS.

Figure 11

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Size of Farm (SIZE FARM), Costa Rica

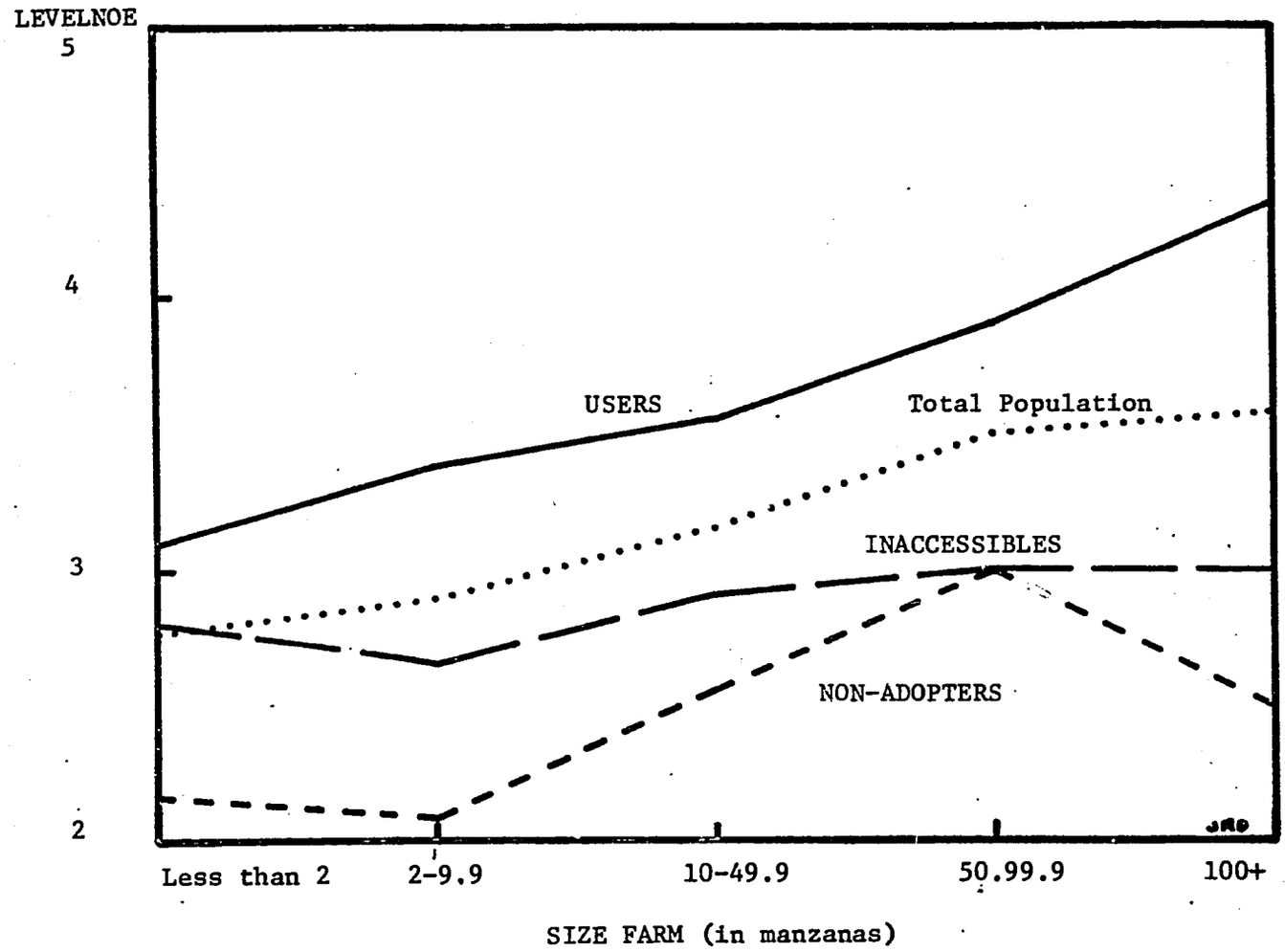
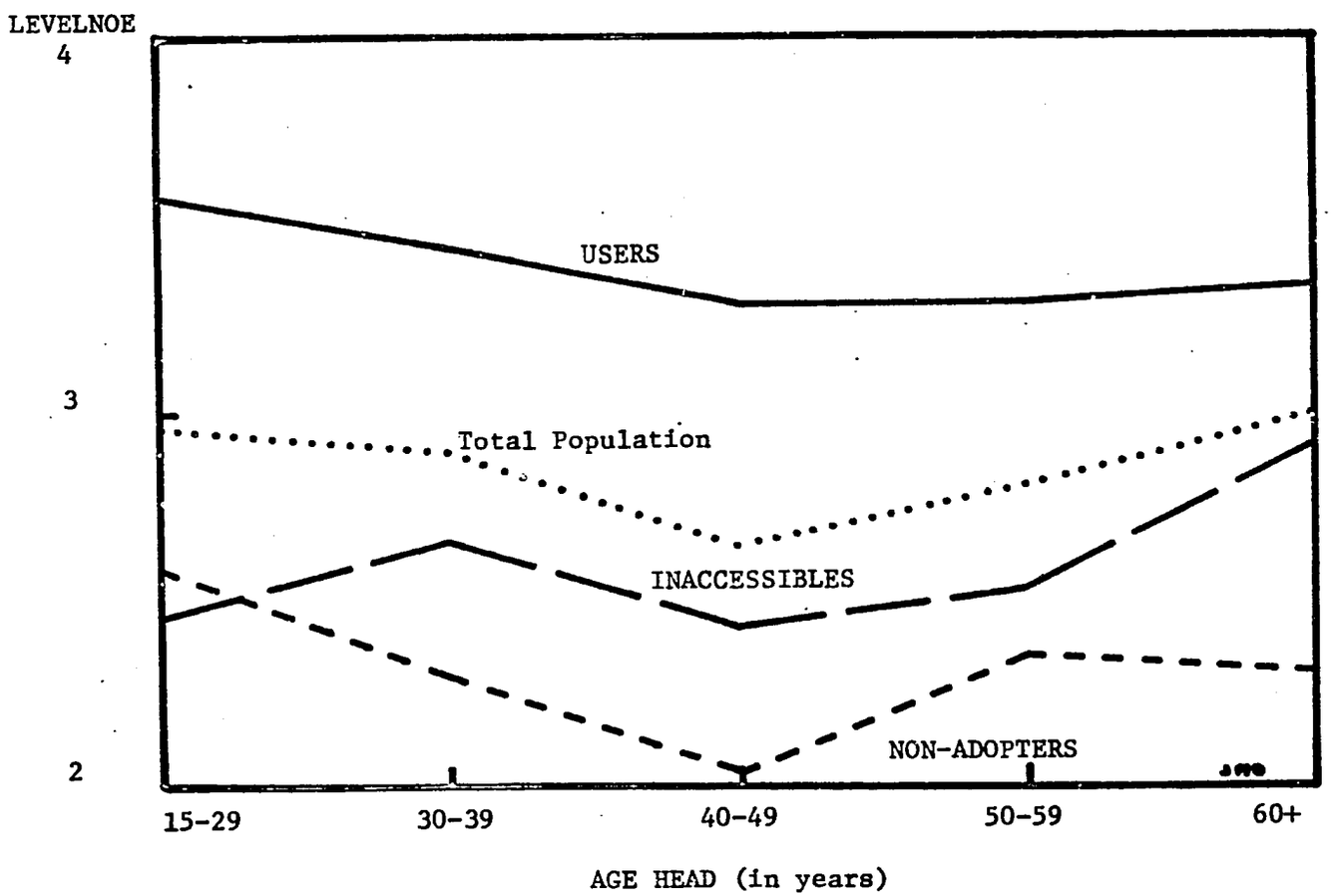


Figure 12

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Age of Heads of Households (AGE HEAD), Costa Rica



Users of electricity have been shown to have higher levels of living than non-users of electricity. The introduction of control variables which might explain the differential in LEVELNOE existing between USERS and others failed to do so, and the difference persisted. Although the data do not conclusively prove that electricity is causal in this relationship, they strongly suggest that electricity use is one of probably several causal factors which contribute to the higher levels of living of those who use it in the Costa Rica study area. The data also support the contention that where electricity was not available in the area of those who now use it they would have lower levels of living. This first, and largely exploratory, study of the correlates of electricity use cannot provide an answer to the question of what precise variables account for higher levels of living of electricity users and in what sequence. Or whether, conceivably, some variable not yet identified completely explains the observed differences. Nevertheless, the fact remains that electricity users have higher levels of living at least in part due to electricity use. Until data are presented to disprove this finding, increased level of living must be counted as one of the social benefits of rural electrification in the Costa Rica study area.

Satisfaction With Life Situation

Several hypotheses regarding the relationship between satisfaction with life situation and electricity use underlay this analysis. First, that USERS would score higher on SIT PRES than NON-ADOPTERS and INACCESSIBLES (See Chapter II for a description of these variables). Second, that USERS would score higher on SIT PAST than NON-ADOPTERS or INACCESSIBLES. Both of these seem reasonable suppositions since users possess an important source of energy that many of their neighbors do not have, and because USERS have been served by electricity for a relatively short time and therefore, in this respect, are better off now than they were five years before and better off than their fathers were. Third, that USERS would perceive a better future for themselves and for their children, scoring higher on SIT FUT. This hypothesis stands on thinner ice, namely, that persons having electricity perhaps anticipate ways in which it will be used in the future so as to improve their life situation and that of their children. Nevertheless, it was included as a logical extension of the first two hypotheses and as a useful indicator of mood and attitude toward the future in and of itself. Fourth, if the preceeding hypotheses are substantially true then it would also be true that USERS would score higher on SIT TOT than NON-ADOPTERS and INACCESSIBLES.

Results of the cross-tabulation of the users variable and SIT PRES are presented in Table 15. This tabulation reveals a positive association between electricity use and satisfaction with present life situation. Although the modal category is "same" (3) for each class of the users variable, higher proportions of USERS (38%) than of INACCESSIBLES (26%) and of NON-ADOPTERS (14%) consider their life situation to be better or much better than that of their neighbors. Precisely the reverse occurs with regard to the proportions who consider their life situation to be worse or much worse than that of their neighbors. Of particular interest is the fact that NON-ADOPTERS are the most

dissatisfied with their present life situation. This is the group to which electricity is accessible but who have not for some reason used it, in contrast with many of their neighbors who have done so. The feeling of deprivation or dissatisfaction is, perhaps, related to this differential. On the other hand the NON-ADOPTERS may be the least privileged group to begin with, explaining both their dissatisfaction with their present life situation and their non-use of electricity. This question is explored in greater detail below.

Table 15

Percentages and Numbers of Respondents in Present Satisfaction with Life Situation Index (SIT PRES) Categories by Users Variable, Costa Rica

Users Categories	SIT PRES Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	9.1 (1)	23.2 (13)	38.9 (100)	56.4 (57)	51.9 (14)	40.9 (185)
INACCESSIBLES	27.3 (3)	35.7 (20)	40.1 (103)	29.7 (30)	48.1 (13)	37.4 (169)
NON-ADOPTERS	63.6 (7)	41.1 (23)	21.0 (54)	13.9 (14)	0.0 (0)	21.7 (98)
TOTAL	100.0 (11)	100.0 (56)	100.0 (257)	100.0 (101)	100.0 (27)	100.0 (452)

Mean scores on the satisfaction with life situation indexes by user categories are presented in Table 16. USERS are revealed to have a higher SIT PRES mean score (3.378) than INACCESSIBLE (3.178) or NON-ADOPTERS (2.765). USERS as a whole feel that their present life situation is better than that of their neighbors, INACCESSIBLES feel somewhat better off than their neighbors but NON-ADOPTERS as a whole feel that their neighbors are better off than they. It is noteworthy that the mean score of SIT PRES for USERS and NON-ADOPTERS as a whole and for INACCESSIBLES are virtually identical, indicating that taken as a whole, the population in the electrified area is similar in this respect to that in the area which is out of reach of the power lines. It is the low SIT PRES scores of NON-ADOPTERS and the high SIT PRES scores of adopters which contribute to the differences observed. Furthermore, even when all non-users (INACCESSIBLES and NON-ADOPTERS) are combined their mean SIT PRES score (3.026) remain considerably below that of USERS (3.378).

Table 16

Arithmetic Means for Respondents of Satisfaction with Life Situation Indexes for Categories and Combinations of Categories of Users Variable, Costa Rica

Users Categories and Combinations of Categories	Satisfaction with Life Indexes			
	SIT PRES	SIT PAST	SIT FUT	SIT TOT
USERS	3.378	4.054	4.346	4.265
INACCESSIBLES	3.178	3.822	4.426	4.178
NON-ADOPTERS	2.765	3.265	4.286	3.826
USERS and NON-ADOPTERS	3.166	3.781	4.325	4.113
NON-ADOPTERS and INACCESSIBLES	3.026	3.618	4.374	4.049
TOTAL	3.170	3.796	4.363	4.137

The significance of the differences between these means was calculated using the T test for difference between means. T test scores and their corresponding level of significance are presented in Table 17. There is a statistically significant difference between the SIT PRES means of USERS and NON-ADOPTERS. The same is true for the USERS and INACCESSIBLES, confirming the first hypothesis. Significant differences persist, although to a lesser degree, when USERS are compared with NON-ADOPTERS and INACCESSIBLES as a whole and when USERS and NON-ADOPTERS as a whole are compared with INACCESSIBLES. It can, therfore, be stated that USERS are more satisfied with their life situation in comparison with that of their neighbors than their peers who could but do not use electricity. The same can be said of the comparison between those who use electricity and all of those who do not.

Table 17

Scores of T Tests for Difference between Arithmetic Means and Levels of Significance for Categories and Combinations of Categories of Users Variable by Satisfaction with Life Situation Indexes, Costa Rica

Satisfaction with Life Situation Indexes	T Test Score	Level of Significance for Two-tailed Test
SIT PRES		
USERS/NON-ADOPTERS	6.441	0.001
USERS/NON-ADOPTERS and INACCESSIBLES	4.648	0.001
USERS and NON-ADOPTERS/INACCESSIBLES	2.844	0.010
USERS/INACCESSIBLES	2.432	0.020
SIT PAST		
USERS/NON-ADOPTERS	6.939	0.001
USERS/NON-ADOPTERS and INACCESSIBLES	4.726	0.001
USERS and NON-ADOPTERS/INACCESSIBLES	1.696	0.100
USERS/INACCESSIBLES	2.349	0.020
SIT FUT		
USERS/NON-ADOPTERS	0.673	None
USERS/NON-ADOPTERS and INACCESSIBLES	0.431	None
USERS and NON-ADOPTERS/INACCESSIBLES	1.500	0.200
USERS/INACCESSIBLES	1.126	None
SIT TOT		
USERS/NON-ADOPTERS	5.821	0.001
USERS/NON-ADOPTERS and INACCESSIBLES	3.629	0.001
USERS and NON-ADOPTERS/INACCESSIBLES	1.049	None
USERS/INACCESSIBLES	1.379	0.200

Cross-tabulations, identical to that performed with SIT PRES were made between the users variable and the past satisfaction with life situation index and the future satisfaction with life situation index. The results appear in Tables 18 and 19, respectively. The results of the SIT PAST tabulation are generally similar to those of the SIT PRES tabulation. A higher proportion of USERS (75%) than of INACCESSIBLES (69%) and of NON-ADOPTERS (38%) considered their present situation to be better or much better than that of their fathers' or their own life five years before. The reverse trend is found with regard to the proportions in each user category who considered their present situation in life to be worse or much worse than that of their fathers or their own five years earlier. The contrast between USERS and NON-ADOPTERS is particularly striking. The means of the scores on SIT PAST of each user category are presented in Table 16. USERS, with a mean score of 4.054, consider themselves better off than in the past while NON-ADOPTERS with a score of 3.265 consider themselves more nearly as having the same life situation now as in the past.

Table 18

Percentages and Numbers of Respondents in Past Satisfaction with Life Situation Index (SIT PAST) Categories by Users Variable, Costa Rica

Users Categories	SIT PAST Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	20.0 (2)	9.4 (3)	35.3 (42)	43.5 (74)	52.9 (64)	40.9 (185)
INACCESSIBLES	40.0 (4)	43.7 (14)	29.4 (35)	41.8 (71)	37.2 (45)	37.4 (169)
NON-ADOPTERS	40.0 (4)	46.9 (15)	35.3 (42)	14.7 (25)	9.9 (12)	21.7 (98)
TOTAL	100.0 (10)	100.0 (32)	100.0 (119)	100.0 (170)	100.0 (121)	100.0 (452)

Table 19

Percentages and Numbers of Respondents in Future Satisfaction with Life Situation Index (SIT FUT) Categories by Users Variable, Costa Rica

Users Categories	SIT FUT Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	0.0 (0)	0.0 (0)	44.0 (22)	41.8 (77)	39.6 (86)	40.9 (185)
INACCESSIBLES	0.0 (0)	0.0 (0)	30.0 (15)	36.5 (67)	40.1 (87)	37.4 (169)
NON-ADOPTERS	100.0 (1)	0.0 (0)	26.0 (13)	21.7 (40)	20.3 (44)	21.7 (98)
TOTAL	100.0 (1)	0.0 (0)	100.0 (50)	100.0 (184)	100.0 (217)	100.0 (452)

The significance of the differences between means for SIT PAST are found in Table 17. Significant differences exist between the mean scores of USERS and NON-ADOPTERS and of USERS and INACCESSIBLES. The second hypothesis is, therefore, supported. Additionally, USERS compared with all non-users (NON-ADOPTERS and INACCESSIBLES) have significantly higher SIT PAST scores. The relationship also holds, but to a lesser degree in the comparison of the population in the electrified area (USERS and NON-ADOPTERS) with that in the non-electrified area (INACCESSIBLES). This relationship, however, is a function of the higher SIT PAST scores of users.

Although on an average those in the research population consider that there has been an improvement in their lives, the change has been major for the USERS, moderate for the INACCESSIBLES, and relatively minor for the NON-ADOPTERS. Because of the statistical significance of the analyses, it can be stated that there is a positive correlation between increased satisfaction with life compared with the past and tendency to use electricity-- no causality is posited.

The results of the cross-tabulation between the future satisfaction with life index and the users variable is set forth in Table 19. Only one respondent is pessimistic about the future. Only about one tenth, (11.1%), of them feel that things will be the same in the future. The remainder believe that the future will be at least better than the present. The arithmetic averages of the various categories, shown in Table 16, demonstrate that regardless of the use or non-use of electricity, the respondents are very optimistic. The INACCESSIBLES are slightly more inclined to expect future betterment than are the USERS who in turn have SIT FUT scores which exceed those of the NON-ADOPTERS. There are no statistically significant differences in the mean scores of the various categories and combinations of categories according to SIT FUT. Therefore, the third hypothesis is rejected.

Although the variations found in the analysis of the future satisfaction with life index are not statistically important, it is nevertheless interesting that the INACCESSIBLES scored higher on this index than the other groups. While the survey data were being gathered, plans to electrify the area between La Fortuna and Los Angeles were being readied. The residents of the area were aware of this. The expectation of receiving electricity on the part of the respondents in this area might have affected their optimism for the future. This could account for the somewhat higher mean score of the INACCESSIBLES than of NON-ADOPTERS on the SIT FUT index.

The total satisfaction with life index is a compilation of the three indexes already discussed. The SIT TOT was cross-tabulated with the users variable; the results are presented in Table 20. Due to the statistical procedures used, the scores are slightly skewed towards the upper portions of the index. The discriminatory power of this index however is demonstrated in the analysis of the arithmetic means presented in Tables 16 and 17. The mean score of USERS is higher than that of INACCESSIBLES which in turn surpasses that of NON-ADOPTERS.

Table 20

Percentages and Numbers of Respondents in Total Satisfaction with Life Situation Index (SIT TOT) Categories by Users Variable, Costa Rica

Users Categories	SIT TOT Categories 1	2	3	4	5	TOTAL
USERS	0.0 (0)	0.0 (0)	20.0 (12)	41.9 (112)	49.2 (61)	40.9 (185)
INACCESSIBLES	0.0 (0)	0.0 (0)	33.3 (20)	37.1 (99)	40.3 (50)	37.4 (169)
NON-ADOPTERS	0.0 (0)	100.0 (1)	46.7 (28)	21.0 (56)	10.5 (13)	21.7 (98)
TOTAL	0.0 (0)	100.0 (1)	100.0 (60)	100.0 (267)	100.0 (124)	100.0 (452)

The total satisfaction with life index is a statistical combination of the other three indexes. Because of the tendency of the negative and positive responses to cancel each other out in the construct, a statistical regression to the mean was built into it. It is however, the most accurate representation of the overall satisfaction with one's life situation taking into account the present, past and future. Because it is the most balanced indicator of the phenomenon being studied, SIT TOT is relied upon to a greater extent than the other indexes.

The T test for difference in means, reveals that the variations between USERS and NON-ADOPTERS and USERS and INACCESSIBLES are statistically significant. The fourth hypotheses is, therefore, supported. That is to say that USERS are more satisfied with their life situation than are INACCESSIBLES or NON-ADOPTERS. The statistically significant difference persists when comparing the USERS with the combined scores of both types of non-users. The variation, however, disappears when comparing those within reach of the electrical distribution lines and those situated in the area not serviced by the power lines. Because of its discriminatory powers and aggregate capabilities, SIT TOT is the only satisfaction with life situation index to be used in the remainder of this study.

Certain tentative conclusions can be drawn from the preceding analysis. Those who use electricity are more satisfied with their life situation than either those who could but do not use this source of energy and those who cannot utilize electrical current. Also, those who have not taken advantage of the chance to connect with the electrical energy source are less satisfied than are those who are beyond the reach of electricity distribution lines. Before assuming that one of the results of the impact of electrification might be an increase in satisfaction with life situation, alternate possible causes of differentials in satisfaction with life situation must be examined and controlled for. Accordingly, those variables incorporated into the study which could reasonably be used as control variables were so used. These are age, education, level of living and size of farm. In each case it is reasonable to suppose that the control variable is positively associated with satisfaction with life situation and, in turn, that the characteristic in question is more prevalent among users of electricity than among others, thus partially explaining, at least, the differences found above.

The variables used in the following analyses are: age of the head of the household (AGE HEAD), education of the head of the household (ED HEAD), size of the landholdings (SIZE FARM), and electricity-free level of living scale (LEVELNOE). In summary fashion the definition of and the number of cases in each of the categories of these variables is presented in Table 21. In order to eliminate cells containing a small number of cases, the two upper groups of LEVELNOE were combined for this analysis.

Table 21

Definition of and Number of Cases in Categories of Size of Farm (SIZE FARM), Age of Head of Household (AGE HEAD), Education of Head of Household (ED HEAD) and Electricity-free Level of Living Scale (LEVELNOE), Costa Rica

AGE HEAD			ED HEAD		
Category Number	Category Definition	Number of Cases	Category Number	Category Definition	Number of Cases
1	Less than 30 years	84	1	None and No Data	140
2	30-39 years	131	2	1-2 years	107
3	40-49 years	97	3	3-4 years	123
4	50-59 years	68	4	5-6 years	61
5	60+ years	66	5	7+ years	21
Total		446	Total		452

Table 21 (continued)

SIZE OF FARM			LEVELNOE		
Category Number	Category Definition	Number of Cases	Category Number	Category Definition	Number of Cases
1	Less than 2 manzanas	22	1	Low	48
			2	Lower Middle	136
2	2-9.9 mz.	89			
3	10-49.9 mz.	71	3	Upper Middle	149
4	50-99.9 mz.	18			
5	100 + mz.	12	4	High	119
Total		212	Total		452

The SIT TOT scores were cross-tabulated with the users variable while controlling for the additional variable being examined. For example, AGE HEAD contains five categories. Arithmetic means of SIT TOT were calculated for USERS, INACCESSIBLES, and NON-ADOPTERS in each category. The mean score for each of the categories of AGE HEAD was plotted and joined with lines for presentation in graphic form. The results of the analysis when controlling for AGE HEAD is set forth in Figure 13.

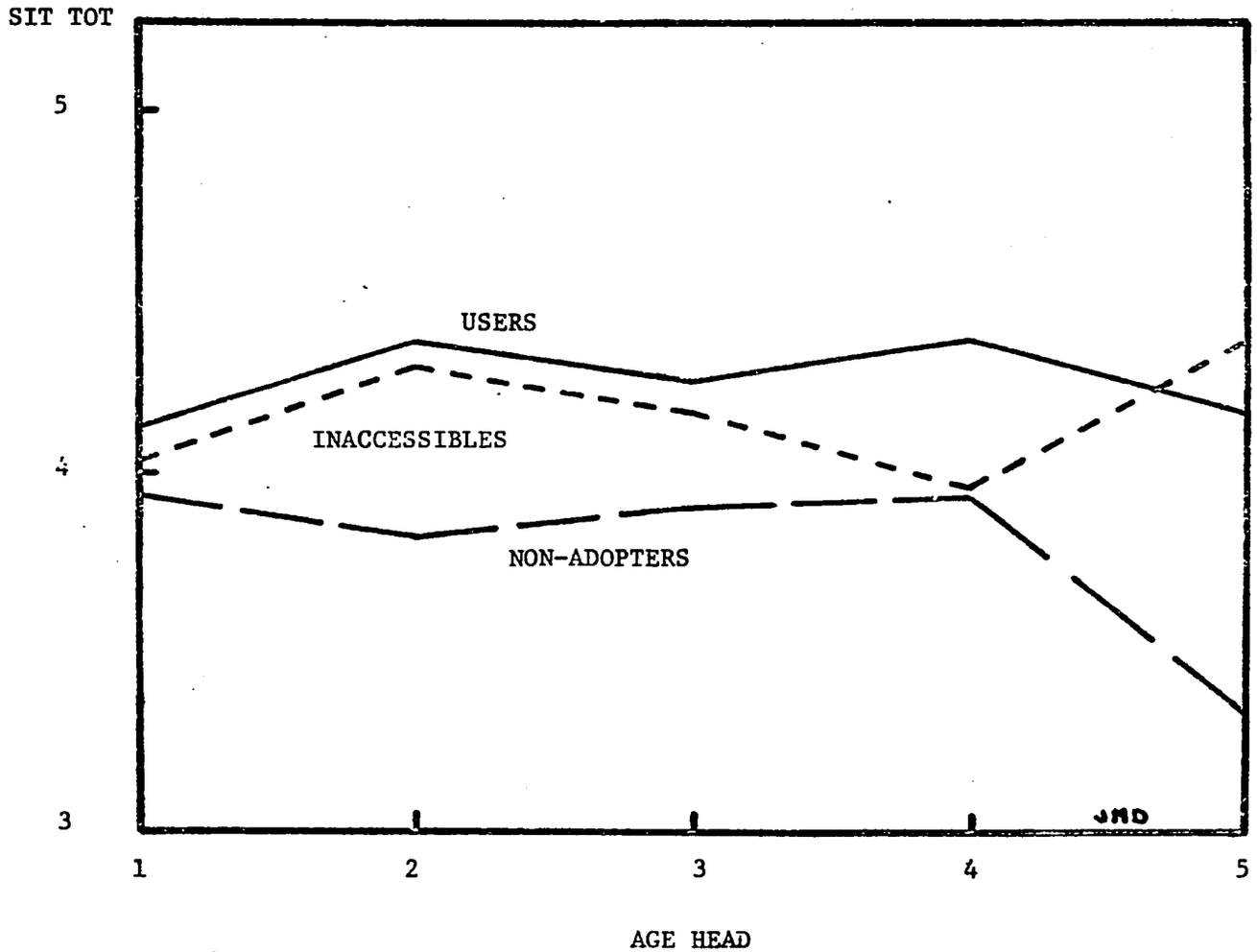
No significant association between age of the head of the household and total satisfaction with life index is revealed. Definite patterns are revealed when user categories are compared. Regardless of age, USERS are more satisfied with their life situation than are NON-ADOPTERS. For heads of the household under 30 years of age, the difference is not great. Thereafter, the gap between the two widens. Although SIT TOT varies more for the INACCESSIBLES than it does for those in the other two groups, with one exception, the scores for these non-users are intermediate between those of the USERS and NON-ADOPTERS. The oldest INACCESSIBLES are more satisfied than are the remainder of the respondents. The older NON-ADOPTERS are the least satisfied.

The conclusion can be reached that age of the head of the household is not a significant factor in determining the level of satisfaction with life situation, since differences in this measure persist, with the exception of the oldest family heads, regardless of age.

There is a slight correlation between the education of the head of the household and satisfaction with life situation. It should be noted that those who did not provide information on their last year of schooling were grouped with those who had not attended school. Analysis of the data indicated that most of the non-responses were of illiterates not wishing to reveal the fact. This process has of course introduced some error. But the error is such that our findings will be conservative rather than exaggerated. The average score on SIT TOT rises slightly with a corresponding increase in the amount of education. But the change is slight, from low arithmetic mean of 4.086 for those with no education to a high of 4.428 for those with at least seven years of schooling.

Figure 13

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Age of Head of Household (AGE HEAD)
Costa Rica



The variations in SIT TOT for the users variable when controlling for education of the head of the household are presented graphically in Figure 14. Regardless of the amount of education, the USERS have a uniformly high level of satisfaction with their life situation. With the exception of those having had at least seven years of schooling, USERS are much more satisfied than are the NON-ADOPTERS in each educational bracket. Also with the exception of those having the most education, the INACCESSIBLES rank between the USERS and NON-ADOPTERS. Although the analysis might be biased because of the small number of cases, (See Table 21) it appears that the best educated non-users are more satisfied than are their colleagues who do utilize electricity in their homes. For the rest of the population, however, regardless of the amount of education, USERS are more content than INACCESSIBLES who, in turn, score higher on SIT TOT than do NON-ADOPTERS.

The correlation between education of the head of the household and the total satisfaction with life situation is minor. It is not strong enough to adequately explain significant variation in the SIT TOT scores. With the exception of the very best educated, regardless of the influence of years of schooling, the analysis shows that USERS are more satisfied with their life situation than are both types of non-users.

Two additional measures were used for examining the influences on satisfaction with life situation. The first deals with the size of farms or landholdings. It should be noted that there are only 212 agriculturalist and stockraisers among the total sample of 452. There is a direct, although minor correlation between size of farm and satisfaction with life situation. While those with the smallest places have an average SIT TOT score of 4.095, the scores gradually increase until those with the largest landholdings have an average score of 4.500. The analysis for SIZE FARM is presented in Figure 15. Regardless of the size of the place, however, USERS are more satisfied than are the NON-ADOPTERS. The gap between the two is widest at each end of the continuum. The INACCESSIBLES closely parallel the USERS in their SIT TOT scores when SIZE FARM is controlled. In the cases of smaller sizes of farms, the USERS are the more satisfied, this is reversed for those with the larger parcels of land. Although the analysis might be influenced by the small number of cases, and the difference is small, the most content are the INACCESSIBLES with large holdings; the least satisfied are the NON-ADOPTERS with large places.

Finally, the effect of level of living on satisfaction with life situation was examined. There is a direct association between level of living and satisfaction with life. Those with the lowest LEVELNOE scores have an arithmetic average of 4.025 on the SIT TOT, while those with the highest LEVELNOE scores average 4.310 on the total satisfaction with life index.

Figure 14

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Education of Head of Household (ED HEAD), Costa Rica

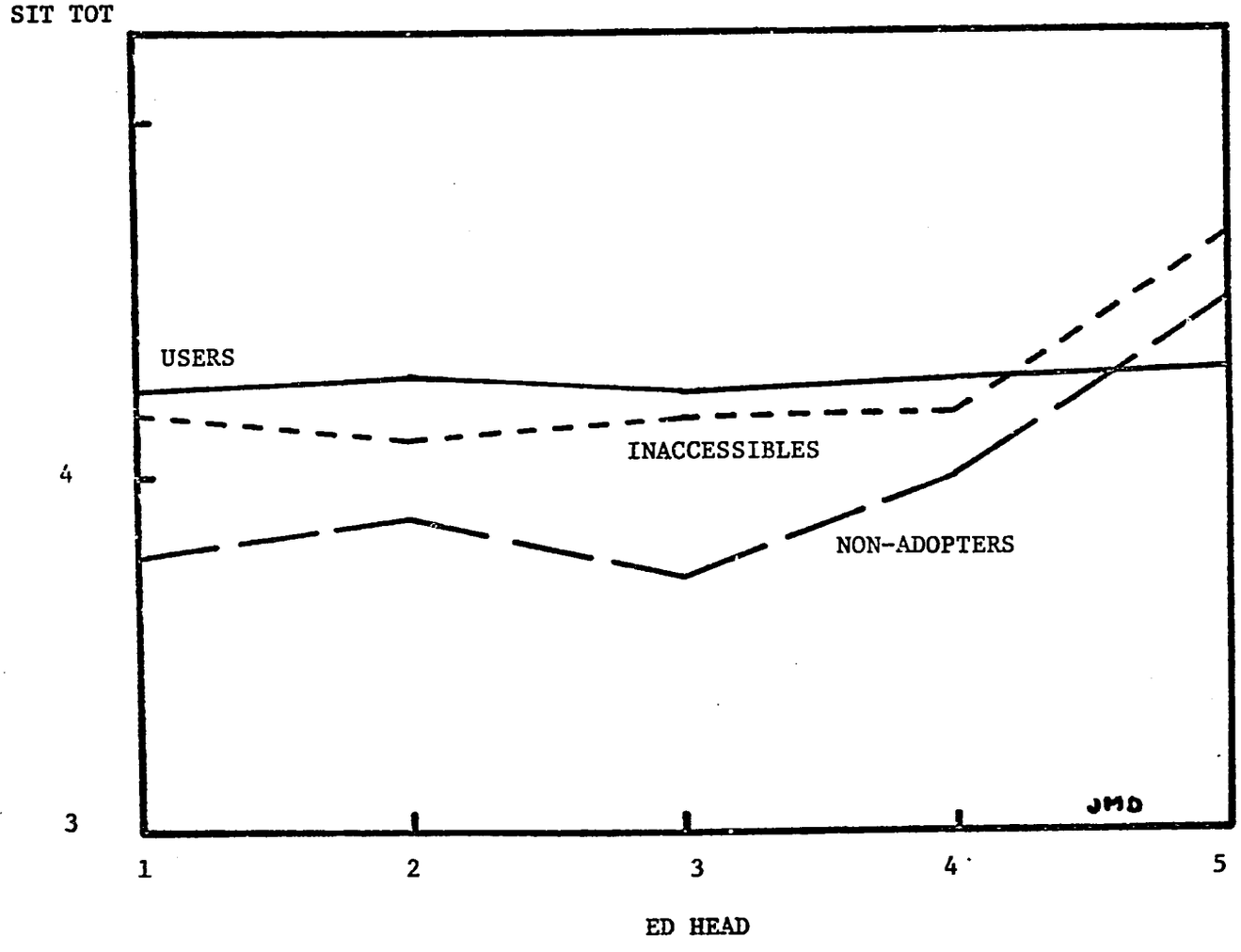
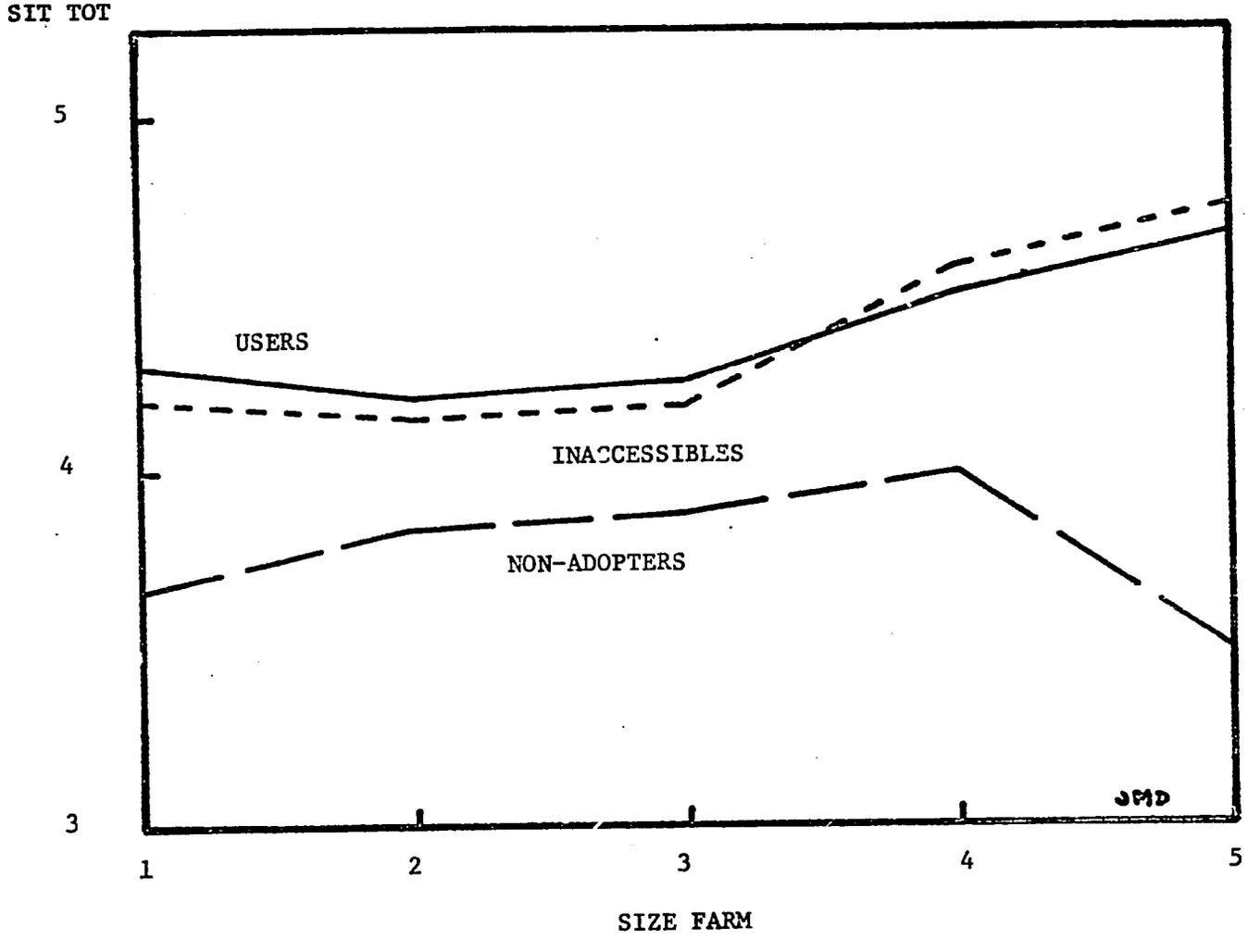


Figure 15

Satisfaction with Life Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Size of Farm (SIZE FARM)
Costa Rica



The level of living scale was cross-tabulated with the users variable controlling for LEVELNOE. The results are presented in Figure 16. This analysis is of interest in that only the NON-ADOPTERS parallel the trend found when viewing the LEVELNOE scores of the entire population. USERS score lower than INACCESSIBLES at the extremes and higher in the middle. For all categories of the level of living scale the USERS are more satisfied than are the NON-ADOPTERS. The differences are smallest for those with the lowest level of living, increase for those in the middle range, and begin to converge for those at the highest level.

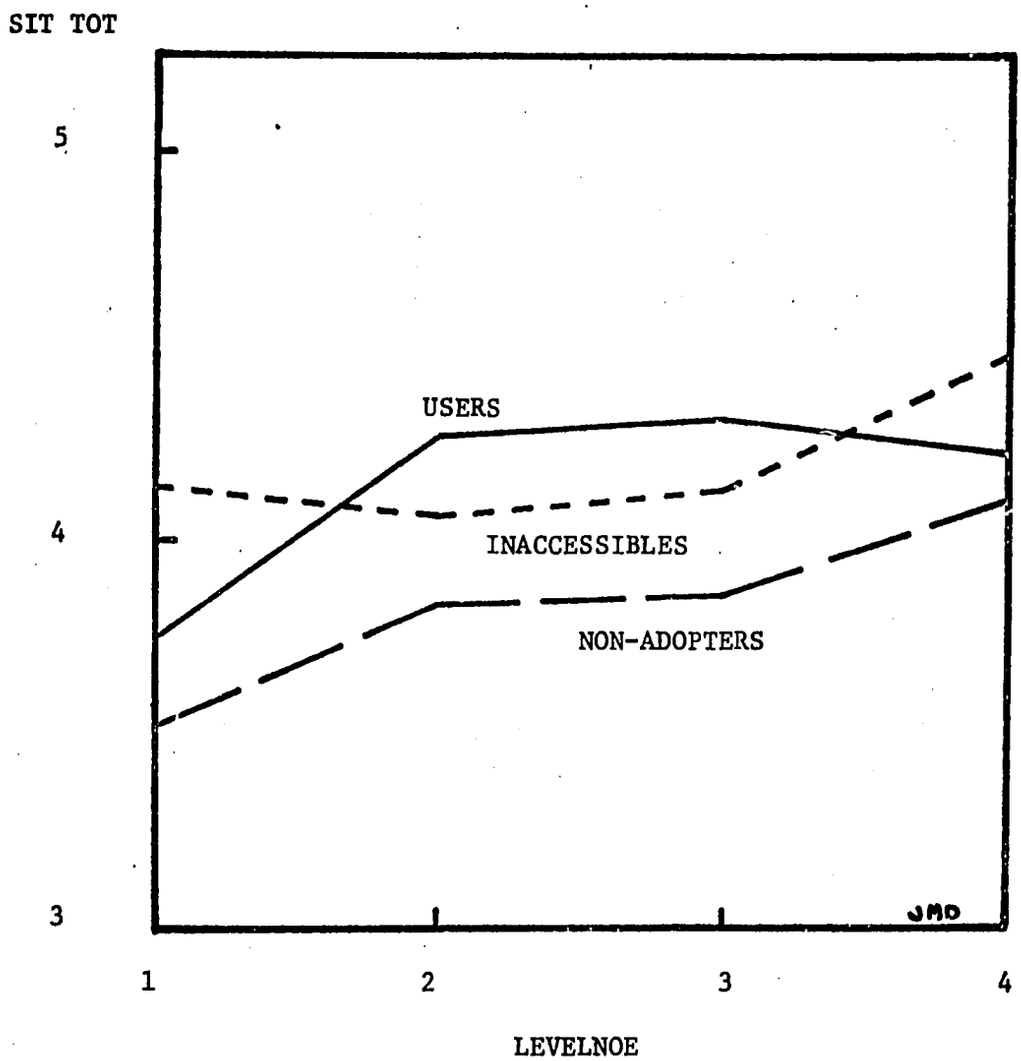
In the analysis of each of the satisfaction with life situation indexes, the USERS were more satisfied with life than were the non-users. With the exception of the SIT FUT, USERS were more satisfied than were NON-ADOPTERS and INACCESSIBLES. While age of the head of the household did not influence SIT TOT, education of the head of the household, size of landholdings, and level of living were each found to exert a direct influence on the total satisfaction with life situation index. In each of these instances however the differences between users and non-users generally persisted when age, education, size of farm and level of living were controlled.

We can, therefore, conclude that while the control variables are associated with the satisfaction with life situation, none of them accounts for the differences in satisfaction with life situation found between users and non-users of electricity and especially between USERS and NON-ADOPTERS. It is, of course, always conceivable that had other control variables been used one or more of them might have explained the observed differences in satisfaction with life situation between users and non-users of electricity. Nevertheless, we can conclude from this analysis that use of electricity is a factor, although not the only one, associated with a heightened satisfaction with life situation of users. It is also pertinent to observe that the availability of electricity appears to have a depressing effect on the satisfaction with life situation of family heads who do not connect (NON-ADOPTERS).

The fact that users of electricity express greater satisfaction with their life situation than non-users has significant implications for development projects designed to improve the quality of life in rural areas. Thus, the social value of electricity should be taken into account as a factor additional to purely economic considerations of the value of implementing rural electrification projects. If an objective of development projects is to improve the <u>total</u> well-being of rural residents, then the satisfaction with life situation of the target population should be evaluated.

Figure 16

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Electricity-free Level of Living Scale (LEVELNOE)
Costa Rica



Exposure to the Mass Media

Ideas and thoughts, the basic building blocks of all social processes, must be communicated between individuals to be spread and disseminated. All social dynamics, and in fact social equilibrium, depends on the transfer of concepts from a person to his fellow human beings (See DeFleur, 76-7). The variety of types of communications range from the most intimate person to person contact among members of a family to the television broadcast of events simultaneously to all parts of the world via satellite relays. One type of communications, that of the mass media, has been singled out in this study.

Various types of mass media spread their influence into San Carlos. A score of radio stations emit signals which are received in the area. The national television network covers the area (1) (2). The major national newspapers, La Nacion and La Republica, as well as the local Prensa Libre are widely circulated in San Carlos.(3) Numerous publications ranging from weekly news magazines to monthly romance publications, are readily accessible in not only Ciudad Quesada but also throughout the adjacent area.

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1. See Ronald A. Kuisis for both a thorough review of the literature dealing with various aspects of mass media and communications in Latin America and for an analysis of radio and television transmission in Costa Rica.

2. The field research for this study was conducted while the 1972 Olympic Games were being held in Munich, Germany. Because of the low voltage of the private electricity distribution system in Ciudad Quesada, the television reception in the urbanized area is inferior. However, outside of the city, television sets using the high quality COOPELESCA current bring in clear pictures. Consequently, those who were able to, at night fled the city for the surrounding rural areas to view clear images of the Olympic Games.

3. Our chauffeur, who lives in a suburb of Heredia, a city included in the San Jose metropolitan area, was amazed one morning when we were in the hamlet of El Tanque to find a current copy of La Republica at 11:00 A.M. He said that this newspaper was not available in his neighborhood until at least 3:00 P.M.

It has been shown that the mass media facilitate the cognition of innovations, particularly of technological developments (See Rogers, 1969:96-123). In an attempt to explain some of the characteristics which differentiate users of electricity from non-users, we examined the exposure to the mass media using data compiled through the survey schedules. The effectiveness of communications in affecting change is not measured. Although there is, obviously, a relationship (most probably a positive one), between the intensity of exposure and effectiveness of the messages transmitted, no effort is being made here to evaluate this relationship. Rather, the focus is merely on the association between exposure and use of electricity. (See Chapter II for details of the construction of the mass media exposure index MMEI).

The general level of exposure to the various possible types of mass media is low in the San Carlos area. Nearly three-quarters, 74.1 percent or 335, of the respondents scored in the lower half of the MMEI. This signifies that at most these individuals were infrequently exposed to two of the four types of mass media. In sum, the heads of the households are not in close contact with the messages set forth in newspapers and magazines and over radio and television.

Those who use electricity in their homes are likely to be more highly exposed to various types of mass media, as indicated by their higher score on MMEI than are those in either of the two categories of non-users of electricity (Table 22). Whereas 34.6 percent of the USERS are in the upper two groupings of MMEI, only 20.1 percent and 19.4 percent of the INACCESSIBLES and NON-ADOPTERS, respectively, are included in these same categories. The relatively similar distribution of the INACCESSIBLES and NON-ADOPTERS according to MMEI indicates that the non-users are uniformly less exposed regardless of the availability of electricity.

Table 22

Percentages and Numbers of Respondents According to Mass Media Exposure Index (MMEI) by Users Variable, Costa Rica

Users Categories	MMEI Categories 1 (low)	2	3	4 (high)	TOTAL
USERS	37.1 (56)	35.3 (65)	48.1 (38)	68.4 (26)	40.9 (185)
INACCESSIBLES	39.1 (59)	41.3 (76)	31.6 (25)	23.7 (9)	37.4 (169)
NON-ADOPTERS	23.8 (36)	23.4 (43)	20.3 (16)	7.9 (3)	21.7 (98)
TOTAL	100.0 (151)	100.0 (184)	100.0 (79)	100.0 (38)	100.0 (452)

Higher MMEI is shown to be positively correlated with the use of electricity. This is in part explained by the fact that television depends, in most instances, on electricity for its reception. In addition, electricity plays an important role in radio reception.

Transistorized battery operated radios are justifiably heralded as being one of the major innovations, along with outboard motors, causing dramatic change in the developing nations. It consequently came as a minor surprise to learn of the importance of electric radios in the study area.

There was a radio reported in more than eight out of ten households. This ranged from a high of 88.1 percent of the USERS having radios to a low of 70.4 percent for the NON-ADOPTERS. Approximately one-third of the USERS owned electric radios rather then or in addition to transistor models. Slightly more than one-tenth of all non-users of electricity reported that if they had electricity they would purchase an electric radio. The point being made here is that there is some preference indicated for owning electric radios. This apparently is because electric radios generally have better capabilities at a lower operating cost than do battery operated radios.

Although it has been shown that high MMEI is positively correlated with the use of electricity, the use of electrically operated televisions and radios provides only a partial explanation for this relationship. An examination of the relationships which exist between exposure to the mass media and level of living as well as satisfaction with life situation provides some insight into understanding this phenomenom.

The results of the cross-tabulation of the MMEI with the electricity-free level of living scale (LEVELNOE) are presented in Table 23. There is a strong positive association between level of living and exposure to the mass media. As can be seen, those with a low level of living are more inclined to have a corresponding low MMEI score; concurrently, those with higher levels of living are more likely to also score high on the mass media exposure index. As indicated by the Chi Square test, the probability of the distribution shown occurring by chance approximates 0.000. The association between the two variables being examined is a strong one as shown by the raw score of the Tau_c test of 0.208 with the level of significance of 0.000.

Table 23

Percentages and Numbers of Respondents According to Categories of Electricity-free Level of Living Scale (LEVELNOE) by Categories of Mass Media Exposure Index (MMEI), Costa Rica

MMEI	LEVELNOE Categories 1 (low)	2	3	4	5 (high)	TOTAL
1 (low)	41.2 (14)	43.8 (63)	31.8 (49)	22.0 (20)	17.3 (5)	33.4 (151)
2 (moderately low)	50.0 (17)	40.3 (58)	39.0 (60)	43.9 (40)	31.0 (9)	40.7 (184)
3 (moderately high)	8.8 (3)	10.4 (15)	24.0 (37)	22.0 (20)	13.8 (4)	17.5 (79)
4 (high)	0.0 (0)	5.5 (8)	5.2 (8)	12.1 (11)	37.9 (11)	8.4 (38)
TOTAL	100.0 (34)	100.0 (144)	100.0 (154)	100.0 (91)	100.0 (29)	100.0 (452)

No attempt is made to impute causality in the relationship found between the MMEI and LEVELNOE. The assumption, however, can be made that the causality would be circular: increased level of living should lead to increased mass media exposure which in turn could lead to an increased level of living. As has been shown there is a positive relationship between the use of electricity and level of living. The relationship found between MMEI and LEVELNOE would seem to indicate that exposure to the mass media is a companion phenomenom positively associated with level of living. Not only is MMEI positively correlated with LEVELNOE, it is also directly related to satisfaction with life situation total score (SIT TOT). This relationship is shown in Table 24.

It has been demonstrated that MMEI is positively associated with both level of living and satisfaction with life situation. Both higher levels of living and satisfaction with life situation previously have been shown to be positively associated with the use of electricity vis-a-vis non-use. Therefore, MMEI which is related to the use of electricity is also related to at least two other characteristics which are simultaneously positively correlated with the use of electricity. Exposure to mass media appears to be a companion characteristic in its relationship with the other variables studied. That is to say that

although the positive association between electricity use and MMEI has been shown, this association is most probably as much a function of higher levels of living, particularly, and perhaps of satisfaction with life situation as of the use per se of electricity. Likewise, the negative association between non-use of electricity and media exposure is influenced by correspondingly lower levels of living and lower satisfaction with life situation.

Table 24

Percentages and Numbers of Respondents According to Grouped Categories of Mass Media Exposure Index (MMEI), by SIT TOT Categories, Costa Rica

MMEI Categories	SIT TOT Categories 1-3 (low)	4	5 (high)	TOTAL
1 (low)	44.3 (27)	38.2 (102)	17.8 (22)	33.4 (151)
2 (moderately low)	41.0 (25)	41.6 (111)	38.7 (48)	40.7 (184)
3 (moderately high)	8.2 (5)	14.2 (38)	29.0 (36)	17.5 (79)
4 (high)	6.5 (4)	6.0 (16)	14.5 (18)	8.4 (38)
TOTAL	100.0 (61)	100.0 (267)	100.0 (124)	100.0 (452)

Social Participation

There is a plethora of community development related organizations in the San Carlos area. They may be classified as falling roughly into two types, cooperatives and community improvement associations. Membership in both types is generally open to any interested adult. In some instances, however, membership is in reality limited to those requiring specific services.

Besides the Cooperativa de Electrificacion Rural de San Carlos (Rural Electrification Cooperative of San Carlos) (COOPELESCA) which offers its members a specific service, there are at least two other cooperatives in the area. Cooperativa de Ahorro y Credito de Ciudad Quesada (Savings and Credit Cooperative of Ciudad Quesada) (COOCIQUE) is, as its name implies, a savings and credit cooperative. Cooperativa Agropecuaria y Industrial Trinidad R.L. (Agricultural and Industrial Cooperative of Trinidad) (COOPETRINIDAD) is an agricultural cooperative which deals primarily with the marketing and selling of the crops produced by its members.

The national community development agency, (Direccion Nacional de Desarrollo de la Comunidad) (DINADECO) is attempting to establish its juntas (committees) throughout the region as well as elsewhere in Costa Rica. Theoretically the Asociaciones de Desarrollo Comunal (community development associations) being organized by DINADECO are designed, among other things, to replace the multiple project-specific juntas found in the area. DINADECO has established its juntas in La Fortuna, La Tigra, La Vega, and San Isidro del Rio Penas Blancas. These juntas have not as yet superseded the project-specific organizations. In many of these same communities, and elsewhere in the research area, are found some or all of the following organizations: junta de bienestar comunal (committee for community well-being) which is an extension of the public health service; junta de patronato escolar (school committee) for the improvement of public schools; junta en edificadora (building committee) for constructing the local church, usually the Roman Catholic church; and junta de progreso (progress committee), a community action committee.

The investigator who talks only with the change agents and community leaders of the area would be led to believe that there is widespread social participation in the numerous juntas found in the area. The survey research findings, however, do not support this contention. Seven out of every ten people interviewed stated that they belonged to no organization whatsoever. The amount of reported membership in organizations, associations, and cooperatives is presented in Table 25. An inescapable conclusion from these data is that not only do more USERS belong to organizations, 57.6 percent, than do both types of non-users of electricity, but more belong simultaneously to more than one organization.

These results are, of course, influenced by membership in the electric cooperative. To be a customer of the cooperative you have to be a member. Consequently, unless someone else is paying for the electricity, as in the case of many of the farm laborers living in electrified houses, users of electricity in this population are ipso facto members of an organization. Yet, even so, 78 of the USERS or more than 40 percent, did not consider that they belonged to an organization. When they were asked in a later question specifically if they belonged to COOPELESCA, only 46 of these same respondents then stated that they were members of the cooperative.

Table 25

Responses to Question Concerning Membership in Organizations, Associations, and Cooperatives by Users Variable, Costa Rica

Users Categories	Number of Organizations, Associations and Cooperatives Belongs to None	1	2	3	4+	TOTAL
USERS	42.4 (78)	46.2 (85)	7.5 (14)	2.7 (5)	1.2 (2)	100.0 (184)
INACCESSIBLES	89.9 (151)	10.1 (17)	0.0 (0)	0.0 (0)	0.0 (0)	100.0 (168)
NON-ADOPTERS	90.8 (89)	9.2 (9)	0.0 (0)	0.0 (0)	0.0 (0)	100.0 (98)
TOTAL	70.7 (318)	24.7 (111)	3.1 (14)	1.1 (5)	0.4 (2)	100.0 (450)

The data underscore two points. The first is the lack of awareness and self-perception by the members of COOPELESCA of their membership. The second is that USERS are more inclined than non-users of electricity to belong to more than one organization.

The structure of COOPELESCA is such that every tem members have an elected delegate who has a vote at the general assemblies of the organization. All of the members of COOPELESCA who were interviewed were asked to name their delegate. One hundred and fifty-two or 82.6 percent could not name their delegate. An additional 32 (17.3 percent) gave a name which was assumed by the researchers to be a valid answer. Respondents were also asked if they had ever attended any of the COOPELESCA assemblies. Only 18 percent of the USERS recalled having attended such a meeting.

In sum, USERS participate in more formal organizations than do either type of non-users. The extent and degree of their participation, however, is low and largely attributable to the necessity of membership in the cooperative in order to be connected. The differences between USERS and non-users is substantially reduced when COOPELESCA membership is excluded from consideration. Since two-fifths of the cooperative's members did not name the organization when asked about their memberships; since two fifths of these, in turn, did not acknowledge membership when specifically asked about it; and since only 18 percent of the cooperative's members had ever attended a meeting it is reasonable to infer that certainly for these members and very probably for many other members as

well, the cooperative is simply a supplier of electricity and has little other meaning. The data do reveal that a higher proportion of USERS, 11.4 percent, acknowledge membership in two or more organizations, as compared to zero percent for INACCESSIBLES and NON-ADOPTERS. The significance of this difference is, however, doubtful for the results may be due to an interview effect which triggered the memories of those who recalled membership in the cooperative. It is also well to note from the data in Table 25 that if the INACCESSIBLES and the NON-ADOPTERS who belong to one organization were to join the cooperative thus belonging to two, the proportions belonging to two organizations in each of these categories would exceed the proportion of USERS belonging to two organizations.

Size of Farm

This discussion of the correlates of electricity and the size of farm is based solely on information compiled through the use of survey research. Data concerning the size of farm includes the farms of all of the agriculturalists interviewed. Because the households of some owners or operators of farms are located beyond sight from the road and therefore were excluded from the respondent selection, not all of the agricultural enterprises in the survey area were included. Excluded from the population were operators of such large haciendas as Chachagua and San Cristobal. Although data were collected from some farm laborers working on the larger farms, no information was compiled for several of these enterprises. Thus, the importance of large landholdings is understated.

Contrary to what had been anticipated, no use of electricity for agricultural purposes was found on the farms of the respondents. Although some use of electrically powered apparatus was noted, especially in conjunction with dairy operations on some of the larger places immediately outside of the research area, the smaller farmers interviewed had not yet adopted the use of electricity for improving their farm operations or productivity. The ensuing discussion then is limited to an examination of those farmers who use electricity solely for domestic purposes and those who use no electricity.

The portion of San Carlos surveyed is one of moderate size farms. A total of 212 agricultural-pastoral units were enumerated in the survey research process. They range in size from less than one-half manzana to eight hundred manzanas (See Table 26). The farm units have been classified in the following five categories: category one contains the lotes of less than two manzanas, category two the minifundia with from two to less than ten manzanas, category three the genuine family farms with at least ten but less than fifty to less than one hundred manzanas, and category five embracing those haciendas with one hundred or more manzanas.

Only twenty-two places are classified as being sub-farms or lotes of less than two manzanas. The modal group is that of the minifundia, 89 places had from two to less than ten manzanas. A total of 89 family-sized farms were also counted (categories 3 and 4). Seventy-one of these are in category three which indicates that they are larger than fifty

Table 26

Percentages and Numbers of Respondents in Size of Farm (SIZE FARM) Categories by Users Variable, Costa Rica

Users Categories	SIZE FARM Categories 1 (Less than 2 mzs.)	2 (2-9.9 mzs.)	3 (10-49.9 mzs.)	4 (50-99.9 mzs.)	5 (100+ mzs.)	TOTAL
USERS	50.0 (11)	42.7 (38)	43.7 (31)	55.6 (10)	50.0 (6)	45.3 (96)
INACCESSIBLES	22.7 (5)	42.1 (38)	43.7 (31)	8.9 (7)	33.3 (4)	40.2 (85)
NON-ADOPTERS	27.3 (6)	14.6 (13)	12.6 (9)	5.5 (1)	16.7 (2)	14.5 (31)
TOTAL	100.0 (22)	100.0 (89)	100.0 (71)	100.0 (18)	100.0 (12)	100.0 (212)

manzanas. The remaining 18 fall in category four having at least 50 but less than 100 manzanas. Only 12 haciendas of more than 100 manzanas were found. The distribution of farm size by user categories is shown in Table 26.

The focus of the following discussion is on the differences in household adoption of electricity by holdings of different sizes. Agricultural-pastoral activities are engaged in by nearly an equal percentage of all USERS (those who use energy supplied by COOPELESCA) and all INACCESSIBLES (those beyond the COOPELESCA lines). While 51.9 percent of all USERS have farms or farm-like entities, 50.3 percent of the INACCESSIBLES have landholdings. Significant, is the fact that only 31.6 percent of all NON-ADOPTERS (voluntary non-users of Co-op electricity) use land for either agricultural or pastoral activities. This suggests that those with some land are more likely to adopt the use of electricity, while also indicating landholdings are not nearly an exclusive factor.

When the use of electricity is examined according to the size of landholdings (Table 26), an interesting result emerges. There are USERS, INACCESSIBLES, and NON-ADOPTERS in all farm size categories. No strong relationship is immediately evident therefore, between size of farm and the adoption of electricity for household purposes; as previously indicated, farm use was non-existent among those surveyed.

Each category of landholding can be compared according to the users variable in Table 27. This demonstrates that the percentage of USERS who have minifundia (category 2) is lower than the comparable percentage for INACCESSIBLES and NON-ADOPTERS. Relatively fewer lotes and relatively more minifundia and family farms are held by INACCESSIBLES than by the other two classes. INACCESSIBLES occupy an intermediary position between USERS and NON-ADOPTERS when it comes to use or possession of larger landholdings. (Because of the small number of cases, SIZE FARM categories four and five were combined for this analysis). Although there are differences in the size of farm between INACCESSIBLES and USERS, the variation does not follow a pattern and is not significant.

However, there is an interesting variation between USERS and NON-ADOPTERS with regard to farm size (Table 27). Whereas 11.5 percent of the USERS are grouped in category one, 19.4 percent of the NON-ADOPTERS are included in that category. The ratio between these figures is 0.593. The magnitude of the ratio increases directly with increases in the size of farm. The same pattern is found in the ratios of INACCESSIBLES to NON-ADOPTERS, demonstrating once again that NON-ADOPTERS own or operate smaller farms.

Table 27

Percentages of USERS, INACCESSIBLES, and NON-ADOPTERS by Size of Farm (SIZE FARM) Categories and Ratios of Percentages of USERS to INACCESSIBLES and NON-ADOPTERS, Costa Rica

	SIZE FARM Categories				
	1	2	3	4&5	TOTAL
USERS (percentages)	11.5	39.6	32.3	16.6	100.0
INACCESSIBLES (percentages)	5.9	44.7	36.5	12.9	100.0
NON-ADOPTERS (percentages)	19.4	41.9	29.0	9.7	100.0
All Classes (percentages)	10.4	42.0	33.5	14.1	100.0
Ratio of percentages of USERS to INACCESSIBLES	1.949	0.886	0.885	1.287	---
Ratio of percentages of USERS to NON-ADOPTERS	0.593	0.945	1.114	1.711	---
Ratio of percentages of INACCESSIBLES to NON-ADOPTERS	.304	1.067	1.259	1.330	---

These findings have a practical import. Since minimal use is made here of electricity for agricultural production, nearly all of the use being residential or commercial, it would indicate that lines strung through similar areas of small landholders would serve more customers than would lines strung through an area in which large landholdings predominate because the homes of small owners are, generally, closer together.

Clearly, type of farm must be considered along with size to determine the relative significance of landholdings on use of electricity. This analysis is presented in the next section. At this point it is sufficient to note that both user and non-user categories are represented in each farm size category. While NON-ADOPTERS tend to own smaller farms than either USERS or INACCESSIBLES, there is no clear association between electricity use and size of landholdings.

As might have been anticipated, there is a direct correlation between SIZE FARM and level of living, as measured using the electricity-free level of living scale. The relationships between these two variables is shown in Table 28. The larger the farm, the greater is the likelihood of the operator to have a higher level of living. Thus while 47.7 percent of those living on places of less than two manzanas have a low score of LEVELNOE, 53.3 percent of those with the largest farms have high levels of living.

Size of farm is shown to be associated with LEVELNOE. The association, however, is by no means perfect as demonstrated by the occurrence of some cases in all of the cells of the cross-tabulation table. For instance, 19.0 percent of those with the smallest places have high levels of living and 16.7 percent of those having the largest farms are among the lowest scores on LEVELNOE. Thus it must be concluded that other considerations along with the size of farm influence the observed variations in level of living of agriculturalists. In part non-farm income must be taken into consideration along with type of farm. While an analysis of SIZE FARM is of value in viewing those factors which relate to the economic considerations influencing the use of electricity in rural areas, it is by itself insufficient.

Table 28

Percentages and Numbers of Those in Categories of Size of Farm (SIZE FARM) by Categories of Electricity-free Level of Living Scale (LEVELNOE), Costa Rica

LEVELNOE Categories	SIZE FARM Categories 1 (less than 2 mzs.)	2 (2-9.9 mzs.)	3 (10-49.9 mzs.)	4&5 (50+ mzs.)	TOTAL
1 & 2 (low)	47.7	24.8	25.4	16.7	30.3
	(10)	(31)	(18)	(5)	(64)
3 (medium)	33.3	39.3	39.4	30.0	37.4
	(7)	(35)	(28)	(9)	(79)
4 & 5 (high)	19.0	25.9	35.2	53.3	32.3
	(4)	(23)	(25)	(16)	(68)
TOTAL	100.0	100.0	100.0	100.0	100.0
	(21)	(89)	(71)	(30)	(211)

Type of Farm

The portion of San Carlos included in this study is more a crop than pastoral (livestock) area. An examination of the division of farms surveyed into groupings of those devoted primarily to agricultural or pastoral endeavors supports this contention (Table 29). Slightly more than three-quarters, 75.7 percent, of the farms successfully classified by type are primarily concerned with the raising of crops. The proportion of crop-raising places varies among the users categories from a high of 86.7 percent of the NON-ADOPTERS to a low of 68.1 percent of the USERS. Primarily livestock activities are engaged in by 31.9 percent of the USERS compared with 19.5 percent of the INACCESSIBLES and 13.3 percent of the NON-ADOPTERS.

The variation between the categories of the users variable diminishes when the USERS and NON-ADOPTERS are combined, that is when all of those within reach of the COOPELESCA lines are placed in one group. Given this combination, 72.6 percent of those in the electrified area raise mainly crops as compared with 80.5 percent of those in the non-electrified area. The similarity of these two figures is construed as an indicator of the homogeneity of the entire research area with respect to type of agricultural and pastoral activity.

A classification schema of type of farm (TYPE FARM) containing five categories was devised. Although the llanos being studied is a lowlands area, coffee was the predominate crop. The coffee grown there is not of premium grade and must be mixed with mountain grown varieties to result in the quality blends produced in Costa Rica. More than two-fifths of all of the farms are classified as coffee farms. The categorization of farms according to TYPE FARM is shown in Table 30.

Included in the coffee farm category are entities which are given over almost exclusively to coffee monoculture and those where coffee is grown in conjunction with another crop. Prominent among this second type are instances where coffee and bananas are grown together on the same plot. Coffee plants need shade. In San Carlos, banana plants and other plantains are frequently used as the source of shade. By using selective cutting procedures the plantains furnish a second cash crop in the coffee fields.

The second TYPE FARM category includes other types of farms having predominantly agricultural production. Grouped together are the places typed as being devoted to sugar cane, plantains, field crops, root crops, and miscellaneous and other types of crops. There is an interesting plantain crop grown in the area. The local inhabitants refuse to consume guineo cuadrado (a large plantain) yet they raise this as a crop for exportation to Nicaragua. Other crops typically produced on farms in this group are corn, beans, and yuca.

The mixed-agricultural classification is for those general farms where although there are both crops and livestock, crops predominate. The mixed-livestock places are general farms where livestock are more important than crops. Although some chickens and pigs are raised in

Table 29

Percentages and Numbers of Those Engaged in Agricultural or Pastoral Activities by Users Variable, Costa Rica

Users Categories	Type of Farm Agricultural	Pastoral	TOTAL
USERS	68.1 (64)	31.9 (30)	100.0 (94)
INACCESSIBLES	80.5 (66)	19.5 (16)	100.0 (82)
NON-ADOPTERS	86.7 (26)	13.3 (4)	100.0 (30)
TOTAL	75.7 (156)	24.3 (50)	100.0 (206)

Table 30

Percentages and Numbers of Those in Categories of Type of Farm (TYPE FARM) by Users Variable, Costa Rica

Users Categories	TYPE FARM Categories 1 (coffee)	2 (Other agriculture)	3 (Mixed-agriculture)	4 (Mixed-livestock)	5 (Livestock and dairy)	TOTAL
USERS	26.6 (25)	9.6 (9)	31.9 (30)	19.1 (18)	12.8 (12)	100.0 (94)
INACCESSIBLES	11.0 (9)	41.5 (34)	28.0 (23)	8.5 (7)	11.0 (9)	100.0 (82)
NON-ADOPTERS	36.7 (11)	23.3 (7)	26.7 (8)	10.0 (3)	3.3 (1)	100.0 (30)
TOTAL	21.8 (45)	24.3 (50)	29.6 (61)	13.6 (28)	10.7 (22)	100.0 (206)

the area, beef cattle account for most of the livestock production. The final category of TYPE FARM includes those entities producing mainly livestock. It should be noted that on most of the spreads included in this category, regardless of the importance of beef cattle or dairy production, both beef and dairy cattle were found.

As shown in Table 30, there are some major variations in types of farms among those in the three categories of the users variable. Coffee is more important in the area serviced by COOPELESCA (USERS) than in that beyond the electrical distribution lines (INACCESSIBLES). Other types of purely agricultural production farms, mainly bananas and field crops, however, are more concentrated in the area beyond the electric lines than in the electrified area. Livestock related types of farms are more likely to be operated by users of electricity than by those in either of the categories of non-users. In fact, 64.3 percent of all mixed-livestock places and 54.5 percent of all livestock and/or dairy farms are operated by USERS.

Type of farm is but one of several sociocultural systems which make up the way of life of agricultural people.[1] Another of these sociocultural systems is size of farm. The interrelationship between type of farm and size of farm is strong and must be examined in order to gain a fuller understanding of the influence of specific types of agricultural and pastoral production on the lives of rural inhabitants.

The results of the cross-tabular analysis of TYPE FARM and SIZE FARM are presented in Table 31. An immediate conclusion which can be derived from the material presented is that the agricultural producing entities in the area are smaller than are those places devoted to pastoral activities. In fact, only three agricultural places encompass more than 50 manzanas of land and only one place typed as a livestock or dairy producer is a minifundia. The modal size of all three of the agricultural types of farms is from 2 to 9.9 mazanas; that of mixed-livestock places is from 10 to 49.9 manzanas; and that of livestock and dairy spreads is from 50 to 99.9 manzanas.

It has been shown that there are definite relationships between TYPE FARM and SIZE FARM. The pastoral farms are larger than are those given over to agricultural production. Previously, it has been demonstrated that by itself, the size of farm is not an adequate predictor of level of living, a factor which has been shown to be highly associated with the use of electricity. It is, consequently, of interest to view the relationship between TYPE FARM and LEVELNOE (Table 32). While each type of farm is represented in each LEVELNOE strata, there are some correlations between type of farm and level of living. While the coffee growers are rather evenly distributed

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1. T. Lynn Smith, 1969:17. In this article Smith provides a complete enumeration and cogent discussion of twelve rural sociocultural systems.

Table 31

Percentages and Numbers of Those in Categories of Type of Farm (TYPE FARM) by Categories of Size of Farm (SIZE FARM), Costa Rica

SIZE FARM Categories (manzanas)	TYPE FARM Categories 1 (coffee)	2 (other agriculture)	3 (mixed-agriculture)	4 (mixed-livestock)	5 (livestock and dairy)	TOTAL
1 (less than 2)	18.2 (8)	16.0 (8)	4.9 (3)	0.0 (0)	4.6 (1)	9.9 (20)
2 (2-9.9)	59.1 (26)	44.0 (22)	50.8 (31)	26.9 (7)	9.1 (2)	43.3 (88)
3 (10-49.9)	22.7 (10)	36.0 (18)	42.6 (26)	38.5 (10)	22.7 (5)	34.0 (69)
4 (50-99.9)	0.0 (0)	4.0 (2)	1.7 (1)	23.1 (6)	31.8 (7)	7.9 (16)
5 (100+)	0.0 (0)	0.0 (0)	0.0 (0)	11.5 (3)	31.8 (7)	4.9 (10)
TOTAL	100.0 (44)	100.0 (50)	100.0 (61)	100.0 (26)	100.0 (22)	100.0 (203)

according to LEVELNOE, those who raise other types of crops are concentrated in the lower and middle ranks of the level of living scale. Those with general farms, where agricultural pursuits prevail over pastoral activities, are proportionally distributed in the level of living groups, but those having general farms where the importance of livestock supersedes that of crops have high levels of living. Over one-half, 54.6 percent of those with livestock or dairy farms have high scores on LEVELNOE. The conclusion is that specific types of farming appear to be associated with higher levels of living, with general agriculturists having lower levels of living and livestock raisers having higher ones.

The above analysis explains some of the apparent discrepancies in the preceding section dealing with size of farm. It had been shown that some of those having the smallest places had high levels of living, while some having the largest places had low levels of living. When the findings on the analysis of both SIZE FARM and TYPE FARM are combined,

these peculiarities can in part be explained. The type of production is of at least equal importance to the amount of land devoted to production in determining level of living. Thus, for example, because of the high productivity and value of the crop, a small acreage of coffee might provide the means for a level of living comparable to that from a larger area of land devoted to raising corn or beef cattle. However, smaller farms devoted to mixed crop activities are associated with lower levels of living and include a higher percentage of NON-ADOPTERS.

Table 32

Percentages and Numbers of Those in Categories of Type of Farm (TYPE FARM) by Categories of Electricity-free Level of Living Scale (LEVELNOE), Costa Rica

LEVELNOE Categories	TYPE FARM Categories 1 (coffee)	2 (other agriculture)	3 (mixed-agriculture)	4 (mixed-livestock)	5 (livestock and dairy)	TOTAL
1 & 2 (low)	31.1 (14)	44.0 (22)	29.5 (18)	7.1 (2)	22.7 (5)	29.6 (61)
3 (medium)	31.1 (14)	42.0 (21)	41.0 (25)	39.3 (11)	22.7 (5)	36.9 (76)
4 & 5 (high)	37.8 (17)	14.0 (7)	29.5 (18)	53.6 (15)	54.6 (12)	33.5 (69)
TOTAL	100.0 (45)	100.0 (50)	100.0 (61)	100.0 (28)	100.0 (22)	100.0 (206)

Agricultural and pastoral pursuits are the major economic activities in the rural portions of San Carlos. They are consequently basic considerations which must be taken into account in evaluating the economic factors influencing the adoption and use of electricity. Because of the unique interrelationships between size and type of farm, it must be concluded that an evaluation of the one without the other is inadequate. When viewed together, however, these two variables help to explain the life of those in rural areas.

While it has been shown in this and the preceding section that NON-ADOPTERS tend to have smaller farms devoted to mixed agricultural activities while USERS tend to have larger landholdings devoted to livestock production, the association of these factors is not sufficiently strong to suggest that size and type of farm are major factors associated with the use of electricity. Put somewhat differently, if size and type of farm were the primary means by which USERS were economically able to adopt the use of electricity, then NON-ADOPTERS would not be represented in all size and type of farm categories. The data clearly demonstrate that they are so represented. Furthermore, land ownership was prevalent, although less so, for NON-ADOPTERS as well as USERS and INACCESSIBLES. These findings suggest that the economic factors stemming from size and type of landholdings do not conclusively determine the ability to adopt the use of electricity.

Income Data

Given the expected significance of income in relation to electricity consumption, any study dealing with rural electrification must come to terms with the practical problems of obtaining accurate and reliable income data. Because of the lack of continuous research in the area of rural electrification in developing countries, data collection procedures are further complicated by the extent of unknown variables and factors significant to levels of electricity consumption or the impact of electrification projects. The following discussion will treat briefly some of the problems involved in obtaining income data, thus attempting to justify the exclusion of a specific income figure from the analysis.

In the United States, the vast majority of employed people are salaried on a daily, weekly, or monthly basis. Accurate awareness of a net, if not gross, weekly, monthly, or annual income by an interview respondent can thus be assumed not to require undo mental computation. Compulsory filing of income taxes provides a further awareness of annual income. (This implies only that the average respondent himself has an accurate idea of his income and does not mean that he will necessarily respond with this figure when it is solicited in the course of an interview). Even in rural areas, many farm workers are employed on a permanent and salaried basis. However, obtaining income data from migrant or seasonal farm workers in the United States creates many of the problems outlined below for farm workers in developing countries.

Several alternatives exist for obtaining data which may be used in analyzing the relationship between income and a dependent variable such as electricity consumption. One approach is to conduct a budget study of the households surveyed so that the sources and amounts of income may be determined as well as the amounts and direction of expenditures, including the important component of savings.

A second method would be to merely ask the respondent to note his position on a scale or ladder of income. This would result in an ordinal ranking of income rather than a cardinal value. A third method would be to obtain data on characteristics related to income, such as age, education, occupation, size of landholdings, and level of living. These approaches and their consideration for the present study are discussed in detail below.

Budget Studies for Determining Income

Probably the most reliable and accurate method of obtaining family head or household income data is through a budget study. The most accurate figure to use as an independent income variable would include all sources of income to the household. However, some justification could be developed for considering only the income of the household head (primary income source) for analytical purposes. A complete budget study would solicit information on expenditures also, thus providing data on the allocation of income and assuring greater accuracy of the income figure.

It should be obvious that this approach would require a time-consuming, in-depth interview concerning all income sources and expenditures for such items as food, rent, energy, clothing, entertainment, etc. Assuming only one member of the family was employed and that employment was on a salaried basis, the source and amount of income would not create too many problems. Although such factors as social benefits (thirteenth month salary common in Latin America) and the value of home-grown produce would still have to be included.

On the expenditure side, problems arise in estimating expenditures for such goods as food and energy (candles, kerosene, etc.) where these items are commonly purchased on a nearly daily cash basis without receipts, such that even weekly totals require mental computations by generally uneducated respondents. Such estimates are also subject to bias because of any unusual or extenuating circumstances occurring in the day or week in which the interview is conducted. To avoid these estimation problems, some detailed budget studies of families in the United States have utilized printed forms to be maintained over a period of time. While probably quite accurate, such studies would be extremely costly and time-consuming and subject perhaps to distortions of expenditures due to the on-going record keeping process itself.

In the more common situation of a farm worker (peon), both the sources of income as well as expenditures become more complex. The amount of income may vary widely throughout the year based on such factors as: type of job, number of days employed, seasonal variations, payment basis, and employer. Peones commonly are paid differing amounts

for such work as clearing land, weeding crops, milking cows, operating machinery, etc. The number of days employed by a given employer may also vary depending on such things as social legislation (benefit payment requirements), type of farming operation, and the vagaries of weather. Depending on the season and type of job, a worker may be paid on the basis of the amount of land cleared or weeded, by the hour, week, or month, or on a piece-rate basis (boxes of coffee or fruit, for example). This should provide an indication of the complexities of estimating the income of a farm worker who quite logically might have been involved in a variety of activities during a year.

The most common procedure of course is to level out these substantial variations by requesting the average wages earned and average number of days employed. This again requires a relatively sophisticated mental computation on the part of the respondent in order to provide data with any degree of accuracy or reliability. Sophisticated probing by the interviewer is also necessary to stimulate respondent recall of employment activities in the past. Such probing however yields data of mixed quality and quantity depending on the ability of the interviewer.

In this example, we have dealt only with the income data problem for an individual farm worker. If the objective is to determine income of the household as a viable economic unit the problem is further compounded. This may involve the estimation of income for a number of family members employed full-time, part-time, or on a seasonal basis in a variety of jobs. In addition, where the peon or family also has land to work the value of crops and livestock consumed or sold by the household should be estimated.

So far we have dealt with only two types of situations, the salaried employee and the non-salaried farm worker. Any comprehensive survey would also cover farmers and owners of commercial establishments. On the expenditure side, in addition to the problems noted previously, some value would have to be imputed to the products raised and consumed on the farm or goods and services obtained from the owner's commercial enterprise. To obtain accurate income figures from the farm owner or commercial operator would probably in most cases require a production study of the farm to determine net income and a generalized accounting study of the individual firm. Finally, it is not uncommon to find individuals operating a small store, selling produce from a small plot of land, and occasionally working as a farm laborer. Clearly, the depth and extent of income data to be obtained in a general survey interview are bewildering.

Scale or Ladder Determinants of Income

To avoid the many problems inherent to family budget studies noted above, a second approach to obtaining income data is to request the respondent to place himself (or his household) on a scale or ladder of income categories. This procedure essentially places full responsibility for an accurate figure on the respondent, in effect asking him to mentally compute his income in light of the factors noted above and respond accordingly--and promptly!

Justification for this approach is that the grossly over and under estimated incomes will cancel out in a normally distributed population or that the expected error in estimation will not be so great as to exceed the range of values within each income category.

However these justifications may be criticized on the grounds that the range of incomes observed in normal rural surveys is heavily weighted toward the low end. Consequently, it is not safe to assume that gross errors in estimation will be canceled out between levels of the scale. Secondly, this technique may result in a mixture of net and gross incomes depending on the interpretation and estimation of the respondent and his position as a salaried worker or entrepreneur. Finally, because of the normally disproportionate number of respondents with low income and few with high income, there is likely to be inadequate differentiation of income levels at the low end of the scale. Greater precision could be obtained by expanding the number of income categories, but respondent estimation errors would then result in category classification errors and would also require a sufficient sample size to provide adequate observations in all classifications for analytical purposes. In summary, the greater detail sought through an expanded classification scheme is likely to result in more errors of classification and thus nullify its usefulness for sophisticated analysis. Collapsing the scale into low, middle, and high income groupings offers little differentiation for detailed analysis. Nevertheless, the simplicity of this technique leads to its use and subsequent over-confidence in the analytical power of the results.

Indirect Indicators of Income

As the title implies, the use of family head and/or household characteristics normally assumed to be related to income does not provide an income value or even a direct scale or classification of income. Rather, characteristics such as size of landholdings, levels of living, occupation, and education may be used as control variables when analyzing the impact of rural electrification or levels of electricity consumption.

Unfortunately, sufficient research in rural areas of developing countries has not been conducted to permit the estimation of the exact association of these characteristics to income levels and furthermore, the association would probably vary widely according to any given area being surveyed. Consequently, the contribution to income of any set of characteristics will probably remain largely unknown and prohibit the derivation of an income figure from associated characteristics.

The primary reason for using this indirect approach to control for income in analysis is that characteristics such as occupation, education, and levels of living are generally obtainable through normal interview procedures. Perhaps even more important, these data normally have a high degree of reliability--repeating the interview at a later time with the same respondent will result in the same response.[1]

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1. In the present survey, repeat interviews were conducted in Costa Rica and analysis showed a high coefficient of reliability for such characteristics as age, education, family data, level of living, etc.

(Such generally cannot be said for income data). This is true because such facts as occupation and education are easily remembered, assuming there are no overt reasons for the respondent to deceive. The level of living scale (as used in this survey) also requires no recall or mental computation since most of the household characteristics used in the index are based on interviewer observation of the physical appearance of the house or performance of household functions.

The resulting series of reliable variables then has wide application: as controls for income levels when analyzing the differences between sub-samples of the survey population; to provide characteristic profiles of these sub-samples; as baseline data against which to measure change at a later time; and as information against which to test the many assumptions and hypotheses concerning the impact of rural electrification projects.

If the detailed procedures necessary to obtain reliable income data were undertaken, the effect of electrification on education, levels of living, community involvement, etc., could not have been analyzed except through subjective observation. Contract provisions led the research team to feel that these factors were of major concern and justified the emphasis on characteristics other than income. It was also felt that an income figure superficially obtained and of doubtful reliability might bias results and lead to over-confidence and mis-interpretation of analytical conclusions. Too often in field surveys of this type conclusions are utilized without adequate consideration of the data base on which they were formulated.

Power Consumption and Alternative Energy Sources

This section continues the analysis of saturation survey data by focusing primarily on the users of COOPELESCA electricity. Where previously, emphasis has been placed on comparing USERS, NON-ADOPTERS, and INACCESSIBLES, we are here concerned with characteristics of USERS related to levels of household electricity consumption and expenditures for various energy sources by users and non-users of electricity. In addition, data for electricity consumers concerning appliance ownership and use of electricity is presented.

Use of Electricity

The use of electricity by members of the San Carlos Rural Electric Cooperative as demonstrated by appliance ownership is presented in Table 33. These data are based on interviews with 171 members with household meters only. An additional 10 members had meters for business establishments.

Appliance ownership is based on the availability of Cooperative electricity for a maximum of a little over three years for these respondents. However, 25 percent stated they had used electricity for less than one year, 42 percent for one to two years, and 27 percent were in the category of three to four years. Only 12 percent indicated use of electricity from other sources prior to the Cooperative.

Table 33

Appliance Ownership for Surveyed Members of the San Carlos Rural Electric Cooperative, Costa Rica

Appliance	Percent Owning
Iron	96.5
Electric Radio[1]	30.4
Refrigerator	27.5
Television Set	24.6
Electric Stove	18.7
Washing Machine	16.4
Blender, Beater	7.6
Sewing Machine	6.4
Record Player	3.5
Water Pump	3.5
Hotplate	2.9

1. May be slightly over-stated because of confusion with transistor radios.

Table 33 shows the typically high percentage ownership of electric irons and also relatively substantial ownership of refrigerators and television sets among members surveyed. Lightbulbs were used by all respondents with 28 percent using at least two, 38 percent with three, and 44 percent four or more bulbs. These were generally bulbs of 50 watts or less. Fluorescent tubes were occasionally used in the household, but were more common in commercial establishments.

While the ownership of appliances is interesting from the standpoint of household utilization of electricity, the question of who benefits from the availability of rural electricity may also be examined on the basis of appliance ownership. Table 34 presents data concerning the ownership of major household appliances according to occupation.

Several factors, some peculiar to the survey area, affect the data in this Table. First, the high percentage of teachers owning these appliances was due in part to professors with substantial incomes employed by the technical school in Santa Clara. Second, the low percentage of merchants with the listed appliances in their households was due to the use of these appliances for both household and commercial purposes. Considering ownership regardless of purpose shows 41 percent of these merchants with refrigerators, 46 percent with television sets, and the same (14 percent) with stoves. The unemployed category included primarily females supported by children or relatives. The ownership of appliances in these cases was often through gifts from supporting family members. Surprising, is the low percentage ownership of television sets for those in this situation.

Table 34

Household Appliance Ownership by Occupation for Members of the San Carlos Rural Electric Cooperative, Costa Rica

Occupation	Number Surveyed	Percent Owning Appliance		
		Stove	Refrigerator	Television
Teacher[1]	12	83.3	66.7	66.7
Merchant[2]	22	13.6	4.5	13.6
Farmer, Admin.	75	13.3	33.3	28.0
Peon and Other	67	10.4	14.9	13.4
Unemployed[3]	9	22.2	33.3	11.1

1. This occupation classification was influenced by a number of professors at the Santa Clara vocational-agricultural school whose electricity bills were paid by the school.

2. Appliances used by store-owners for both household and business purposes were not included.

3. Includes widows and female household heads often supported by children or relatives.

Since electricity was not used on farms included in the survey area, the primary benefit was through household and commercial utilization. Besides the use of electricity for lighting (which was universal), further household benefits are dependent on appliance ownership. Table 34 demonstrates that the benefits of electricity for cooking, refrigeration, and television entertainment (or instruction), primarily accrue to those in the higher socio-economic occupations.

Another aspect of the distribution of benefits from appliance ownership concerns the concentration of appliance ownership. Forty percent of the COOPELESCA members surveyed owned at least a stove, refrigerator, or television set for household purposes only. However, 17 percent of those owning at least one of these items, owned all three appliances; 35 percent owned a refrigerator and television set; and 26 percent owned a combination of stove and refrigerator or stove and television set. This further demonstrates the use of electricity for more than household lighting is relatively concentrated.

These data on appliance ownership are reflected in responses to questions concerning the use and importance of electricity to Cooperative members. Table 35 presents the major responses to the following questions in the survey schedule (Appendix A): (100) In your opinion,

what can you do with electricity that you could not do without electricity? (101) What would be the major problem you would have if the electricity failed for one whole month? (102) For you, what are the most important uses of electricity? Only the first response was coded for question 102 and this answer corresponded very closely with question 103 which sought to elicit the single most important use of electricity. It should be noted that these questions were open-ended so as to permit free expression by those interviewed. However, because of the uniformity of responses, the lack of structure created minimal problems in categorizing the statements.

Table 35 thus demonstrates that the most important perceived functions of electricity are for ironing and lighting. Regardless of the manner in which this matter is approached in an interview schedule, the result is remarkably similar. However, their closeness to or familiarity with alternative energy sources is perhaps indicated by the relatively low percentage who consider lighting and ironing a problem if there were an extended power failure.

Table 35

Major Use and Importance of Electricity for COOPELESCA Members, Costa Rica

Do with Electricity That Cannot be Done Without It		Major Problem if Electrical Failure For One Month		Most Important Use of Electricity	
Function	Percent	Function	Percent	Function	Percent
Ironing	27.2	Lighting	42.0	Lighting	65.8
Lighting	17.9	Ironing	19.3	Ironing	20.7
Television	16.8	No Problem	18.8	Various	13.5
Refrigerate	6.5	Refrigerate	7.2		
Various	31.6	Various	12.7		

The preceding tables indicate appliance ownership and use of central station electricity during a period up to nearly four years. Of interest also is the question of continuing or future utilization of electricity. In this respect, 90 percent of the respondents had no plans to purchase additional household appliances. Of the 10 percent who did expect to make purchases, the most common items were refrigerators and television sets. There also appears to be little expectation of future productive use of electricity on the farms surveyed in this area since 95 percent with landholdings had no plans to purchase electrical items for use in their farming operations.

The conclusion is then, that the household benefits of electricity to the majority of respondents stem from its use for lighting and ironing. The ownership of stoves, refrigerators, and television sets is concentrated among those in the higher socio-economic occupations and the potential benefits of electricity for use with these appliances is not even perceived by the majority of Cooperative members, despite the availability of electricity for up to four years.

Turning to the non-users of electricity (NON-ADOPTERS and INACCESSIBLES), the expected uses and benefits of electricity are much the same as demonstrated above for current users. Furthermore, there was very little difference in responses between the two categories of non-users. This discussion, for the most part, applies to both NON-ADOPTERS and INACCESSIBLES.

Ninety-three percent of these respondents reported never having had electricity in their households. However, 84 percent considered the availability of electricity an advantage. It is in the statements regarding the advantages of electricity that a possible significant difference emerges between NON-ADOPTERS and INACCESSIBLES.

The following statements were given by the indicated percentage of non-users as being advantages of electricity:

Stated Advantage	NON-ADOPTERS	INACCESSIBLES
One could live more comfortably	40.7%	36.1%
Economy of electricity	14.8	24.3
Useful for ironing	4.9	12.5
Useful for lighting	8.6	9.7
One could have appliances	2.5	4.9
Advantage, but no reason given	1.2	3.5
One could work at night	0.0	0.7
Other reasons, varied	27.2	8.3

One of the interesting differences concerning the advantages of electricity between NON-ADOPTERS and INACCESSIBLES is that pertaining to the economy of electricity as an energy source. Only 14.8 percent of the NON-ADOPTERS suggested economy (or related statements) as an advantage of electricity, while 24.3 percent of the INACCESSIBLES volunteered this reason.

It can reasonably be assumed that all those beyond the Cooperative distribution system (INACCESSIBLES), still had some awareness or knowledge of electricity. NON-ADOPTERS of course, were in the area serviced by the Cooperative but did not use electricity, though it may also be assumed that they were quite familiar with electricity in the houses of neighbors or others in the vicinity. This suggests that they may have been aware of the cost of electricity compared to their own expenditures for alternative energy sources and consequently were not as likely to consider economy an advantage of electricity as were INACCESSIBLES. (Other data concerning expenditures for various energy sources will be presented later in this section). Of the 16 percent of non-users who considered electricity a disadvantage, 77 percent listed expense as the reason, while some 15 percent were afraid of electricity.

Regardless of the advantages of electricity, close to 90 percent of all non-users stated they would use electricity in their homes if they had the opportunity. The most common expected use of electricity by these respondents was for lighting and ironing.

Alternative Energy Costs

A common characteristic of households in the rural areas of developing countries is a relatively low level of energy consumption. Major household functions and the energy using apparatus for their performance are indicated in the following outline according to electrical or non-electrical sources:

Household Function	Energy Using Apparatus: Electrical	Energy Using Apparatus: Non-Electrical
Lighting	Lightbulbs, florescent	Candles, kerosene
Cooking	Stove, oven, hotplate	Wood, kerosene, gas
Refrigeration	Refrigerator	Kerosene, gas, icebox
Washing clothes	Washing machine	Mechanical equipment
Ironing clothes	Iron	Charcoal, stove top
Entertainment	Radio, television, Record Player	Battery operated items
Heating	(Not necessary in the areas of Costa Rica and Colombia investigated)	

Each household will incur some real or implied cost in meeting their household energy needs. Real costs involve cash expenditures in two categories, fixed and variable. Fixed costs include the cost of appliances such as stoves, refrigerators, radios, irons, etc., and will be applicable whether the household has electricity or not, though the range of possible expenditures will vary depending on the availability of electricity. Variable costs include expenditures for electricity, candles, petroleum products, wood, etc.

While the purchase of appliances is a real cost involving an exchange of money for the item, some variable costs may involve implied expenditures or no direct money exchange. The most obvious example is where a member of the household collects wood for cooking purposes. While no money may change hands for this energy source, it does have an implied cost if the person collecting the wood could be gainfully employed during the time he takes to cut and haul the wood. The "cost" of the wood then becomes the amount of money he could have earned in an alternative activity (opportunity cost).

There is reason to believe that alternative employment opportunities for either the family head or other members are limited in relation to the time spent collecting wood. Consequently, the use of wood for cooking may very well involve no direct cost to the household. Expenditures for this energy source are not considered here. Most respondents used wood for cooking and most collected their own. The supply of wood for cooking is not limited at present in San Carlos. However, obtaining dry wood during the rainy season can cause some problems.

Except for firewood, most other energy sources involve real costs or the exchange of cash for the item. Since expenditures for candles and kerosene are often made on a very frequent basis, it is somewhat difficult to obtain accurate data, especially on a monthly basis, by means other than asking average daily (or at most weekly) use and expanding this figure. Electricity consumption is much more accurately measured by meters and through examination of billing records.

In comparing the cost of alternative energy sources to meet a given function, the convenience and efficiency of the energy source are factors. Thus a few small lightbulbs are much more convenient and provide better light than numerous candles. Electric refrigerators are simpler to operate than kerosene, regardless of strict cost differentials. Central station electricity is more dependable than that of private generators.

Table 36 presents data on the cost of candles and kerosene for electricity users and non-users and the average total cost of non-electric energy for these groups. (There was little difference in expenditures for candles and kerosene between NON-ADOPTERS and INACCESSIBLES, so these non-user categories were combined). As noted previously, the primary household use of electricity was for lighting and Table 36 demonstrates that users of electricity have cut expenditures for candles by more than 90 percent. The smaller difference in expenditures for kerosene between users and non-users is because kerosene is much less commonly used for lighting purposes. Part of the difference is explained by the substitution of kerosene for electric refrigerators, but with the limited use of electricity for cooking, both groups still use kerosene for stoves or at least to aid in lighting firewood.

Table 36 indicates then that surveyed users of electricity have average monthly expenditures for household energy of ¢21.37 compared to non-user expenditures of ¢9.01. Much of this difference results from the substitution of electricity for the cheaper candles as a source of home lighting. As the ownership of major appliances such as stoves and refrigerators increases, central station electricity becomes a cheaper energy source in relation to gas and kerosene. From a limited number of observations, it appears that a gas stove costs about ¢30 per month to operate. This is equivalent to 100 kWh of electricity at the current Cooperative rate. Kerosene stoves cost ¢40 to ¢60 per month for fuel, which is equivalent to 140 to 220 kWh of electricity. Kerosene operated refrigerators in San Carlos were estimated to consume ¢35 to ¢40 of fuel per month, equivalent to 120 to 140 kWh of electricity. Based on appliance electricity consumption figures for the United States, the use of electric stoves and refrigerators in San Carlos would be much cheaper than gas or kerosene operated appliances at prevailing rates and prices.

The fact remains that strict cost comparisons do not take into account differences in the quality, dependability, and convenience of electricity compared to alternative energy sources. This is especially true in relation to lighting. Electricity consumers have demonstrated

a willingness to pay ¢10 to ¢20 per month for electric service since no alarming number have asked to be disconnected (this being more a function of migration than dissatisfaction, apparently). Secondly, complaints by some consumers over the high cost of household electricity were a result of the use of stoves and refrigerators (where these appliances had not been owned previously) rather than for lighting and irons.

Table 36

Expenditures for Alternative Household Energy Sources by Electricity Users and Non-Users, Costa Rica

User Class and Energy Source	Percent Using	Average Cost Per Month - ¢ (All Consumers)
USERS		
Candles	15.7	¢ 0.41
Kerosene[1]	47.0	2.24
All Non-electric sources[2]	53.6	2.99
Electricity[3]	100.0	18.38
Total user cost		¢ 21.37
NON-USERS		
Candles	74.9	4.50
Kerosene[1]	73.6	3.86
All alternative sources[4]	96.3	9.01
Total Non-user cost		¢ 9.01

1. Includes use for lighting, stoves, and refrigerators where applicable.

2. Includes total of candles, kerosene, and three cases of gas stoves.

3. Based on average household electricity consumption of 55 kWh for respondents in July, 1972.

4. Includes total of candles, kerosene, and seven cases of gas stoves.

The conclusion is that the use of electricity simply for lighting and ironing will result in higher household energy expenditures by the low electricity consuming households. However, as demonstrated by their willingness to continue service, this additional expenditure is apparently covered by the convenience and dependability of electricity for these purposes. The relative savings in energy expenditures do not begin to take effect until one is able to substitute central station electricity for a private generator, or eliminate expenditures for kerosene with an electric stove or refrigerator.

Characteristics Related to Electricity Consumption

The objective of examining selected characteristics of survey respondents in relation to their average monthly electricity consumption is to determine if certain of these factors can be isolated for use in estimating household power consumption in feasibility studies. Given certain factors related to demonstrated household electricity consumption, surveys of potential project areas could focus on these characterisitcs and their prevalence or absence could be used to determine future project sites as well as potential consumption.

Since consumption of electricity generally increases over time, it is necessary in the analysis of characteristics to select survey respondents who have had the use of central station electricity for a comparable period of time. Table 37 presents selected characteristics of COOPELESCA members who have used Cooperative electricity from the time of energization in 1969 through August, 1972. Their level of consumption was based on the eight-month average for 1972 and their characteristics from the August survey. Additional USERS were not included because their initial connection with Cooperative service varied from late 1969 to a few months in 1972.

The major differentiation in characteristics between levels of electricity consumption occurs around the 40 kWh per month point. Those on the average using more than 40 kWh of electricity per month for household purposes were appreciably younger, better educated, and included a higher percentage of teachers and merchants. All three of these characteristics of course may well be closely interrelated. A somewhat higher percentage of the larger electricity consumers were born in the San Carlos area. Such characteristics as previous experience with electricity, and ownership and amount of land do not clearly differentiate electricity consumption levels for these respondents. Previous experience with electricity was generally negligible for all respondents in the area surveyed, perhaps resulting from the limited use of private generators on farms included in the survey population. A relatively high percentage of landholders were found at each consumption level and the consumption of electricity did not increase directly with farm size when one observation of 400 manzanas was excluded from the highest consuming group. This again indicates that land ownership is not as significant a factor in the ability to use electricity for household purposes as might be expected.

The electricity consumption levels in Table 37 were designed to differentiate the characteristics of minimum (0-20 kWh), low (21-40 kWh), intermediate (41-100 kWh), and high (100+ kWh) consumers. Results indicate however that classification by low (0-40 kWh) and relatively high (41+ kWh) would provide sufficient refinement. This undoubtedly results from the fact that the low consuming group uses electricity only for lighting, ironing, and possibly television or some small appliance. More than 40 kWh per month represents the ability to purchase major appliances such as stoves and refrigerators and a wide range of smaller items. The ownership of more than one major appliance by those who own at least one was previously indicated. Examination of individual electricity consumption records over time revealed that those initially in the low

(0-40 kWh) consuming group tended to remain in that same group for the nearly four year period examined, though their average monthly consumption increased somewhat over time. Those in the high (41+ kWh) consuming group however tended to increase their consumption substantially in the first and second year.

Table 37

Selected Characteristics of COOPELESCA Members by Levels of Electricity Consumption, Costa Rica

Characteristic	Units	Average Monthly Electricity Consumption 1972, kWh			
		0-20	21-40	41-100	100+
Observations[1]	No.	20	24	13	8
Ave. Age	Yrs.	51.6	52.8	42.8	42.9
Ave. Education	Yrs.	1.4	1.7	4.7	4.1
Those with Land	Pct.	65.0	87.0	50.0	75.0
Ave. Amt. Land	Mzs.	10.2	17.2	35.3	83.0[2]
Previous Use of Electricity	Pct.	5.0	16.7	15.4	0.0
Birthplace					
San Carlos Area	Pct.	36.8	20.8	41.7	75.0
Meseta Central	Pct.	36.8	45.8	25.0	25.0
Other Costa Rica	Pct.	26.3	33.3	33.3	0.0
Occupation					
Teacher	Pct.	0.0	0.0	23.1	12.5
Merchant	Pct.	5.0	0.0	15.4	0.0
Farmer	Pct.	55.0	66.7	38.5	62.5
Peon	Pct.	35.0	16.7	7.7	12.5
Other	Pct.	0.0	8.3	7.7	12.5
Unemployed	Pct.	5.0	8.3	7.7	0.0

1. Total of 65 respondents for whom consumption data was available over a period of nearly four years.

2. This average greatly influenced by one respondent with 400 manzanas. Eliminating this observation results in an average of 19.6 manzanas.

Table 38 shows the increase in average yearly and monthly consumption of electricity for those on which the above analysis was based. This indicates a small increase (3.5 percent) after the first year of system energization which was doubled (7.0 percent) in the second year, before returning to 3.6 percent in the third year. Since there was little previous experience with electricity among those surveyed, this would indicate many appliance purchases were made in the second year following system energization.

Table 38

Average Yearly and Monthly Household Electricity Consumption for Surveyed Members of the San Carlos Rural Electric Cooperative, Costa Rica 1969-1972[1]

Year	Ave. kWh per year	Aver. kWh per month	Percent Change
1969[2]	--	40.2	--
1970	499.5	41.6	3.5
1971	534.0	44.5	7.0
1972[3]	--	46.1	3.6

1. Consumption records were available over a nearly four year period for 65 of the surveyed members.

2. Energization of the system did not take place until June, 1969 in the surveyed area. Consequently, average monthly consumption is based on a maximum of seven months.

3. The field survey was conducted in August, 1972. Consequently, billing records were available for only eight months for 1972.

SOURCE: Computed from billing records in COOPELESCA office.

A somewhat similar pattern of increasing electricity consumption may be observed in Tables 39 and 40. These tables show average yearly residential consumption of electricity increasing by 18 percent in the first year following energization and then falling off to a four percent increase. Part of the immediate and dramatic increase in average annual residential consumption reflected in these tables is due to the more than doubling of initial consumers.

The next section of this report includes an analysis of characteristics related to electricity consumption for COOPELESCA members who were re-interviewed in a follow-up study from 1968. Results from that analysis point to occupation as being the most significant factor related to the level of electricity consumption, with education and previous experience with electricity also important. In terms of feasibility studies then, it appears that among several potential project areas, those in the higher socio-economic occupations, better educated, younger, and with previous experience with electricity will more likely make greater utilization of electricity for household purposes.

Table 39

Number of Consumers and Electricity Consumption by Consumer Classification for the San Carlos Rural Electric Cooperative, Costa Rica, 1969-71

Classification	1969			1970			1971		
	Number Consumer	Sales (MWh)	kWh/ Consumer	Number Consumer	Sales (MWh)	kWh/ Consumer	Number Consumer	Sales (MWh)	kWh/ Consumer
Residential	542	279	515	1,206	732	607	1,361	858	630
General	62	173	2,790	179	490	2,737	225	711	3,160
Secondary Industry	31	503	16,226	61	1,558	25,540	73	1,698	23,260
Pub. Lighting	10	33	3,300	23	76	3,304	38	91	2,395
Total	645	988	1,532	1,469	2,856	1,944	1,697	3,358	1,979
Residential as Percent of Total	84	28	34	82	26	31	80	26	32

Table 40

Percent Change in Number of Consumers and Electricity Consumption by Consumer Classification for the San Carlos Rural Electric Cooperative, Costa Rica, 1969-71

Classification	1970			1971		
	Number Consumer	Sales (MWh)	kWh/ Consumer	Number Consumer	Sales (MWh)	kWh/ Consumer
Residential	123	162	18	13	17	4
General	189	183	- 2	26	45	16
Secondary Industry	97	210	57	20	9	- 9
Pub. Lighting	130	130	0	65	20	-28
Total	128	189	27	16	18	2

SOURCE: ICE, Direccion de Electrificacion, Informe de Operacion de las Principales Empresas Productoras y Distribuidoras de Energia Electrica en Costa Rica, Ano 1971, San Jose, Mayo, 1972.

Re-Interview Analysis

In August, 1968, Moses conducted a survey for AID[1] in Costa Rica of three newly formed rural electric cooperatives. One of the objectives of the 1968 survey was to establish benchmark data from which changes resulting from the rural electrification projects might be measured in future years. Methodology was also developed and attempts made to estimate the anticipated use of electricity and benefits which might accrue to households, farms, and businesses following electrification by means of personal interviews prior to system energization.

The three Costa Rican Cooperatives surveyed in 1968 were located in San Carlos, San Marcos, and Guanacaste. A summary report of this research was submitted to AID in January, 1970, and the full study is included in Moses' unpublished Master's thesis entitled, "Cooperative Rural Electrification In Costa Rica," University of Florida, December, 1969.[2]

Emphasis in this study was on the development of methodology and measurement of differences between those with electricity, those not using electricity within the electrified area, and those outside the rural electrification project area. Because of the resources devoted to the technique of saturation surveying, only limited support was available to conduct a follow-up study of the 1968 survey. This section will thus report on the actual situation in August, 1972 of the same San Carlos, Costa Rican households, farms, and businesses surveyed in 1968, to the extent that the same respondents were available for interviewing and that limited time and resources permitted.

The 1968 survey utilized a stratified cluster sampling procedure to select a representative sample of the San Carlos Rural Electric Cooperative membership at that time. This led to interviews with 38 members (Table 41). Attempts to re-interview these same members in August, 1972, were complicated by the fact that many had moved out of the area, a few had died, and others could not be located with the time and transportation available. Data concerning the number and location of re-interviews and status of those not contacted is also presented in Table 41.

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1. University of Florida, Contract AID/la-261 (Costa Rica).

2. The 1968 survey, with some follow-up observations, is also summarized in chapter 3 of Cooperative Rural Electrification by James E. Ross, Praeger, 1972.

Table 41

Original Sample and Re-Interview Data for the San Carlos Rural Electric Cooperative, Costa Rica

Strata and Clusters	Total Number Members-1968	Number Sampled-1968	No. Re-Interviewed-'72	Status of '72 Non-Respondent		
				Moved	Died	Not Loc.
Urban Stratum	113	16	9	5	1	1
Pital	55	7	3	3	1	0
Venecia	58	9	6	2	0	1
Rural Stratum	1,280	22	11	5	1	5
Aguas Zarcas	35	6	4	1	0	1
Florencia	7	1	0	0	0	1
Veracruz	20	4	2	1	1	0
San Isidro	20	4	3	0	0	1
Buena Vista	28	7	2	3	0	2

It is not feasible to statistically estimate population parameters from re-interview data because of the large number of non-respondents to re-interviews out of the original sample. This also complicates complete analysis of re-interview data, especially in relation to the generalizations or conclusions which may be drawn. Consequently, all succeeding information can only apply strictly to those Cooperative members actually re-interviewed.

Objectives

The objectives of re-interviewing a sample of members of the San Carlos Rural Electric Cooperative after a period of four years were: (1) to evaluate the baseline survey approach and methodology, (2) to determine characteristics related to initial and continuing household consumption of electricity, and (3) to determine the effectiveness of projecting power consumption based on surveys of anticipated appliance purchases prior to project construction. To our knowledge, this is the first concerted effort to conduct a follow-up study of a rural electrification project in a developing country.

Evaluation of Baseline Survey

Through means of a stratified cluster sample, the 1968 survey sought to obtain data from a small sample, which, when statistically manipulated could be applied to the 1968 population of rural electric cooperative members. Re-interview of this sample was expected to yield data for calculating changes and benefits to the original population of the Cooperative and hence indicate the impact of a rural electrification project after a given period of time.

This approach, in its original application was conceptually and statistically valid, but did not anticipate the extent of migration and the degree to which a follow-up survey would find previous respondents unavailable for re-interview. Consequently, the sampling procedure must be considered flawed for purposes of baseline (benchmark) studies.

Outside of complete enumeration however, some random sampling procedure must be utilized when it is desirable to generalize the analysis to the entire population of an electrification project area.[1] It is suggested that a stratified sampling procedure would still be valid given that the sample size in each stratum was sufficiently large to enable statistical analysis following re-interviews, even when a substantial number of the original sample respondents might be unavailable for the follow-up. Of course this would also require additional financial, transportation, and interviewer resources for conducting the original survey.

A stratified or cluster sampling approach may still be considered the best alternative where data applicable to the entire project area are desired. This method concentrates the households to be interviewed to some extent, within given areas thus reducing transportation and communication problems which are often major constraints to survey research in developing rural areas.

The consumer survey questionnaire for the 1968 study was designed to obtain baseline data against which socio-economic change and electricity consumption characteristics might be measured in a follow-up study, as well as information concerning the anticipated use of electricity in 1968. Moses personally conducted all interviews and the survey schedule proved satisfactory in this situation. The major problem with the questionnaire concerned a series of questions intended to measure attitudes toward change, rural electrification, and the

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1. The saturation survey approach used to gather data for the main part of this report was not a sample survey and did not attempt to be applicable to the whole project area, since the objective was to obtain baseline data as well as an immediate analysis of users compared to non-users. In this case the sample respondents and the population were one and the same.

Cooperative. These questions, as worded, resulted in uniformly affirmative responses and thus did not serve to differentiate between respondents. Consequently, this section was dropped as the survey progressed. A much more successful approach to eliciting this type of information was developed for the current survey and included in the questionnaire of Appendix A.

In relation to estimating anticipated appliance purchases and thus electricity consumption, it has been found that the relatively short planning horizon of the average rural family together with income uncertainty, provides little reliability concerning expected appliance purchases beyond a one-year time span. Thus a respondent's stated intention to purchase electric appliances within the first year following system energization is more likely to be carried out than such intended purchases stated to be made from one to three years following energization. Experiences with rural populations to date indicates that estimated appliance purchases beyond three years would be highly unreliable.

The 1968 questionnaire also contained a somewhat detailed form for recording agricultural data--land owned or used, acreage by crop, production and distribution by crop, livestock production, use of machinery. Again, the objective was to obtain baseline data against which change following electrification might be noted and the share attributable to the electrification project might be measured. However, field surveying demonstrated the detailed form was too elaborate to be completed successfully, given the extent of other information deemed essential from each respondent. This matter was dealt with earlier in the section on economic correlates and income statements in survey research.

In summary then, the following observations regarding methodology may be made based on the 1968 and 1972 field surveys:

(1) Saturation surveying maximizes the efficient use of interviewers, supervisory personnel, and transportation resources because of the concentration of interviews in a given area. Furthermore, analysis of the collected data is facilitated since the "expansion factors" necessary to go from a stratified or cluster sample to a population do not have to be calculated (along with attendant problems of missing observations). Statistical manipulation in analysis is thus greatly reduced by using saturation survey data. However, selection of the area to be intensively surveyed must be done with great care to avoid pre-determining or biasing the analytical results since in this approach selection is normally based on subjective observation rather than a statistically random basis.

(2) If the objective of the survey is to obtain data against which quantifiable costs and benefits of an electrification project may be weighed in an evaluation or feasibility study, then it would generally be necessary to utilize a sampling procedure such as stratification or clustering over a definable project area. This results from the problem of extracting fixed and operating costs for a given sub-sector

of the total project. Cost and revenue records in the normal electricity distributor's office are not maintained for this purpose. The 1968 survey in San Carlos has demonstrated the necessity of relatively large-scale sampling even under a stratification procedure in order to assure sufficient observations in a follow-up study.

(3) The most reliable estimates of anticipated appliance purchases result from respondents' stated intentions for the first year following system energization; less reliable estimates may be derived from stated intentions for the first three years of the project, but beyond that time intentions appear to have little rational basis. This suggests that further research of established electrification projects from which data concerning the ordering and timing of actual purchases can be obtained may result in more reliable projections of energy consumption based on average electricity consumption of owned appliances.

(4) Experience has shown that attempts to obtain household income and/or agricultural production data under the constraints of extensive surveying are likely to be unsuccessful. The detail necessary for accurate and reliable income and agricultural data virtually preclude the obtaining of more generalizable data dealing with household social-economic conditions. This suggests that where desirable, such information be obtained through special intensive surveys or case studies. Indicators of economic conditions in extensive surveys may be derived from such characteristics as occupation, size and type of farm, and levels of living. Nevertheless, most researchers realize the need for greater study of these characteristics in relation to reliably quantifiable estimates of economic conditions.

Characteristics of Surveyed Respondents

This section is divided into several parts to present data concerning characteristics related to levels of electricity consumption, migration, and previous experience with electricity. In each case, factors other than electricity consumption were obtained from the 1968 benchmark survey.

Electricity Consumption

Tables 42 and 43 present electricity consumption data in somewhat narrow ranges to more accurately indicate distribution of the observations and the change in this distribution between 1969 and 1972. Because of limited observations, these categories will be combined for discussion purposes into low (0 - 40), medium (41 - 100), and high (101) kWh groups.

Since the Cooperative system was first energized in 1969, data in Table 42 indicate the characteristics associated with initial consumption. This table shows that higher levels of average monthly electricity consumption were associated with previous experience with electricity, fewer years residence in the area, more years of education, and a more sophisticated occupation level. In all of these aspects, the difference between the low and high consuming groups is quite pronounced, with the medium group being intermediate.

The consistency and direction of these characteristics in relation to electricity consumption provides some confidence in their ability to profile consumption levels. However, it may be reasonable to assume that previous experience with electricity and years of education are extensions of the merchant-farmer occupation group. Thus in terms of estimating future consumption, occupation appears to be one of the most significant characteristics to examine.

Examination of these same characteristics for respondents with consumption data in 1972, Table 43, shows basically the same associations indicated previously. However, there was some shift of respondents in this period from the low or medium consuming groups to higher electricity consumption levels. This tends to demonstrate that not only initial but also continuing levels of consumption are affected by such characteristics as prior experience with electricity, years in the area, and occupation; education appearing to be less significant over time.

Table 42

Selected 1968 Characteristics of San Carlos Rural Electric Cooperative Members by Average Monthly Household Electricity Consumption in 1969, Costa Rica

Characteristic	Average Monthly Electricity Consumption, kWh[1]					
	0-20	21-40	41-60	61-100	101-200	200
Observations #	6	10	5	2	3	4
Prior Elect. %	33	60	80	-	67	100
Ave. Years in Area #	25	23	19	-	11	13
Ave. Age #	41	45	42	-	55	34
Ave. Education (years) #	3.5	4.4	4.6	-	4.5	6.2
Occupation[2] Index	2.0	1.8	2.2	-	3.0	3.5

1. Average monthly electricity consumption was calculated for the seven months following energization in 1969.

2. Occupation index is an arbitrary construct developed by assigning a value of 4 to merchants, 3 to farmers, 2 to self-employed tailors, barbers, carpenters, etc., and 1 to peones, general laborers, etc.

Table 43

Selected 1968 Characteristics of San Carlos Rural Electric Cooperative Members by Average Monthly Household Electricity Consumption in 1972, Costa Rica

Characteristic	Average Monthly Electricity Consumption, kWh					
	0-20	21-40	41-60	61-100	101-200	200
Observations[1] #	4	3	1	2	9	5
Prior Elect. %	25	66	-	100	67	100
Ave Years in Area #	20	29	-	24	21	16
Ave. Age #	53	36	-	42	40	42
Ave. Education (years) #	4.3	4.3	-	4.5	3.4	6.0
Occupation Index	1.7	1.6	-	1.5	2.6	3.6

1. Most of those who had migrated by 1972 were in the 1969 electricity consumption range of 21-40 kWh per month.

Migration

The number of 1968 respondents who had moved out of the San Carlos area by 1972 was surprising, especially since the area may be considered progressive, with substantial economic potential in relation to other areas.[1] Time did not permit tracing those who had moved, but neighbors of the former respondents indicated while some of the people had moved to the larger cities of the Meseta Central a few others had moved to more recently developed areas (where electricity was probably not available except from private sources).

1. Analysis of saturation survey data showed that the population in that area of the Cooperative was also highly mobile. Only 30 percent of those respondents were born in the San Carlos area. Furthermore, only slightly over one percent had always lived in the same house; about 24 percent had previously resided outside the San Carlos area.

Of the ten sample respondents who had moved out of the area between 1968 and 1972, six had had some experience with electric service prior to the Cooperative system. While definitely based on limited observations, this would seem to suggest that at least for the San Carlos area, the actual delivery of 24-hour electric service by the Cooperative was not sufficient to overcome the pull of other factors (possibly economic) leading these people to move out of the area, despite knowledge of electricity and supposedly some idea of its potential application in the home or for business opportunities.

Analysis of selected household characteristics obtained in the 1968 survey was made to determine the general characteristics of the migrant and non-migrant groups and the relationship between previous sources of electricity and these groups. Data pertaining to these relationships and group characteristics are presented in Tables 44 and 45.

Table 44

Selected Characteristics of a 1968 Sample of San Carlos Rural Electric Cooperative Members by Migration Status in 1972, Costa Rica

Characteristic	Total 1968 Sample[1]	Respondents in Area, '72[2]	Respondents Migrated[3]
	Average or percent		
Age	42	42	37
Education[4]	4.1	4.0	4.8
Household Size	7.4	7.6	6.7
Years in Area	19.4	22.4	15.3
Rooms in House	3.1	3.3	3.1
Committee Membership[5]	70%	67%	80%
Use of Periodicals	45%	37%	67%

1. Maximum number of observations, 34.
2. Maximum number of observations, 19.
3. Maximum number of observations, 10.
4. One respondent with a high school education not included.
5. Membership in organization or committee other than the rural electric cooperative.

It is apparent from Table 44 that household heads in the migrating group on the average were somewhat younger, slightly better educated, had smaller families, and up to 1968 had been in the San Carlos area a shorter period of time than the non-migrating group. Furthermore, the migrating group was more involved in the community as expressed by committee membership and had a greater readership of newspapers and magazines. Thus it appears the migrants were a more progressively oriented group rather than an illiterate, constantly shifting, uninvolved people. The assumption that they left the San Carlos area because of dissatisfaction and to search for a better opportunity elsewhere can only be speculative, since they were not traced for interviewing in their new location. Nevertheless, it is obvious the arrival of central station electricity was not in itself sufficient to keep them from moving out of the area.

Examination of Table 45 indicates the above analysis of household characteristics between migrants and non-migrants holds true regardless of experience with electricity prior to Cooperative energization. Thus, regardless of previous experience with electricity, the migrated group was younger, had somewhat more education, a smaller household size, fewer years in the area, a greater degree of committee membership, and a higher use of newspapers and magazines.

Within the respective migrant and non-migrant groups of Table 45, the characteristics of household heads related to previous experience with electricity may be compared. Such analysis reveals that age and education are the most significant of the characteristics examined in differentiating previous experience with electricity; for both groups, those with prior electricity were somewhat younger and better educated.

Table 45

Selected Characteristics of a 1968 Sample of San Carlos Rural Electric Cooperative Members by 1972 Migration Status and Previous Electricity Experience, Costa Rica

Characteristic	Electricity Before Co-op			No Electricity Before Co-op		
	Overall[1]	Stayed[2]	Migrated[3]	Overall[1]	Stayed[2]	Migrated[3]
	Average or Percent					
Age	40.5	40.6	35.5	45.0	43.7	38.5
Education[4]	4.5	4.2	5.0	3.5	3.7	4.3
Household Size	7.6	7.7	6.7	7.2	7.4	6.8
Years in Area	19.1	20.6	15.5	19.9	27.2	15.0
Rooms in House	3.2	3.3	2.8	3.0	3.0	3.5
Committee Membership[5]	67%	67%	83%	75%	67%	75%
User of Periodicals	45%	36%	67%	45%	40%	67%

1. Includes all 1968 respondents in respective electrification categories regardless of their re-interview status in 1972. Maximum of 23 respondents with previous electricity and 13 without.
2. Maximum of 14 respondents in prior classification and six respondents without prior electricity available for re-interview in 1972.
3. Maximum of six respondents with prior electricity and four without.

4,5 See respective footnotes, previous table.

There was little difference for either group between household size and, surprisingly, use of periodicals and previous electricity experience. Community involvement expressed through committee membership was only slightly higher for those with previous electricity in the migrant group. The major difference between the two groups occurred in relation to number of years in the area, where the non-migrants with previous electricity had fewer years residency (20.6) than those without prior electricity (27.2), while for the migrants a slightly longer residency (15.5 versus 15.0) was associated with previous electricity experience.

The migrants then are an interesting group, since many of their characteristics indicate they should have been significant consumers of electricity. Yet as noted in Table 46, their initial consumption before moving was generally low. The extent of migration in an area such as San Carlos indicates that this factor must be considered when estimating increases in the number of consumers and electricity consumption in feasibility studies.

Previous Experience with Electricity

Questions dealing with the history of electrification of 1968 respondents indicated that a substantial number of Cooperative members had had some prior experience with electric service. This source of electricity was generally private plants owned by respondents, their neighbors, or local businesses. Respondents indicated service was generally erratic due to equipment failures and most often was only provided for a few hours in the evening for the purpose of lighting and possibly the use of an iron.

Since knowledge of and especially experience with electricity is considered important in relation to increasing consumption of electricity, it was expected that those with previous experience would have a higher initial consumption of Cooperative electricity and that continued use might increase more rapidly than those without prior experience with electric service. (Though it should be remembered that in no case did prior experience involve the completely dependable and steady service provided by the Cooperative). Regression analysis of the expected consumption of electricity in the 1968 study supported this hypothesis for San Carlos, though with conflicting results for the San Marcos and Guanacaste Cooperatives.[1]

Analysis of billing records from 1969 through 1972 along with age, education, and occupational characteristics of Cooperative members interviewed in 1968 suggests that greater initial and continuing consumption of electricity is more a function of occupation than previous experience with electricity. Table 46 indicates that Cooperative members with the highest average monthly electricity consumption were the non-migrants with previous electric energy in the farmer and merchant occupation categories. It should be noted that billing records used for this analysis included only household (residential) meters. In some cases, refrigerators and television sets might be used for both household and commercial purposes, but normally this would require a commercial meter classification.

Those with the lowest average monthly electricity consumption were non-migrants with no previous electric energy experience and with occupations in the peon, self-employed, and general labor categories. The other levels of electricity consumption in 1969 are similarly associated with intermediate occupational categories.

Thus, of the characteristics examined in this group of Cooperative members, the closest association with electricity consumption is that of occupation. Such characteristics as migrant status, previous experience with electricity, age, and education do not have a consistent association with use of electricity for these data.

Probably the most interesting observation from Table 46 is the initial and continuing level of average monthly electricity consumption. Since the Cooperative system was first energized in May, 1969, consumption figures for this year reflect average monthly consumption for the initial seven months. The 108 kWh average monthly consumption figure for the farmer-merchant, non-migrant group with previous electric energy sources is nearly three times that of any other group.

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1. It was felt that this conflict might be explained by differences in the qualitative aspects of prior electric service between San Carlos and the other areas.

Table 46

Selected Characteristics and Average Monthly Household Electricity Consumption by Migrant Status and Previous Experience with Electric Energy, Costa Rica

Status	Occupation[1] Index	Age	Education	Ave. Monthly Elect. Use, kWh 1969	1970	1971	1972
Non-Migrants							
Previous[2] Elect.	3.0	41.3	4.5	108	126	143	185
No Prior[3] Elect.	1.3	43.7	3.7	28	34	53	81
Migrants							
Previous[4] Elect.	1.5	35.6	5.0	39	(6)	(6)	(6)
No Prior[5] Elect.	2.7	38.5	4.3	40	(6)	(6)	(6)

1. Occupation index is an arbitrary construct developed by assigning a value of 4 to merchants, 3 to farmers, 2 to self-employed tailors, barbers, carpenters, etc., and 1 to peones, general laborers, etc.
2. Based on 13 observations.
3. Based on 6 observations.
4. Based on 6 observations.
5. Based on 4 observations.
6. Insufficient electricity consumption data.

Because of erratic consumption data for those who migrated, it was not possible to compute their average monthly use of electricity beyond 1969. However the data for non-migrants is very interesting. The farmer-merchant group increased average monthly consumption 17 percent from the initial seven month period through the first full year, even though initial levels were quite high. It appears that they used previously purchased appliances during the initial period and then added a few items after that. A 30 percent increase between 1971 and 1972 indicates additional uses for electricity and appliance purchases were undertaken at that point in time.

In contrast, non-migrants without previous sources of electric energy, in the "lower" occupation categories show initial consumption levels equivalent to several light bulbs, an iron, and perhaps some other small appliance. But substantial increases of 50 percent or more in succeeding years would seem to indicate a slow and continuing increase in the stock of appliance ownership. After three years, average monthly consumption is nearly three times that of the initial period and nearly one-half that of the "higher" occupation group.

Before suggesting the significance of these observations, a comment should be made concerning the composition of what has here been labeled the farmer-merchant occupation category. In the San Carlos area of Costa Rica, those in the merchant classification were located primarily in the "urban" centers of Pital and Venecia. Consequently, they represented rather substantial commercial enterprises rather than the "front room" stores found in more rural areas. Likewise, farmers represented substantial dairy, beef cattle, or crop enterprises rather than small or medium sized farms. Generalization concerning the size of these farms is necessary because land was frequently owned by several family members and thus difficult if not impossible to allocate among family members. It appeared that surveyed farmers on the average controlled more than 100 manzanas.

From the limited observations on which the consumption figures and characteristics of Table 46 are based, it appears that a substantial portion of initial household electricity consumption will come from large farm and commercial enterprises who previously had electric energy from private sources. Furthermore, substantial increases in consumption may be expected throughout the first three years of system energization. Household electricity consumption of peones, general laborers, and small scale self-employed workers will average under 40 kWh monthly, but may show increases of 50 percent or more through at least the first three years of the project.

Business and farm use of electricity among those interviewed was too diversified or limited to permit sufficient observations for detailed analysis. Business enterprises ranged from general store-dance hall-bar combinations to a small furniture making operation. Several farmers lived near the power lines but their farming operations were beyond the distribution system, while others did not use electricity for productive purposes. Observations concerning commercial use of electricity are included in the section on Supplementary Interviews which were conducted in addition to those re-interviewed from 1968.

Estimating Household Electricity Consumption

The following section of the re-interview analysis considers two problems based on data obtained through interviews in 1968 and re-interviews with the same respondents in 1972 and billing records available for the period 1969 through 1972: (1) comparison of respondent's actual ownership or anticipated purchase of appliances in 1968 compared to actual ownership in 1972; (2) estimated electricity consumption based on United States calculations of appliance electric use compared to actual electricity consumption from billing records.

The purpose of such analysis is to determine the validity and reliability of estimating future project household electricity consumption based on interviews with a sample of potential consumers to determine their actual and anticipated appliance purchases. Secondly, to determine the validity in developing rural areas of average appliance electricity consumption figures estimated for the United States.

Reliable estimates of the future consumption of electricity are important in the selection, planning, and implementation of rural electrification projects in developing countries. Estimates of future consumption are necessary in order to design a project with proper and sufficient load capacity, assure adequate power supply, and as a basis for estimating revenue generated by power sales. Consumption estimates could also be used to select project areas with high potential use and where projects are planned for marginal areas, prior consumption estimates could indicate the need for educational inputs to assure fuller utilization of the electric energy.

In the development of the three rural electric cooperatives in Costa Rica, "KWH usages and KW demands were based on historical information taken from the ICE system and weighted to reflect the local conditions including income levels" (Benjamin, 1964). The exact data used for these estimates is not indicated in the report, however it is believed that they were based primarily on subjective observation. Furthermore, the experience of ICE at this time was primarily with urban or small-town distribution and there is reason to believe estimates made on this basis would not be adequate for rural distribution systems.

The estimates developed by these procedures predicted average monthly electricity consumption for residential and commercial users in San Carlos of 80, 86, 92, 98, and 105 KWH in the first five years, respectively. Consumption at the end of ten years was estimated at 150 kWh.

Records available for the first three years of the San Carlos Cooperative show actual average monthly consumptions for the residential and general classification was 62, 74, and 82 kWh, respectively. Consequently, revenue based on estimated energy sales to these consumer classes would have been over-estimated.

While this feasibility study is not examined as an example of poor planning or estimating procedures, it does demonstrate the problems involved in predicting electricity consumption (and revenue) when the significant factors are unknown. It is hoped that one value of this report will be in providing better guidelines of the significant factors in estimating electricity consumption in rural project areas of developing countries.

Anticipated and Actual Appliance Ownership

Tables 47 and 48 present data from limited observations concerning actual and anticipated household appliance ownership for those interviewed in 1968 and actual ownership by the same respondents who were available for re-interview in 1972. Table 49 provides a comparison of actual and anticipated 1968 appliance ownership for respondents who had moved out of the San Carlos area by 1972 and thus were not available for re-interview. Appliance ownership for the re-interviewed and migrated groups may also be examined in relation to previous experience with electricity.

Based on the limited observations indicated in Tables 47 and 48, it can be seen that anticipated purchases of household appliances is somewhat inconsistent in relation to actual ownership by 1972. Regardless of previous experience with electricity, irons were the first appliance purchase anticipated and universally made as demonstrated by actual ownership. (This of course, has been documented in all previous surveys). Electric stoves were also an item which demonstrated apparent close relationship between anticipated and actual ownership by 1972. The reverse situation is revealed in the case of washing machines, where actual ownership did not meet anticipated purchases.

The major difference between those with and without a prior source of electricity occurred with anticipated and actual ownership of electric radios. Battery operated radios were universally utilized by those respondents without previous electricity, while electric radios were slowly replacing battery powered units for the other group. In the case of refrigerators, a difference also existed between the two groups. Those with a prior source of electricity actually purchased more refrigerators than anticipated, while the reverse was true for those without a prior source of electricity. Some of this difference may be explained by the greater number of kerosene operated refrigerators among those with previous electricity and the unanticipated exchange of these refrigerators for electric ones.

It is difficult to draw any definite conclusions based on the data from such a limited number of observations presented in Tables 47 and 48. However, it is interesting to note that the priority of appliance purchases revealed by actual ownership is very similar for both groups. This suggests that while the rate of purchase, i.e., the percentage purchasing, may be higher as a result of previous electric service, the priority or ordering of purchases is similar. This has implications for the initial demand for electricity and the increase in consumption over time in a project area. Continued observations in four or five years may show the level of appliance ownership for those without prior electricity reaching that demonstrated after only four years by those with previous sources of electricity. Such a result would yield an idea as to the time lag in appliance ownership and the significance of electric energy sources before system energization in consumption projections.

Table 47

Summary of Prior and Anticipated (1968), and Actual (1972) Household Appliance Ownership for Those With Some Source of Electricity Prior to Energization of the San Carlos Cooperative Who Were Re-interviewed in 1972[1], Costa Rica

Electric Appliance	1968 Owning	1968 Anticipating Purchase[2]	1968 Owning or Anticipating	1972 Actual Ownership
	Percents			
Transistor Radio	100	0	100	89
Electric Radio	0	21	21	21
Television[3]	21	9	29	71
Iron	78	67	93	100
Refrigerator[4]	21	36	50	78
Stove[5]	0	57	57	50
Washing Machine	36	33	57	36
Beater and/or Blender	42	27	57	57
Light bulbs (Ave. number)	4	--	--	5

1. Maximum number of observations was 14.

2. Percent of those not owning appliance in 1968.

3. Includes use in store where applicable.

4. In three cases, refrigerators operated by kerosene prior to energization were changed for electric by 1972.

5. In three cases, gas or kerosene stoves were changed for electric by 1972.

Table 48

Summary of Anticipated (1968) and Actual (1972) Household Appliance Ownership for Those With No Prior Source of Electricity in San Carlos Who Were Re-interviewed in 1972[1], Costa Rica

Electric Appliance	Anticipating Purchase-1968	Actual Ownership-1972
	Percents	
Electric Radio[2]	0	0
Television	33	50
Iron	83	100
Refrigerator[3]	50	33
Stove[4]	33	33
Washing Machine	33	0
Beater and/or Blender	0	16
Light bulbs (Ave. number)	3	5

1. Based on maximum of six observations.
2. All of the sample respondents reported owning transistor radios in 1968 and 1972.
3. There was one case of a kerosene operated refrigerator in 1968 still being used in 1972.
4. There was one case of a gas stove being purchased since 1968. Another respondent had purchased a hotplate after energization but had sold it by 1972 because its operation was too expensive, according to the respondent.

Another aspect of anticipated versus actual ownership not revealed by Tables 47 and 48 is that individual responses regarding anticipated purchases were more in variance with actual ownership than the average figures. Examination of individual interview schedules revealed that in some cases the anticipated purchase of an appliance by one respondent was not actually made, while actual ownership of the same appliance was revealed by another respondent not previously anticipating purchase.[1] To the extent some consistency exists in this situation, there would be little effect on consumption projections based on average anticipated purchases, but it does indicate the necessity of increasing sample survey size to avoid irregularities and substantial projection errors.

1. This may be peculiar to the San Carlos area, where it was found that relatives had given appliances to members of households in the Cooperative area following energization.

Table 49 provides data for comparing the ownership and anticipated purchase of appliances by previous electric energy experience of those who had left the San Carlos area by 1972 with available respondents of Tables 47 and 48. The objective of such a comparison is to determine if the availability of previous energy sources together with appliance ownership and anticipated purchases reveal any clues as to the relationship between electric energy and out-migration.

Table 49

Summary of Prior and Anticipated (1968) Household Appliance Ownership by Prior Electric Experience for Those in San Carlos Who Had Migrated by 1972[1], Costa Rica

Electric Appliance	With Prior Source of Electricity[2]		Without Prior Source of Electricity[3]	
	Owning	Anticipating Purchase	Owning	Anticipating Purchase
	Percents			
Transistor Radio	100	0	100	0
Electric Radio	0	0	0	0
Television	17	0	0	25
Iron	50	67	0	75
Refrigerator[4]	17	60	0	75
Stove[5]	17	80	0	25
Washing Mach.	0	37	0	50
Beater and/or Blender	0	0	0	0
Light bulbs (Ave. number)	4	-	-	4

1. Those who could not be located for re-interviews or who had died are not included.

2. Maximum of 6 observations.

3. Maximum of 4 observations.

4. One case of kerosene operated refrigerator in 1968.

5. One case of gas stove in 1968.

It is evident from Table 49 that the general level of appliance ownership for those with electricity prior to Cooperative energization was lower for the group who had migrated than for those still in the area in 1972. Only in the case of one stove, did the migrating group show a higher level of appliance ownership than the group remaining as members of the Cooperative. This would suggest that the non-migrant group was more established with better income, permitting them to not only pay the cost of private electricity but also to purchase more of the appliances for its effective utilization.

Along with a lower prior appliance ownership level for the migrated group with previous sources of electricity goes a higher level of anticipated purchases for such items as refrigerators, stoves, and washing machines, in comparison with the corresponding group remaining in the area. This suggests that for the migrating group, their experience with electricity prior to Cooperative energization had been sufficient to give them high expectations as to future applications of electricity as demonstrated through anticipated household appliance purchases. Since these migrants had moved out of the area and were not traced, it is impossible to determine whether these anticipated purchases were actually made, or whether a lack of economic opportunity making the attainment of expectations impossible led the migrants to seek out better conditions elsewhere.

Comparing the migrants and non-migrants with no prior source of electricity in relation to anticipated appliance purchases yields mixed results. For television sets, irons, and stoves, anticipated purchases were higher for non-migrants than migrants (and actual ownership, Table 48, was higher than anticipated purchases for this group), while for refrigerators and washing machines, the migrants had a somewhat higher anticipated purchase level than non-migrants. However, for these appliances it is interesting to note that actual purchase was lower than anticipation for the non-migrants available for re-interview in 1972. Thus there appears to be little relationship between the level of anticipated appliance purchases and the migrating or non-migrating groups with no previous source of electricity.

This examination of anticipated ownership of appliances prior to system energization in San Carlos reveals substantial inconsistencies in relation to actual ownership within the first three years. The discrepancy is greater for larger electricity consuming items such as refrigerators and television sets. Analysis also suggests that those who migrate may over-estimate appliance purchases and that those with stoves and refrigerators operated by kerosene or gas are likely to under-estimate their exchange of these items for electric appliances. This means that careful attention must be given to questions dealing with anticipated appliance purchases where these survey responses are to be used in feasibility studies to estimate future electricity consumption.

Electricity Consumption of Appliances

In addition to analyzing differences between migrants and non-migrants and the effect of previous experience with electricity on anticipated and actual appliance purchases, it was hoped that the relationship between appliance ownership and electricity consumption could be analyzed. Thus, by computing the average consumption of each appliance owned based on previously determined figures for rural households in the United States and comparing this total with average monthly consumption, the applicability of the average appliance figures could be determined for rural areas of a developing country. The ultimate purpose of such a procedure would be to determine the validity of estimating future project electricity consumption based on respondents' actual or anticipated purchases and the average electricity consumption of each appliance.

Again, the limited number of 1968 respondents available for re-interview to determine actual appliance ownership reduces the generalizability of the analysis. However, a comparison was made of consumption estimated in 1968 on the basis of average electricity consumption for each appliance owned or anticipated and actual average monthly consumption obtained from billing records for the seven months of 1969 in which the system had been energized, for 12 respondents. The estimated average monthly consumption for these respondents was 124 kWh compared to actual consumption of 108 kWh. Thus actual consumption for these respondents was 87 percent of estimated electricity use. In five cases estimated consumption over-stated the actual figure, four cases were under-estimated, and in three cases the estimated and actual figures were within 14 percent of each other.

These respondents were in the farmer-merchant occupation classification previously mentioned and had used private sources of electric energy prior to Cooperative energization. Consequently, most of them owned a stock of basic appliances at the time of energization. The major reason for either over or under estimation of electricity consumption of individual respondents was often the purchase or non-purchase of electric stoves, since this single appliance accounts for an average of 100 kWh monthly based on estimates for rural households in the United States.

While computed consumption for the above group resulted in an over-estimate of 13 percent compared to actual electricity use, a similar comparison for only five respondents in the peon-worker occupation classification who had not previously had electricity resulted in an over-estimate of 52 percent. Estimated average monthly consumption based on anticipated appliance purchases for this group was 48 kWh, whereas actual billing records for 1969 showed an average monthly electricity use of 23 kWh. Three cases here were over-estimated, one was under-estimated, and one compared exactly. Again, extreme errors in estimation were attributable primarily to discrepancies between anticipated and actual purchases of major appliances such as stoves and refrigerators. Since average consumption was so low for this group, and the number of cases so small, estimation errors were greatly compounded by these discrepancies.

Combining these two groups for a total of 17 observations resulted in an estimated average monthly electricity consumption of 101 kWh compared to actual consumption of 83 kWh in 1969. This led to an overall estimation error of 18 percent with eight cases over-estimated, five under-estimated, and four close comparisons between the estimated and actual consumption figure.

Another effort was made to test the validity of average electricity consumption by appliances based on United States estimates. In this case, each appliance actually owned by respondents re-interviewed in 1972 was multiplied by the average electricity consumption of that appliance to develop an estimate of average monthly household electricity consumption which could be compared to billing records for 1972. (It was assumed that the appliances had been owned and regularly used throughout 1972, since in most interviews respondents were unable or unwilling to indicate when they had purchased individual appliances).

This procedure utilized nine re-interview respondents in the higher occupation categories who had used electricity prior to Cooperative energization. On the basis of estimated appliance electricity consumption of items owned in 1972 by each respondent, average monthly electricity consumption was 144 kWh. Actual consumption from billing records averaged 200 kWh, indicating use of appliance consumption figures based on United States estimates resulted in an under-estimation of 28 percent for the selected respondents in Costa Rica.

However, the same procedure for five respondents in the lower occupation categories without electricity prior to the Cooperative system resulted in an estimate of 68 kWh average monthly consumption in 1972 compared to the actual consumption of 62 kWh. For this group the United States appliance consumption figures yielded only a nine percent over-estimate between calculated and actual consumption.

Calculations for the two consumer groups resulted then in an under-estimation of 28 percent for one group and an over-estimate of nine percent for the other. This radical difference in estimation error direction and amount does not make the effort fruitless, however. First, we are dealing with actual 1972 appliance ownership and average monthly electricity consumption for both groups. Consequently the data sources can be considered reliable. Second, we are dealing with two distinct consumer groups; a relatively high electricity consuming farmer-merchant occupation group and a low consuming general laborer group.

Examination of estimation errors for each respondent within the respective groups suggests that appliance electric consumption errors resulting from the use of United States calculations are most prominent for such appliances as refrigerators, stoves, and television sets. These are items which use substantial amounts of electricity and are more commonly owned by the higher occupation group. In contrast, United States consumption figures for smaller items such as light bulbs and irons appear to have greater applicability and reliability in the Costa Rican situation. Further testing of these tentative conclusions will be presented based on the saturation surveys in Costa Rica and Colombia.

If these results are upheld through further testing, it suggests that estimated household electricity consumption in rural electrification projects should be calculated separately for at least the two occupation groupings analyzed here. For the low occupation group the 3.5 kWh average monthly figure for light bulbs and 6.5 kWh for irons appears to be reliable. However further testing will be necessary to determine the actual energy use of larger appliances such as stoves, refrigerators, washing machines, and television sets in the rural areas of developing countries.

General Observations

The impact of the San Carlos Rural Electric Cooperative on commercial, farm, and industrial consumers is discussed in the next section. The following are general observations derived from statements of family heads or members re-interviewed from the 1968 survey.

All respondents were in agreement that the Cooperative was doing a good job in providing dependable electric service. Thus from the personnnel and technical standpoints the Cooperative was successfully completing its function to on-line consumers. One remark concerning electric service was, "it is the only thing with which we are satisfied." The convenience of electricity for lighting was the universal benefit expressed. Further reaction tended to be a function of the appliances owned by the respondent.

The primary complaint of those interviewed, especially those in low income occupations, was the high cost of electricity to operate major appliances such as refrigerators and especially stoves. It will be a difficult problem for the Cooperative to overcome. Assuming the regular use of a stove would consume at least 100 kWh per month, this would add approximately ¢30 per month to a base bill for light bulbs, an iron, and some other small appliance. This could represent seven to nine percent of a peon's monthly salary for daily labor. Consequently, it appears to be more than many are willing or able to pay on a regular basis. Some who had purchased stoves have either sold them or are using them only occasionally.

The problem stems from several sources over which the Cooperative has no control; the rate for electricity, which is regulated by the National Electric Service, the inefficiency of low voltage stoves, and family cooking habits. In August, 1972 the three rural electric cooperatives in Costa Rica had joined forces in seeking rate reductions for their consumers from the National Electric Service. The result of this action is not known, but it would appear to require a substantial rate reduction to alleviate the cost problem of operating electric stoves for low income families.

The inefficiency of low voltage stoves means they should probably not be recommended for the heavy demands of constant family cooking. This is also related to the custom of eating beans and rice, foods which require relatively long periods of cooking over low heat. Obviously, little change can be expected in eating habits, but the Cooperative could make an effort (along with appliance dealers) to promote the use of 220-volt stoves. Such stoves would require a higher initial investment by the consumer as well as probably an additional cost for house wiring, two factors which most likely deter their present use. However, substantial economies in monthly bills should be realized in the long-run.

Another area of occasional complaint over electric bills was that a neighbor with the same appliances was supposedly paying less than the respondent. It appears however, that this is largely a false or artificial complaint. First, consumption will vary depending on the actual use of appliances and second, meters are read only to the tens position, so that for a given month there may be some difference between similar households. The difference between 20 and 40 or 40 and 60 kWh per month appears substantial to many low consuming households for a given month, where over the year average consumption will be very close. There was no indication that more than the normal percentage of meters were inaccurate, that meter readers were making errors, or that billing procedures were at fault.

There were virtually no complaints concerning the break-down and repair of electric appliances. This is most likely because the appliances are still quite new. One appliance dealer in Ciudad Quesada had a shop to repair major appliances and smaller items could be repaired in several small shops.

A suggested benefit of rural electrification is its use as an energy source for the development of household industries. This use of electricity has not been exploited in the San Carlos area. One reason perhaps, is that Costa Rica does not have a handicrafts tradition. Secondly, the women of some households indicated there was very little local market for home-produced apparel or other items since most households individually made whatever items they did not purchase from commercially mass produced stocks.

Some women indicated this left few employment opportunities (outside of the coffee harvest) for themselves or their children. Furthermore, children who were educated had to leave the rural communities to find employment other than agricultural labor if there was no family business for them to enter. As indicated in the next section, some small-industry activity was being developed in Pital. This would be one aspect where the Cooperative could take a more active role in investigation, development, and promotion of electric energy utilization.

Some final comments should be made concerning a specific area of the Cooperative distribution system, Buena Vista. The "good view" of the area's name does not apply to economic conditions. It is a small area on the fringe of the Co-op distribution system located in the mountains to the southwest of Ciudad Quesada. It does not have the natural resources found in the foothills and plains of San Carlos.

Buena Vista was noted as a relatively poor area in 1968 and conditions have not as yet changed much following system energization. Small farms have a limited resource base from which to derive income from agricultural activities. A primary source of income to residents of the community is a hacienda engaged in various activities which no longer appear to be prosperous. Farm wages are low compared to other areas of San Carlos and extensive migration was noted through attempts to re-interview 1968 respondents from this area. Electricity consumption was generally low for both household and commercial activities. No significant industrial enterprises were observed in the immediate area. Consequently, the promotion of greater electricity consumption in this area will be dependent on the development of more economic activity.

Supplementary Interviews and Observations

In addition to re-interviewing available respondents from the 1968 survey, Moses conducted interviews with farm, business, and industrial owners, managers, or workers outside the area of the saturation survey. The objective of these interviews was to determine the variety of uses for electricity by a broad spectrum of Cooperative members, to determine the general degree of satisfaction with the electrical distribution system, and where possible, to obtain specific examples of economic or other benefits or disadvantages attributable to the electrification project.

These interviews were conducted as time and transportation resources permitted during August, 1972. Observations in this section are based on interviews with people connected with the following establishments: cooperative milk receiving station, dairy equipment distributor, two haciendas, numerous dairy farms, agro-industrial cooperative, coffee beneficio, a sugar ingenio, six sawmills, three wood-working shops, a vocational-agricultural college, an agricultural extension agent and director, a savings and loan cooperative, a nutrition center (CARE), a government medical clinic, a branch bank, general stores and cantinas, a leather shop, butcher, mechanic, two tailors, a barbershop, and two appliance dealers. The general distribution area of COOPELESCA and the location of some of these establishments is indicated in Figure 17. The following discussion is organized according to the general type of enterprise where interviews were conducted.

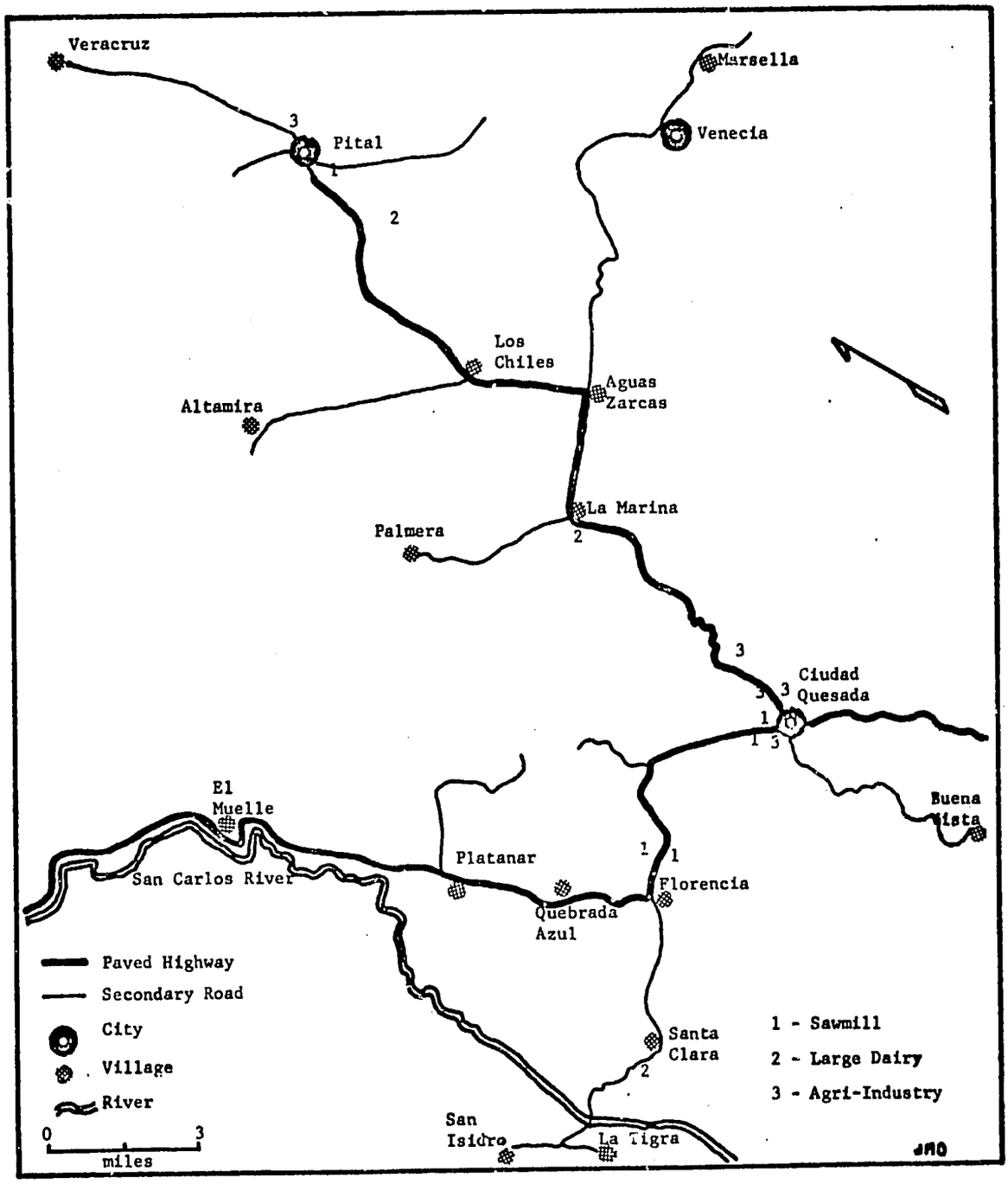
Commercial Establishments

The owners or workers in most retail businesses found it impossible to express results of Co-op electrification in precise economic terms. The majority of these establishments had had electricity prior to the Co-op from their own private plants or those of neighbors.[1] The almost universal comment was that Co-op electricity was a great convenience, more dependable, and did not have the fluctuating voltage of their previous sources. Generally, the out-of-pocket cost of Co-op electricity was higher than what they had previously been paying for other than their own private plants.

1. Most private plants had been sold to cover the cost of shares in the Co-op, to provide power to farms in rural areas beyond the line, or to purchase equipment for business.

Figure 17

Distribution Area of COOPELESCA Showing Supplementary Interview Sites, Costa Rica



Most dance halls, general stores, and cantinas in such urbanized centers as Pital and Venecia had electrical items such as coolers, jukeboxes, blenders, and hotplates used with prior electricity sources. However, Co-op power permitted them to get larger and more modern coolers or freezers and generally those previously using kerosene refrigerators had switched to electric. These large commercial items were commonly purchased in San Jose with credit from the seller.

Night time activities in the two towns did not appear to have changed much since 1968. On week nights most activity closed down by 8:30 p.m., stores opened again about 6:00 a.m. Street lighting was limited (by United States standards). Electricity was not used for external advertising, though with the few stores in such small rural towns there is little need to advertise what everyone knows!

In the more rural areas, a number of new small stores or cantinas had opened since 1968. These owners would probably not previously have been able to afford the investment in private electric plants and thus were pleased to have electricity available for refrigeration and lighting. Most of these places also had television sets which attracted local workers without their own sets. Operators of these establishments did not charge for watching television and in fact seemed somewhat surprised at the question. They felt the business it brought was well worth the cost.

Tailors and barbers in Pital and Venecia also noted the convenience and dependability of Co-op power over previous sources. This was especially true for barbers who had more dependable lighting for evening work and uniform current to power electric clippers. The major advantage to tailors was in ironing. Few indicated they had the need to work much at night except on special occasions and they seemed to find little advantage in electric sewing machines--some with small motors connected to the machines were using the machines manually (though there was no power outage!).

A butcher in Pital indicated that people were accustomed to buying fresh meat every day and consequently he had not changed his pattern of operating and had no cooling facilities. However he did use Co-op power for a meat saw. The idea of storing meat in home refrigerators and purchasing meat from coolers at the butcher shop has not been adopted in these rural/urban areas.

The owner of a shoe repair and saddle shop in Pital felt investment in equipment and cost of electricity did not justify the installation of electrical equipment in his shop. His only business use of electricity was for lighting and all other work continued to be done by hand.

A mechanic in the same town however, felt electricity was the salvation of his business. While complaining about the availability of credit, he had a full complement of drills, grinder, welders, etc., and indicated that business had greatly increased because of the heavy work he could now perform which had previously gone to Ciudad Quesada or elsewhere. He also indicated the availability of electricity had prompted two other people to go into the mechanical repair business. In this case, of course, there would be a net business loss for Ciudad Quesada, but a major saving in time and transportation cost could accrue to the owners of farm machinery and trucks.

In this day of increasing pollution awareness, it was interesting to note a number of people commenting on the reduction in noise with the removal of private electric plants. One plant still chugging away at a bakery in Pital was a noisy exception. It is doubtful that this business will become a electricity consumer however since it faces strong competition with bakery products brought in from Venecia and San Jose.

A better market location and availability of a dependable supply of electricity were the principal reasons the owner-operator of a wood-working shop moved from Chachagua to Florencia. In his former location, he was paying about ¢95 per month for electricity from a private source. He had considered moving his business to Ciudad Quesada, but felt that the irregularity in the power supply there would be detrimental to efficient operation. His shop was equipped with a wide variety of hand and stationary power tools used in the manufacture of truck bodies, wagons, and other wood articles. The owner worked with one assistant but was not planning to expand the business since he had no sons to carry on when he retired.

One obvious economic benefit of rural electrification is the increased sales such projects bring to appliance dealers. In San Carlos, the major dealers are located in Ciudad Quesada with one having a branch office in Pital. Small items such as light bulbs and irons are also sold in general stores throughout the area. Only one new appliance dealer was observed to have begun business in Ciudad Quesada since 1968 and furniture was also sold in this store.

The major dealers of course noted substantial increases in sales of appliances following energization of the Cooperative system. Some remarked that this greater volume of business allowed them to lower prices and meet or beat the prices of dealers in San Jose. A wide choice of brand name stoves, refrigerators, television sets and other appliances was available in these stores. Some are completely imported and others assembled in Costa Rica. A high tariff on imported appliances supposedly encourages the manufacture or assembly of items in Costa Rica. However, until electrification is greatly expanded throughout the country, the national market is probably too small to permit efficient domestic production of the type and variety of appliances available through international markets. In this respect, high tariffs may discourage the purchase of better quality and more efficient stoves and refrigerators. The most popular stoves sold were 110 volt units (assembled in Costa Rica), and 11 cubic foot model refrigerators. (As mentioned elsewhere, the use of inefficient stoves was one of the major consumer complaints registered by the survey).

Dealers indicated 90 percent of major appliance sales were made on credit. Credit was usually extended for a period of 24 months on major appliances with terms up to 36 months in a few cases. The common terms appeared to be one percent of the purchase price per month of credit. Thus, an item costing ¢2,000 on terms of 10 months would result in credit charges of ¢200. The dealers indicated they had no unusual problems with payment defaults as a result of sales to rural residents. (During an interview, one consumer indicated the amount he was paying each month for a refrigerator but could not state how long these payments

were to be made. It appears consumer knowledge of credit arrangements is typically poor and might be one area in which the Cooperative could provide information). When asked how consumers with marginal incomes met their monthly payments, one dealer indicated they would sell a few extra stems of bananas or other produce. This could not be definitely confirmed, but if true would suggest that electrification stimulates productive endeavors by consumers.

Advertising of electrical appliances was common on national television by dealers in San Jose and the Meseta Central. However those in Ciudad Quesada indicated they spent very little on regional advertising, relying more on word-of-mouth by satisfied customers. Dealers as well as consumers indicated door-to-door sales techniques were not practiced.

Agricultural

The most common productive use of electricity in agricultural activities in the San Carlos area was in the dairy industry. As with commercial establishment owners, many farmers had previously had their own diesel generators and they indicated Co-op power was more dependable and much more convenient. While these farmers could not or were not willing to place a dollar (colon) figure on the advantage of Co-op power, they did indicate the sources from which economic advantage derived.

Principal among these were the high cost, inconvenience, and unreliability of diesel units. At least one milking a day was done very early in the morning and the convenience of simply flipping a switch rather than checking and starting a diesel unit was a definite stated advantage of Co-op power. The immediate availability of electricity and dependability of the source for lighting was also noted as an advantage in the event of an illness or injury to a valuable cow.

More direct economic benefits to dairy farmers were realized through the use of cooling facilities powered by Co-op energy. In this case, reliable and steady power permitted the rapid and continued cooling of milk, such that a given volume of production graded higher at the milk receiving station and thus brought higher returns to producers. Farmers interviewed did not keep sufficient records to indicate previous loss of revenue through low quality milk, but they were readily aware of this economic advantage. One farmer indicated contamination sometimes occurred when using private electric plants. This contamination, which caused low quality milk, occasionally resulted when a worker had not cleaned his hands sufficiently between handling diesel fuel containers and returning to milking.

The private electric plants of these farm operators had generally been sold or moved to other farms beyond the distribution lines. Income received from these plants had been used to purchase shares in the Co-op in some cases, while others had used the money to increase their herds.

Much of the dairy industry in San Carlos was situated on the rolling slopes above the San Carlos plains. Consequently, water for livestock and the cleaning of dairy barns was obtained through gravity flow from numerous streams and there was little need for water pumps. Small diesel or gas motors were still quire common for powering forage choppers, but farmers indicated that when these motors needed extensive repairs they would replace them with electric motors.

When questioned about the possibility of installing electric milking machines, some farmers were skeptical while others felt such a possibility was in the near future. A few were already experimenting with portable electric milkers and an article in a newspaper during the interview period proudly announced the first installation of a completely "modern" electric milking parlor in another area of Costa Rica.[1]

Skepticism concerning the use of electric milkers arose from the fear that the machines would in some way damage the cows. However, other farmers indicated that it was becoming increasingly difficult to employ good dairy workers. They indicated that the every day work involved in milking was not popular with younger workers in light of the many holidays and fiestas. Secondly, intoxicated workers sometimes abused or injured valuable cows.

With these problems, some farm operators indicated that mechanization might be the only solution. Some also pointed out the savings in labor costs with the use of electric milkers. One operation with 120 cows cut labor requirements from eight to six milkers with one portable electric unit. (This farm previously had its own hydro plant which was still being used to supply power to a forage chopper and to light on-farm quarters for workers). Those who had installed the portable machines or who were planning to set up a system, indicated that present employees were not likely to be displaced, but moved to other farm activities. The future result however could be a reduction in the need for dairy farm workers.

The dairy industry in San Carlos is still primarily a land-extensive operation. However the agricultural experiment station is actively involved in promoting new and cheaper fencing techniques, improved grasses, and pasture rotation systems which will permit increased production per manzana of land. The availability of electricity will permit the marketing of increasing production at the highest quality standards.

One large dairy operation generated its own power by a hydro plant which was only about eight years old. The owner indicated this plant would be used until maintenance, repair costs, and energy demands of the operation made it profitable to join the Cooperative system.

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1. The estimated cost of equipment and installation was ¢350,000. Production of the farm was 3,000 bottles per day.

While using their own plant to operate a sawmill, central dairy, machine shop, and general lighting, some 30 workers living on the farm received and paid for electricity from the Cooperative. Because of the limited capacity of the farm's plant, these workers had previously only been permitted to use electricity for lighting, while under the Cooperative, electric use was of course limited only by their ability to purchase appliances.

Workers living on this farm were permitted to cultivate plots of unused land and the owner stated he felt these plots were worked more intensively by the people to enable them to raise and sell products providing cash for the purchase of appliances. Family members could also earn supplementary income by picking c ee in the area harvest.

This farm was presently milking nearly 500 cows and increasing their herd five to seven percent a year. Production was estimated at 6,500 bottles per day and was achieved with 27 dairymen employed at ¢120 per week. Because of the expansiveness of the farm, milking was done in field stations and the milk transported to a central point for cooling.

Plans were being developed however to utilize portable electric milkers with use of Cooperative power at the field locations. It was estimated this would reduce the labor needed for actual milking to ten men who would be paid somewhat more than the current wage rate. Under this system, cooling tanks would be used at each location, thus reducing handling of the milk and possible contamination, improving quality standards and hence farm income. An investment of ¢20,000 was estimated to develop this system in each field location.

Another large farm of over 2,000 manzanas had replaced their 16 horsepower diesel electric plant and another smaller generator with power from the Cooperative to operate a sawmill, mechanic shop, and dairy operation. In addition some 1,300 beef cattle were maintained on the farm.

Current dairy production averaged 3,000 bottles per day from 230 cows handled by 14 workers in a central barn. However the owner felt Cooperative power would enable him to increase the herd to 300 cows which would be milked in a modern dairy operation requiring an estimated investment of over ¢30,000. The mechanized operation would reduce his labor requirements from the present 14 workers to four or six who would be paid somewhat more than the ¢100 per week wage he presently paid. Along with the dairy operation, the owner was planning to build a feed milling operation on the farm for the dairy and beef cattle operation. He stated the investment for the dairy operation was expected to pay for itself in five years.

A milking machine equipment distributor in San Jose stated he felt 30 or more cows were needed in a dairy operation for the efficient use of electric milkers. He also indicated a saving in labor of 75 to 80 percent could be realized with the machines. This was somewhat more optimistic than that estimated in the previous examples.

The distributor indicated stable and dependable central station electricity was essential for the installation of modern electric dairy equipment since 220 volts were needed to run the equipment with no more than a ten percent variation in voltage. He felt few small generating units could be depended upon to operate the equipment. While this firm had no major promotional program, they had received free publicity through national press attendance at the inauguration of a modern dairy "parlor" operation near San Jose. The firm installed and maintained dairy equipment and provided training for dairy workers. Benefits of the system as stated by the distributor included less damage to cows, higher milk quality, better working conditions for labor, and greater efficiency.

Examination of the use of electricity in the San Carlos dairy industry also included a conversation with the manager of a cooperative milk receiving station located on the outskirts of Ciudad Quesada. This plant had begun operation in 1969 to coincide with energization of the rural electric system and according to the manager probably would have been impossible without central station power.

This cooperative had 96 members (not all active at the time) in the San Carlos area and in August, 1972 was receiving about 48,000 bottles of milk per day.[1] Maximum production in 1971 was 55,000 bottles and this was expected to increase to 60,000 in 1972 during the peak season of January or February. Dairy farmers were required to invest ¢125 per bottle of daily estimated production sent to the plant. Minimum production for membership was 60 bottles, with half the shares to be purchased in cash.

Farmers were paid for milk according to grade standards involving purity and fat content. Payment per bottle according to grade was: Excellent, ¢0.75; A, ¢0.65; B, ¢0.55; C, ¢0.45. Each producer's milk was graded everyday upon receipt at the station. Thus, there was substantial economic incentive for quality milk.

It should be noted this was the only milk cooperative active throughout Costa Rica. The primary market was in the Meseta Central since most people in Ciudad Quesada and probably other out-lying areas considered the pasteurized milk too expensive for everyday consumption. Crude milk was more common in the San Carlos area. However at the time of the survey another milk cooperative was being formed on a national scale and competition for farmers and consumers was developing. This would be another factor stimulating efficient dairy operations and the adoption of electrical equipment on dairy farms.

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1. Production of dairy farmers interviewed for this survey accounted for slightly over 25 percent of this average total.

A practice of the milk cooperative which might be followed by the rural electric cooperative was that of conducting educational seminars. A seminar conducted during the survey period and reported in the national press included such topics as achieving quality milk standards, avoiding mastitis in cows, and proper accounting procedures. These sessions were led by agricultural extension personnel and other experts. In addition to educational activities, the milk cooperative provides feed concentrates and veterinary supplies to members from the warehouse at the receiving station. This bulk purchasing provides a saving to members and encourages the adoption of good dairy herd nutrition practices for higher quality and greater production.

Despite a plentiful supply of electric energy, the milk receiving station is not likely to become involved in milk processing. At present the station receives, tests, cools, and holds milk for tank truck delivery to San Jose, a tortuous truck trip of four and one-half hours mostly over narrow mountain roads. Future processing activities might be developed near Zarcero, another important dairy production area an hour closer to the Meseta Central along the road from Ciudad Quesada.

The level of infrastructure development, specifically roads, is also an immediate factor curtailing efficient milk collection operations by the dairy cooperative. While the cooperative is promoting the use of bulk cooling tanks on farms for reasons of quality standards, they do not expect to initiate tank truck pickup at individual farms until the road system is improved. Despite initial investments of up to ¢8,000 for the larger cooling tanks, economy would be realized from bulk storage since individual cans cost ¢200 each and are subject to loss, damage, and contamination.[1]

Industrial

The major industrial activities served by the San Carlos Rural Electric Cooperative involve the processing of raw agricultural products such as sugar and coffee, and exploitation of timber resources. Time and transportation facilities did not permit extensive or exhaustive discussions with representatives of these industries, but observations were obtained concerning the use of electric energy in some industrial activities.

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1. Supplemental information concerning the dairy industry in Costa Rica and San Carlos may be obtained from: Ralph A. Eastwood, Economics of the Dairy Industry in Costa Rica, University of Florida Report prepared for US AID Mission to Costa Rica, September, 1969.

Because it is still a developing area, San Carlos offers ample opportunity for the exploitation of forest resources. Interviews were conducted with operators or workers in six commercial sawmills in the area serviced by the Cooperative. Production and operating data varied widely as indicated in Table 50, suggesting errors in the data provided or gross inefficiency in some operations.

Table 50

Production and Operating Data for Sawmills Surveyed in San Carlos

Item	Sawmills Surveyed 1	2	3	4	5	6
Production (inches/day)	2,400	4,500	8,000	14,000	--	8,000
Operating Hours per week	44	44	40	70	80	44
Number workers	14	10	10	21	--	14
Head Rig Motor (horsepower)	60	75	60	--	60	60

Two of these mills began operation following Cooperative energization. However, one of them began with their own hydroelectric plant dispite the availability of Co-op power and did not switch until their own plant broke down. The owner of this operation was not available for questioning as to why the investment in a private generator was originally made.

For some reason, sawmill operators seemed to be the most insecure regarding the use of Co-op power. A mill located near Ciudad Quesada utilized power from the private source supplying the city for half its operation and Co-op power for the other half. For the private source, a flat rate of ¢1,108 was paid per month, while the Co-op rate was based on a demand charge and kilowatt-hour consumption. The operator indicated that an average of five to ten hours were lost each month because of outages from the private plant while similar problems had not occurred with the Co-op. Evidently the owner felt private power was cheaper as long as he had the dependable Co-op energy to avoid production delays. A close examination of his demand charges might not prove the economies of this arrangement, especially if the inefficiences caused by unexpected outages from the private source were considered.

Another operator continued to maintain his previously used diesel motor because of a fear that Co-op power would fail and leave him without energy while worker salaries and business taxes would continue. This fear was largely unfounded since in three years he admitted there had been only occasional outages and he had generally been notified that these would be for short periods due to system construction or maintenance.

The normal procedure for these sawmills was to purchase logs from independent contractors, thus they did not have to maintain their own sawyers. This created competition between the mills in San Carlos as well as other areas. Most of the mills had a large supply of logs to permit year-round operation, but in two cases operators indicated problems of getting logs out of the forest during the rainy season forced them to reduce operating hours of the mills. Expansion of the operations surveyed was not expected due to the age of the owner, lack of log supply, or insecurity as to governmental policies toward taxes and conservation. However, a new sawmill which would utilize Co-op power was under construction along the road from Florencia to Ciudad Quesada.

While indicating Co-op power was a great convenience, the operators or managers of the sawmills could not provide an estimate of the economic benefit of Co-op energy in relation to other sources. Maximum utilization of electricity was not observed in any of the mills, probably due to lack of technical knowledge, investment capital, or the age of the business. Because of similar functions, all mills had basically the same equipment operated by diesel or electric motors: one or two head rigs (band or circular), winches, planer, saw sharpner, board saw, and one had equipment to produce tongue and goove and round stock. The sophistication of equipment varied widely.

The economies of central station electricity in sawmill operations stem from several sources. First, the initial investment for a 60 hp electric motor (including switches) to operate the head rig was about one-half that of a comparable diesel unit. Some of this difference would be balanced initially by the required purchase of electric Co-op shares in the industrial classification. Secondly, operating and maintenance costs of electric motors would be lower than for diesel units. Dependable electric energy would encourage more efficient operation and reduce production losses due to breakdowns and repairs of diesel motors. In addition, the adequate supply of electricity would permit the use of any number of individual motors for equipment and thus avoid the hazards of numerous belts and pulleys operating off one diesel motor. Thus the sources and direction of economic benefits of electric energy compared to diesel motors in sawmill operations is quite obvious. However, if sufficient water power is available a closer examination of the comparative advantage of electricity from central sources would have to be made.

Employment and utilization of labor in the sawmills surveyed has not been measurably affected by the adoption of Co-op electricity. It is doubtful the mills will become much more automated than at present and without the economies of scale the labor situation is not likely to change in the near future.

Several coffee and sugar processing operations exist in the San Carlos area serviced by the electric cooperative. These industries were not closely examined, but conversations with Co-op personnel and others indicated some of the problems these industries created for the Cooperative.

Since coffee and sugar are long established industries in San Carlos, individual processors have made substantial investments in private power systems. Most of these systems utilize water power with supplementary or backup diesel units. Some of these plants have undoubtedly depreciated out and thus provide very low-cost electricity, making investment in Co-op shares and payment of demand charges uneconomic until maintenance and repair costs reach substantial levels. Other operations with somewhat newer equipment will take even longer to fully utilize Co-op power. Sugar mills have the advantage of burning the pulp by-product for steam generation of electricity. (Several people stated the quantity of bagasse was not sufficient to stimulate complementary industries, in addition to the limited market for products which might be manufactured).

Corporate sugar mills cultivated extensive land holdings as well as purchasing cane from private growers. The processing plants operated under a national quota system, producing sugar for the domestic market and export. One owner stated his plant was in operation five to six months a year.

Coffee processing in San Carlos was likewise a seasonal operation extending up to seven months. At least two mills processed coffee through the roasting stage, while several other firms received, washed, and removed bean hulls before sending the coffee on to further processing at central locations. The manager of one of these coffee receiving depots stated electricity had been generated by a 56 hp. diesel motor before Cooperative energization at a cost of ¢0.10 per kWh. He indicated they were now paying ¢0.22 to ¢0.25 per kWh for Co-op power in addition to an average monthly demand charge of ¢612. However, it is doubtful his own figures were based on proper accounting procedures and no indication was given as to why the owners continued with Co-op power considering the stated cost differential.

It is relevant to point out that complaints over "high" demand charges, with a minimum charge even when plants were not operating, was common to most industrial operators surveyed. (The Cartago Municipal system reported on in the following section did not impose a demand charge, though it is not known how common this practice was throughout Costa Rica).

The problem of demand charges and high actual or potential electricity consuming seasonal industries puts any central station supplier of energy in a difficult position. This is further complicated in the San Carlos situation by the practice of using Co-op power as a backup in the event of failure of private plants during crucial periods. Such practices result in low load-factors for the Co-op and fluctuations in revenues. In addition, problems over industrial charges and connections have reportedly created political and management conflicts for the Cooperative.

Two means of alleviating these problems can be suggested. First, clear policies concerning connection and charges for industries desiring to use central station power on other than a continual basis should be developed during project planning. Secondly, the central station supplier could conduct individual or industry studies of the costs of central station energy compared to private sources in order to educate industry management and avoid, where applicable, conflicts over "excessive" charges. On the first point, it is not clear that firm policies have been established for the San Carlos Cooperative regarding industrial connections (although tariff rates are set by the National Electric Service). Thirdly, the Co-op at present has neither the time or personnel to conduct economic studies of power use.

Many of the problems created by on-going industries will not affect a new agro-industrial cooperative being established in the San Carlos area. The manager of this cooperative indicated they now have 660 members in the area and have constructed a coffee processing plant outside of Ciudad Quesada for exclusive use of members. At the same complex, storage facilities have been built for grain, fertilizer, and insecticides for distribution to members. A cement block factory also is in operation there. Plans are being made for construction of a sugar mill in the future and a general merchandizing center for members to be located in Ciudad Quesada. Currently the cooperative is exporting bananas to the United States at the rate of 2,000 cartons per week.

Capitalized from member contributions and the national bank, this cooperative could have a substantial impact in the area, especially if it actively pursues educational activities and production and quality standards similar to those mentioned in relation to the dairy cooperative. The rural electric cooperative has had at least an indirect effect on this agro-industrial cooperative by virtue of eliminating the substantial investment that would have been necessary to develop private power sources for the many activities planned and built. Despite the availability of potential water power at the coffee mill site, the industrial cooperative estimated it would be cheaper to connect to the rural electric cooperative.

On a considerably smaller scale, two other industrial activities were developing in the San Carlos area. Processing of yuca for export to the United States was being planned in the communities of Pital and San Francisco de La Palmera and, also in Pital, a small furniture

manufacturing operation had been initiated since 1968. The rural electric cooperative was not responsible for these developments, nor was it substantially involved in their promotion. However, the mere availability of unlimited and dependable electricity facilitated the development of the enterprises without the substantial investments in private power sources.

In Pital, members of the local savings and loan cooperative have received a loan from the national credit union office to construct a yuca processing plant. The plant will initially be operated by management personnel from a yuca exporting firm located in San Jose. This firm has found markets for yuca in the United States based on Latin American immigrants.

Processing activities will involve washing, peeling, slicing, and packaging of the yuca in plastic bags and then larger cartons. These will be transported to San Jose in refrigerated trucks. Previous attempts to ship yuca without cooling resulted in losses of 20 to 25 percent. The plant will initially hire 20 to 25 employees (mostly women) and much of the work will be hand labor. Initial production is expected to run 150 quintales (one quintal = 100 pounds) per day, five days per week.

If the trial runs prove successful, the cooperative may construct its own cooling facilities, use more mechanical equipment, and drill a well for its own water supply. Yields of yuca are not as high in the area as they might be, but with the addition of technological inputs and better production practices yields should approach 400 quintales per manzana. To obtain these goals will require the cooperation of agricultural extension service personnel or other experts.

The economic impact of this plant should be widespread. Besides employing women and others with marginal or no employment possibilities, demand for the raw product should provide income to the many small farmers who can profitably raise yuca on limited plots of land.

During the inauguration of Co-op electric service to the community of San Francisco de La Palmera, several individuals mentioned the possibility of developing a yuca processing plant in that community along the lines outlined above. Yields in this area were reported to be 600 quintales per manzana, though insect and other production problems mentioned indicated the need for technical assistance. How soon plans for the processing plant will develop is uncertain since it appeared the level of organization and planning did not approach that in Pital. This suggests the role which could be played by an electric use specialist for the rural electric cooperative.

A merchant in Pital who was noted to be very progressively oriented during the 1968 survey has started a small furniture manufacturing business. Prior to the electric co-op he had owned a generator to service his home, retail business, and movie theater. However in 1968 the plant was in a poor state of repair and he was

waiting for co-op electricity. By 1972 he and his wife had become the branch outlet for an appliance dealer in Ciudad Quesada and had discontinued the movie theater to use the space for the furniture enterprise (which he felt was a more profitable business). He estimated gross furniture sales were averaging ¢3,500 per month from the production of family members and one man and his helper employed part-time in the evening. He expected to employ additional help as the business expanded in the converted movie theater. Local wood was used for framing while some upholstery materials were obtained in San Jose and others imported from Nicaragua. Credit was received from the national bank to purchase such electrical equipment as a sander, band saw, lathe, drills, compressor for painting, etc. His previous generator could not have supported the load for all of this equipment and to have installed a plant sufficient to meet initial and anticipated needs would have required considerably more than the ¢1,600 in total Co-op shares purchased for both business and residential electric use. Furthermore, operating costs of an alternative diesel unit would have been far above the ¢100 per month for Co-op power (based on average consumption of 400 kWh per month).

Interestingly enough, even this small family business was affected by international economic and political factors. In September, 1972, problems between Costa Rica and other members of the Central American Common Market developed. The situation was too complicated to report here, but restrictions on the formerly free-trade of various goods between member countries was a threatened and distinct possibility. In Pital, this situation introduced an element of uncertainty as to the availability and price of imported materials for a small businessman struggling to develop a furniture manufacturing operation. This minor example demonstrates the complexities of predicting industrial development following rural electrification projects.

Pital was also the location of a second small furniture manufacturing operation. This shop was funded by the national educational system to produce furniture for schools throughout the country. Desks, chairs, and cabinets were made from local woods by one man and his assistant in a spacious but dusty shed equipped with a variety of power tools. It was stated that the town's educational committee had bid for the shop based on the availability of Co-op electricity. While there was a school in Pital, no efforts were being made to offer wood-working instruction in this shop. The economic impact of the enterprise appeared to be small because of the limited employment and production and would accrue primarily to one man, some of the sawmills, and a few transporters of the finished product.

Miscellaneous

The impact of rural electrification projects supposedly extends to infrastructure or social institutions in addition to individual, commercial, farm and business groups. To obtain observations in this area, interviews were conducted at a nutrition center, government clinic, technical school, and agricultural extension office.

A nutrition center sponsored by CARE opened December, 1970, in Pital, across the street from a government medical clinic. This center serves milk and other food primarily to pre-kindergarten children. Forty to 45 children were served per day during August, 1972. The center was equipped with an electric stove, refrigerator, and 12 light bulbs and was being operated in the mornings by two young girls. In this case, if electricity had not been available from the Cooperative, it would have been provided by a nearby sawmill.

Prior to the electric Co-op the medical clinic had received free electricity from the neighboring sawmill. Typical of most private sources it was not completely dependable. The clinic provides general medical services to an average of 96 people per week in Pital and area, but patients must go to Ciudad Quesada for major operations. Conditions and services have not greatly changed because of the 24-hour electricity. Equipment includes an autoclave-sterilizer, fan, refrigerator, and lighting. The attendant receives free housing and electricity from the government. He felt the major benefit of electricity in community homes would be through the replacement of firewood by electric stoves and for lighting. He stated this would result in less dirt and insects in the homes making food preparation and handling more sanitary and thereby reducing illness.

The director of a vocational-agricultural college in Santa Clara indicated the major advantage of Cooperative electricity stemmed from their ability to expand the school and fully equip various shop instructional areas without investing more funds in their previously constructed and over-loaded hydro system. Because of the location of the school on the plains and consequent lack of water head, further private energy would have to have come from diesel units. This boarding school provided technical agricultural education to some 300 students from Costa Rica and other Central American countries. The first class of 49 students was to graduate in December, 1972. Electricity was used in dormitories, classrooms, offices, and farm activities, including a modern dairy plant which was being constructed.

Discussion with the Regional Agricultural Extension Chief and an extension agent revealed that office had no specific rural electrification promotion or assistance program. The service was responsible for an area larger than that covered by the electric cooperative distribution system and the chief indicated the area was too large and time, funds, and personnel too limited to provide special services related to electrification. He felt that such functions could more easily be handled through the educational activities of interest groups such as the dairy and cattlemens associations.

Programs being conducted by the regional center included efforts to increase pork production through the use of concentrates to reduce the need for imports; encouragement of small scale family chicken production; and programs in pasture fertilization and rotation to increase beef and dairy production.

These men reported occasional shortages of agricultural workers for contract work (clearing land, harvesting coffee), but an adequate supply of full-time labor. They did not expect technological changes to displace many workers and indicated there was plenty of room in the local economy to absorb any that might be displaced.

One agent confirmed the observation noted during interviews that the cost of electricity had forced some people to discontinue the use of such appliances as refrigerators and stoves. He indicated these people had sold livestock or farm products in order to purchase the appliances and then had to sell the items or keep them for only occasional use when they could not afford the monthly electricity payments.

A home economist had also spent time and effort in developing a brochure concerning the household use of electricity. This was never printed because of a lack of funds from the extension service and electric Co-op and additional conflicts which were not fully explained.

Summary and Conclusions

Having presented individual enterprise and industry examples of the uses and benefits of Cooperative electricity, it remains to summarize these findings in relation to their economic impact and effect on employment and personal income.

The primary advantage of electricity, from a technical standpoint, derives from its use as a stationary source of energy for permanent equipment installations. The major economic benefit of central station electricity is its cost compared to obtaining energy from private diesel or hydro plants.[1] In addition, economic benefits result from productive functions performed by central station electricity that cannot be provided by an alternative energy source.

In San Carlos, the major economic advantage of electricity from the Rural Electric Cooperative for commercial, farm, and industrial users has been the cost of that source compared to the fixed and operating cost of private generators. Examples of this comparative economic advantage can be seen in Table 51.

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1. The possibility of wind or thermal energy sources has not been investigated for the areas considered in this report.

The cost of operating private generators was estimated for plants in existence prior to system energization. These plants were used for lighting and to operate commercial coolers or refrigerators, blenders, jukeboxes, and other electrical apparatus found in general stores and cantinas. In the one case noted, the private plant was used only for household purposes of several related families on a large hacienda. The cost of electricity was computed from the rate schedule and average electricity consumption for the first seven months of system energization.

Table 51

Comparative Costs of Electricity Supplied by Private Diesel Generators and the San Carlos Rural Electric Cooperative[1]

Item	Private Generator Capacity 1kw	6kw	8kw	13kw[2]
Motor and Generator				
Purchase Date	1961	1950	1963	1962
Original Cost - ¢	4,800	10,000	10,500	16,000
Hours Used/Month	120	150	300	240
Fuel Cost/Month - ¢	39	86	95	53
Total Cost/Month - ¢	138	182	236	247
Replacement with Co-op Electricity				
kWh/Month, 1969	840	140	204	31
Total Cost/Month - ¢[3]	202	53	65	18

1. Cost figures in this table should not be compared directly for reasons outlined in the text.
2. Plant which served the families of several brothers on a large hacienda.
3. This figure includes interest that could be earned by alternative investment of shares in the Rural Electric Cooperative.

It is felt the economic benefit of Cooperative electricity indicated in Table 51 is conservative, i.e., the comparative economic advantage of Cooperative electricity is probably greater than that shown. This results from differences in appliance ownership and use with private plants compared to Co-op electricity. An exact comparison of costs would require the same usage of the same appliances with both the private generator and Co-op energy. By comparing the cost of private generation immediately prior to energization with the cost of Cooperative energy for the initial seven-month period, this cost comparison was most accurately approximated. However, where new appliances were added following system energization or previously owned appliances were used more intensively, the cost of Cooperative power would be over-stated and thus the comparison would result in conservative economic benefits attributable to central station electricity.

With the smaller private generators, it was not uncommon for respondents to indicate they could not use all the electric appliances they owned at one time without overloading the system. With Cooperative energy, however, there was no limit to the supply of power for normal demands, assuming that proper transformers were available and internal wiring was adequate.

In the case of the one kilowatt capacity generator, the average cost of ¢202 per month for Cooperative electricity was greater than private generation costs of ¢138 per month. However, this respondent had installed a much larger cooler and other appliances immediately following energization which he could not have operated with his previous system. In the other cases, new appliance purchases were not made until sometime after Co-op energization. From this comparative cost base the economic benefit of Co-op electricity increases to the extent differences in cost of larger private generators diverge from the cost of Co-op power.

For dairy farmers, no precise data on the cost of operating private generators for milk cooling purposes were available for the period immediately prior to system energization. Most of these units had been sold by 1972. Many of these units had been utilized to provide electricity for productive purposes in the dairy operation and for the operation of appliances and lighting in the farmer's homes, making it difficult to compute the cost for productive purposes only. However, farmers indicated Co-op electricity was much more convenient and the more economically minded individuals considered it cheaper than their private plants. It is reasonable to assume that actual economic benefits from a comparative standpoint were on the order of those presented for commercial enterprises.

The comparative economic benefit of central station electricity to the large sugar and coffee mills was limited. This is due to the fact that these mills could produce energy for seasonal needs more cheaply from private hydro sources for which investments had been made in the past. Because of minimum demand charges these operations were not willing to wholly use Co-op power until such time as their own systems required extensive repairs, maintenance, or construction for expansion. These enterprises were benefiting from economies of scale and the harnessing of water power for energy production--factors which generally did not apply to smaller commercial or dairy operations.

It is expected however, that economic benefits of central station electricity will accrue to these enterprises in the future when the cost of Co-op electricity will have a comparative advantage to the replacement or expansion of existing systems. In addition to operating cost savings of large electric motors, their initial cost is approximately one-half that of comparable diesel units.

Besides comparative cost benefits, increased productivity of dairy farms was attributable to the availability of Cooperative energy. This was due to the use of cooling equipment which permitted the marketing of higher quality milk and less contamination and spoilage at the farm level. This increased returns to milk producers. Productivity gains and some reduction in labor costs was beginning to be realized with the introduction of electric milking equipment which most private generators could not have operated.

On the larger dairy farms, the availability of electricity in fields bordering roads and the distribution system, meant milking operations could be conducted at various locations without investments in multiple generators. This could encourage more effective pasture utilization since cows would not have to be brought to a central point for milking. The milk at these decentralized locations could also be cooled and handled more efficiently without loss or spoilage.

Dairy farmers further noted that money received from the sale of private generators had been used for productive investments in their dairy operations or to purchase shares in the Co-op. This also could contribute to increased productivity.

Commercial respondents generally did not indicate increased productivity in the form of increased sales following system energization. In areas with relatively low incomes the ability of consumers to increase consumption is also low. The consumer is not interested in whether his cold soda or beer comes from a cooler operated by kerosene or a private generator. However, if the malfunction of these energy sources does not enable him to purchase cold refreshments he will go to the competition. It is this factor together with the reduced loss of perishable goods which increases the economic advantage of Cooperative electricity to the commercial operator.

In more rural areas, Co-op electricity has permitted the development of marginal businesses which are able to provide cold refreshments and entertainment using Co-op electricity where they previously could not have afforded to begin operation because of the necessary investment in private generation facilities. Thus it has enabled to a limited extent the development of small-scale entrepreneurs. These operators indicated the availability of television in their store attracted the business of those who could not afford their own sets. Furthermore, it aided sales of items where expenditures might previously have been made in the urbanized areas.

An easily over-looked benefit of central station electricity stems from its affect on investment by commercial, farm, or industry operators. Because of the relatively unlimited availability of central station electricity, it helps to smooth out the investment of risk capital. The furniture maker in Pital provides perhaps the best example. Starting on a modest scale with limited equipment, the Co-op enables him to meet his energy needs as the business expands without the substantial initial investment in a private generator sufficient for estimated future needs, which might then have to be replaced by still larger generating facilities. With co-op power he avoids the "lumpy" investment problem while continuing to meet his energy demands. If such an enterprise fails, monthly electric bills are reduced accordingly and he is not saddled with an investment in a private generator which he might have to sell at a loss. Similarly for any enterprise, the availability of central station electricity would permit them to experiment with electrical equipment and if it should not prove profitable they could dispose of the equipment without having committed themselves to the substantial expansion of private energy sources.

It can definitely be stated then that electricity from the San Carlos Rural Electric Cooperative provides economic benefits to commercial and dairy farm enterprises. The primary benefit lies in the cost of electricity compared to private generation facilities based on diesel units. Secondary benefits result from greater efficiency, increased productivity, and enterprise expansion potential. For major industrial users in San Carlos these same benefits will be realized in the future when existing hydro plants become obsolete.

Employment

Because central station electricity has been used primarily to replace alternative generation facilities in commercial establishments, farms, and industry, it has not led to any appreciable displacement of labor in San Carlos to date. (Operation and maintenance of private generators was conducted by owners or labor employed for other duties). In existing commercial and industrial enterprises, this situation is not likely to change much in the future. However on dairy farms, there will be a slight reduction in the demand for unskilled labor as electric equipment replaces hand milking. This will require fewer but more skilled dairy workers who will be paid more than general labor. Workers presently employed on dairy farms are not likely to be displaced, but will be transferred to other jobs on the farms.

Central station electricity has not yet been effectively utilized to create substantial new employment. A small furniture manufacturing operation and planned yuca processing plants were two examples of the creation of new employment opportunities for people in the San Carlos area. Construction of a new sawmill may in part be attributable to the availability of Cooperative power. The cooperative milk receiving station and a new coffee beneficio provide a few jobs, but non-traditional, labor intensive activities have not developed around the available power supply.

Income

The lack of household industries utilizing available electricity has not increased the income of individual households. Without alternative employment opportunities, whatever household labor is saved by the use of electric appliances cannot be profitably exploited except perhaps during the coffee harvest. Skilled dairy farm workers, or those who can be trained, will receive increased wages as the dairy industry modernizes. If two planned yuca processing plants materialize, the income of numerous small farmers could be increased. Development of additional processing activities such as this could do much to increase income to all sizes of agricultural enterprises. Of course, the Cooperative itself has provided employment and income to numerous local inhabitants.

Other Benefits

Less obvious benefits of rural electrification to the region and nation may also be noted through commercial, industrial, and farm use of electricity. While the impact on the nation of a small area such as San Carlos may be negligible, nevertheless the displacement of private diesel generators should reduce however slightly the importation of fuel oils. Secondly, the increased productivity of the dairy industry attributable to rural electrification can assist in improving the nutritional standards of people in Costa Rica and may result in some increase in trade from the exportation of dairy products. Finally, in this day of pollution awareness, the chugging of private diesel generators has nearly been eliminated.

Cartago Municipal Electric Distribution System

The 1971 report of the National Electric Institute (ICE) of Costa Rica indicated there were only two private firms involved in the distribution of electricity, neither of which appeared to serve substantial numbers of rural consumers. ICE itself is primarily concerned with the generation and transmission of electrical power rather than distribution. However, the report listed a number of municipalities involved in the distribution of electric energy. Observation during the preliminary site visit for this project indicated that some of these municipalities distributed electricity to rural as well as urban areas.

To meet the objective of analyzing alternative distributional institutions, it was proposed that one of these municipally operated systems be investigated in relation to their rural operations. While not intended to involve the in-depth study of the San Carlos survey, such analysis would serve to yield observations regarding the feasibility of distributing electricity to rural areas by other than a cooperative or state-owned distribution system. This section will present a brief discussion of the area served by one such municipal system in Costa Rica, the Junta Administrativa del Servicio Electrico-Municipal de Cartago (JASEC), an outline of the administrative structure of the municipal agency, and observations regarding consumer power use and promotional activities of JASEC.[1]

Description of the Cartago Area

The city of Cartago is situated in the Meseta Central about 14 miles from San Jose. The population of the Central Canton of the Province of Cartago was estimated to be 57,950 in January, 1970. Its area is 143 kms^2. Of historical interest, Cartago was founded in 1563 and served as the national capital until the early 19th centrury when it lost this distinction to San Jose in a factional political struggle.

Today, Cartago serves as a major urban market and distribution center for the agricultural products of surrounding farms. Farm enterprises include the intensive cultivation of vegetable crops, fruit crops, cabuya, coffee, and livestock and dairy products. The 1963 Census of Agriculture reported a higher percentage of farms utilizing technological imputs such as irrigation, fertilizer, and chemical pest control in Cartago than in San Carlos. At this time also, some five percent of farms in the Central Canton of Cartago had electricity either from private plants or external sources, while this was true for only two percent of the farms reporting in San Carlos.

Thus, in contrast to the more recently settled rural areas of San Carlos, Cartago is an area with a long history of settlement, with major consumer markets in the urban populations of the city itself and the capital, San Jose.

Administrative Structure and Operations

Policy decisions for JASEC are made by a three-man Board of Directors, two of whose members are from the municipality while one is appointed by ICE. Daily operations of the system are supervised by an administrator and technical director (engineer). This system has been in effect for six years following withdrawal of ICE as the distributional institution.

Approximately two-thirds of the Cartago system's 12,000 electric consumers are located in the urban area. Of interest to this study were the operations pertaining to those outside the urban quadrangle. This group of consumers includes both rural farms and residences along the roads followed by distribution lines, as well as the numerous small towns surrounding Cartago.

No summary data were readily available concerning the relative costs of urban versus rural construction and maintenance. However, the various means by which rural extensions are financed was outlined. Theoretically, a group of rural consumers desiring an extension of the distribution system had to put up 70 percent of the cost after an initial study had determined the feasibility of the project. Following completion of

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1. While it would have been ideal, it was not possible to find a rural area served by a municipal agency comparable in major respects to the San Carlos Rural Electric Cooperative area.

the extension, monthly consumer billings would include a charge for electricity consumed as well as a charge to cover JASEC's contribution to construction costs. Under this system, responsibility and initiative for raising the 70 percent of project costs was left to the interested group or committee. It was stated that this generally resulted in individuals contributing according to their ability to pay and their interest in seeing the project completed. The prorating of contributions was determined and handled at the local group or community level.

While such a procedure provided formal guidelines for construction of rural extensions, in practice another method of paying for line extensions was often employed. When a group wanting line extensions was politically active or had an influential representative in the legislature, money could be obtained from national development funds to pay for electric line construction, with possibly only a minimal contribution from people in the affected areas.

Nevertheless available national development funds and private contributions are not sufficient to meet the demand for rural extensions in the Cartago area, even though it was indicated that the system was capable of faster expansion, given the availability of construction funds. While it appears some surplus funds are available from the sale of electricity in the high density urban areas, the policy has been established that this money should not be used to subsidize rural line extensions.

In addition to its own funds, JASEC has obtained a loan through ICE of five million colones from the Central American Development Bank to improve the urban distribution system. Such funds from international organizations are dependent on the ability of ICE to obtain loans and supervise their allocation.

Rural lines are most commonly constructed using steel or concrete poles. Materials are obtained from national or international suppliers and on occasion the system has received donated materials (plus transportation costs) from cooperating electric distribution systems in the United States.

Besides whatever contribution to construction costs they make, rural consumers pay 15 colones (less than two dollars) for a meter and an initial guarantee payment based on estimated monthly electric consumption. Consumers are classified for rate purposes as residential, commercial, or industrial. However, unlike the cooperative system, no purchase of shares is required for any type of user. Also distinctive with the JASEC system is the fact that no demand charge is made for industrial users. This has been done to encourage industrial development in the Cartago area. In the non-urban areas of the system, sawmills and dairies are the principal productive users of electricity, besides general commercial establishments.

On the basis of an average price of 15.07 centavos ($0.018) per kWh sold in 1971, the cost to residential consumers of JASEC is nearly one-half that for San Carlos Cooperative members. This low rate is at least partly due to the fact that JASEC generates more than three-fourths of its power from its own hydro-electric facilities near Cartago and purchases the remainder from ICE.

Another stated cost-reducing factor was the use of a private firm to handle the system's billing. Billing was carried out on a monthly basis and consumers could make payments at local banks.

Promotional Activities and Electric Use

It appeared that the primary concern of JASEC management was to meet construction and maintenance demands of the system. Little emphasis was given to public relations activities or power use promotion. No retailing of appliances was conducted by JASEC, though of course a variety of appliances was readily available in the stores of Cartago or nearby San Jose.

Since JASEC is not a cooperative, no annual meetings of consumers or their representatives is required or sought. Little contact appeared to take place between consumers and management beyond the initial developments regarding line extensions and the normal contact of maintenance staffs or meter readers. No newsletters, magazines, or other printed materials were distributed to consumers on a regular basis. However, JASEC had recently developed and distributed a brochure to all consumers concerning the efficient use of electric appliances and household safety procedures.

The JASEC system as a whole has experienced over a ten percent annual increase in electric consumption since 1969. Average monthly electric consumption for those within the Cartago urban area is approximately 250 kWh. Those in the rural areas and small towns have an average monthly consumption close to 150 kWh. Table 52 provides further data concerning electricity consumption in selected distribution zones for the billing period 21 June to 20 July, 1972.

As can be seen from Table 52, in general, areas with a larger number of consumers showed a higher average monthly electricity consumption. Furthermore, all but one of the areas served by JASEC showed a higher monthly average consumption than the average for the San Carlos Cooperative, which was 53 kWh per month in 1971.

In the General (Commercial) classification there were a total of 1,322 consumers in the JASEC system in this period with an average consumption of 403 kWh. The Industrial classification included a total of 175 consumers averaging 1,425 kWh. Of these 104 were within the urban area, with an average of 935 kWh consumed for the billing period.

Table 52

Number of Consumers and Average Electricity Consumption for Selected Areas of Cartago Municipal Electric Distribution System, June-July, 1972

Areas	Number of Consumers	Average kWh per Consumer
Cartago (urban)	4,305	249
Rural Areas and Towns		
Paso Ancho	22	87
Tierra Blanca	228	83
Dulce Nombre	222	110
Caballo Blanco	166	112
Cot	162	116
Boqueron	13	71
Paraiso	1,104	155
Tobosi	44	57
Barrancas	30	67
Tablon	52	42
La Flor	44	104

SOURCE: Calculated from monthly billing summary of JASEC.

Evaluation

Differing characteristics of the areas of operation of the San Carlos Cooperative and the Cartago Municipal system make a line by line comparison virtually meaningless. Where the Cooperative deals with a relatively low density, mostly rural population in a still developing agricultural area four hours by road from the major domestic market, the Cartago system serves primarily an urban or small town class of consumer in an area of historical development virtually in the center of the major urban market of the Meseta Central.

Nevertheless, observations may be made regarding the ability of such municipal systems to handle loans for rural line extensions and a comparison made of consumer relations and power use or promotional activities.

In Costa Rica, the National Electric Service controls the rate structure for both rural electric cooperatives and municipal distribution systems. Likewise, both types of distributional institutions are controlled or supervised by ICE in regard to managerial and technical operations. Under such a system, international loans to either type of distributor would probably be channeled through a competent and responsible supervisory institution. Consequently, loan security would be the responsibility of more than merely a local distributor of electricity.

At present, the municipal systems in Costa Rica properly place primary emphasis on serving the high-density urban areas, with secondary consideration given to rural line extensions as funds and material resources become available for expanded construction activities. If greater emphasis were given to municipal distribution systems as the vehicle for rural line extensions, than some regulations would probably be desirable to assure the proper representation of rural consumers on boards of directors. It would also seem expedient to develop specific guidelines for the priorities under which rural extensions would be made.

Policies would also have to be developed regarding the contributions for construction to be made by rural members desiring electricity, the possibility of differential rate structures between urban and rural consumers, and the question of the proper allocation of surplus funds arising from relatively high-density, high-use urban areas. The latter problem involves primarily the question of whether urban consumers should subsidize rural distribution through the allocation of surplus funds generated by revenues over and above expenditures in urban areas. These are all serious questions which should be resolved before consideration is given to financing rural construction through municipal systems.

Of course the Costa Rican municipal system should not be considered the "best" or only system for rural electric distribution. In many areas where electric service is requested by a group of potential consumers, no substantial urban area may exist to provide a stable base of management or electric consumption revenues. In such cases, an alternative institution such as a cooperative may be highly desirable.

A final point concerning the comparison of cooperative versus municipal systems for rural electric distribution may be made from observations in Costa Rica. An assumed benefit of the cooperative arrangement is the involvement of member-consumers in the rural electric project and the development of community leadership which may result in further community development activities based on the successful completion of the electrification project. Furthermore it has been suggested that the closer ties between management and consumers involved in the cooperative action and the educational and promotional activities of a cooperative will lead to increasing member knowledge of the uses and benefits of electricity and ultimately increased power consumption.

While it must be remembered that the San Carlos Cooperative is only five years old, most of the suggested institutional benefits from this system of rural electric distribution do not appear to have taken place. Perhaps of greater concern, the structure for educational and promotional activities has not yet been developed. With the tremendous effort involved in completing initial construction, maintaining the system, and meeting the demand for additional extensions, little consideration has been given to concerns that are seen as being of lesser importance or peripheral. Consequently, in these respects, there is little to differentiate the cooperative from the municipal distribution system; yet this has provided one of the primary arguments in favor of the cooperative form of electric distribution.

CHAPTER IV

COLOMBIA

Host Country Support

The Corporacion Regional Autonoma del Cauca (Autonomous Regional Corporation of Cauca) (CVC) is a state-owned electric generation and distribution system operating in the Department of Valle del Cauca. Mr. Alfredo Roa, a CVC employee, was most helpful, especially, in procuring interviewers. A conference room in the CVC building was made available for interviewer training and the CVC placed vehicles and chauffeurs at the disposal of the interviewing team. Furthermore, Mr. Roa was a valuable consultant on the selection of the study site and the revision of the interview schedule to adapt it to local usages and conditions.

Some Characteristics of the Study Area

The area being studied is situated in the Cauca River valley near the large industrial and commercial center of Cali. The Cauca River separates two of the three major ranges of the Andes mountains in Colombia. The river has created a wide, flat valley, which is the site of some of the major agricultural development in South America. This development has been greatly stimulated by the efforts of CVC, an organization patterned after the Tennessee Valley Authority which has developed water resources, including the generation and distribution of electricity, in the river valley and surrounding mountainous areas.

The portion of the river valley near Cali has been inhabited by the Spanish and their descendants for roughly four centuries. Although the land has been extensively farmed for an equal length of time, major agricultural production did not take place until the latter part of the previous century when the owners of the huge sugar cane plantation Manuelita introduced steam-powered machinery in their sugar refinery. Since then the valley has blossomed into a major site of agricultural production. Sugar cane, grown and processed into sugar, candies, and alcohol largely on immense sugar plantations, leads the agricultural production. Following in importance are coffee, cotton, soybeans, rice, corn, beans, and fruits and vegetables. Also of considerable importance to the life of the valley are the pastoral activities of raising beef cattle and dairy herds.

Not only are the rich alluvial soils conducive to agricultural production but so are the climatic conditions. The temperature is temperate, perhaps even warm, being on an average between 23°C and 24°C. Although the region is currently experiencing a severe drought, the annual average rainfall has been 938.0 mm. occurring during 100 days a year.[1]

Nestled in the center of the agricultural sector of the valley is the municipio (county-like entity) and city of Palmira, some 30 kilometers east and across the valley from the city of Cali. The new construction in the urban center of Palmira reflects the industrial and agri-business function of the city. The agricultural strength of the area also is clearly seen in a tour of the farmers' market.

Some 15 kilometers northwest from the center of Palmira, but still part of the municipio, is the corregimiento (township-like entity) and town of Rozo. The area around the town of Rozo is that studied (See Figure 2, a map of the area). The town itself houses a church on the triangular central plaza, a small farmers' market, and wide array of stores, repair shops, and small businesses and offices. Also located near the center of town are several schools, a public health center, and an office of accion comunal (a community development organization). The town is the trade center and point of departure for those traveling to Palmira and Cali for the entire area chosen for this study.

The area near the town is an aggregation of small and moderate sized farms housing a dense population surrounded by huge modernized haciendas and ingenios. This phenomenon came into being both in the 1930's when a General Castro parcelled out his large landholdings and more recently as the late owner of the Hacienda Paso Ancho sold plots of land to his farm laborers. Apparently either expressly or inadvertently, the land near Rozo has been sub-divided and sold in small plots to workers to maintain a stable farm labor force in close proximity to the labor intensive haciendas.

The entire area being studied is labeled as Rozo for convenience. In reality, it also encompasses the corregimientos of La Torre and La Acequia and the Inspecciones de Policia (inspector of police areas) of Mata Palos and Amaime. For ease of communication, unless a specific portion is being referred to by name, the more generic term of Rozo is used.

The nucleated portion of Rozo in reality fades into La Torre along one road and into La Acequia along a second road. La Acequia in turn blends into Amaime. Mata Palos is the only separate completely definable entity. When radiating out from the center of Rozo, one is hard put to determine with precision when he has left the urbanized area and entered the rural confines. Similarly, one cannot tell when he has left Rozo and entered La Torre. This is because the houses clustered along the main roads resemble a line village settlement pattern rather than a dispersed farmstead pattern.

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1. Miguel Camacho Perea, 1962:14. This book is a magnificent treatment of the history and socio-economic conditions of the Valle del Cauca. Many of the facts included in this section are drawn from it.

The area of Rozo, La Torre, and La Acequia resembles an isosceles triangle bordered by roads. On each side of these roads is found one row of houses beyond which are fields. Leading into the center of the triangle, and in certain portions away from the center, are rural lanes called callejones. Beyond the houses along the principal roads on the inside part of the triangle are houses fronting on the callejones. Beyond the fields of the houses on the outside boundary of the triangle are the fields of the large haciendas. These large landholdings were not included in the major survey area; however, owners and administrators of these places were singled out for special intensive surveys.

The entire area around Rozo is flat, and because of the drought, dusty. The main roads are straight and wide, and because they are only gravel, produce vast clouds of throat-clogging dust. The town of Rozo has electricity, water, sewage, and telephone service. Some of these services have been extended into the surrounding countryside. Electric lines parallel the main roads and are being extended along some of the callejones. Water is piped into many of the rural homes along the principal roads from water systems located in Rozo, La Torre, and La Acequia. A major sewage system is currently being constructed in the area. Although there are primary schools in each of the communities, the only secondary schools are in Rozo. Health services are available on a thrice weekly basis in Rozo. Because of the nearness to Palmira, emergency medical attention can be readily obtained there.

Selection of the Study Area

The selection of the Colombia study area was strongly influenced by both criteria established for and accomplishments of the Costa Rican portion of the project. Once certain objectives were realized in Costa Rica, it was imperative to satisfy other objectives in the Colombia phase of the project. Secondly, in order to have valid inter-country comparisons of the findings, it was essential to select areas which were compatible according to certain criteria.

The major emphasis of this investigation in Costa Rica was directed to the examination of an area serviced by a cooperative distribution system. Consequently in Colombia, the focus needed to be directed to either a state or privately owned distribution system. The short time since energization of the Costa Rica study area placed certain limitations on the amount and type of electric use. It was therefore decided to attempt to observe electric use patterns in an area energized for a longer period of time, at least five years.

The area of San Carlos selected for the study was rural, with farms of a wide range of sizes on which were produced a multitude of different crops and types of livestock. Residents of the nucleated towns were excluded from the study population. In order to obtain comparable data, it was felt necessary to find in Colombia an area having these same characteristics. The following characteristics, then were sought in the prospective area for study in Colombia: 1) It must be serviced by either a state or privately owned distribution system. 2) It must have been electrified for at least five, and preferably ten or more, years.

3) It had to contain a substantial population of both users and non-users of electricity living in contiguous rural as opposed to small town, areas. 4) Ideally it should be an area of intensive agricultural production in which several different types of crops were grown, as opposed to a monoculture such as coffee, on farms of varying sizes.

The selection of the study area was a process carried out in close collaboration with members of the economic studies and engineering sections of CVC. Of special assistance was Mr. Alfredo Roa, a trained sociologist and agricultural economist, working in the economic studies division.

Because of assurances of assistance to our project extended by members of the staff of CVC, it was decided to conduct the study in the region serviced by that organization. This decision eliminated the other three areas in the nation which had been considered. These areas were those close to Medellin, Bogota, and Tibu in the Department of Norte de Santander. Because of peculiarities of each of these regions, it had already been determined that substantial difficulties might have been encountered in obtaining sufficient data.

There were three areas served by CVC which on first consideration appeared to meet the necessary requirements. The Sevilla-Caicedonia region was eliminated because although the energy used is generated by a governmentally owned entity, it is distributed by a cooperative system. (This zone, however, has been singled out for special attention in the section dealing with re-interviews of respondents previously studied by Ross.) Because of the relatively small size of the rural electrified population, the sector around Versalles was also rejected. The remaining prospective zone was that in and adjacent to the municipio of Palmira.

Accompanied by Roa and another member of the CVC staff who had worked in the area, we reconnoitered not only Palmira but als Candelaria and La Florida. After having seen several alternate zones, the area around Rozo was chosen. It met all of the criteria previously stated. The one criterion which was not completely filled to our satisfaction was that relating to farms of various sizes. In Rozo there are basically only two sizes of places: very large and small. Nevertheless, it was thought that the small farms were of sufficient size to support use of electricity for agricultural production. The larger places would serve to be isolated for intensive interviews conducted by Moses.

Two additional positive considerations encouraged the selection of Rozo as a study area. Because of the clustering of the houses along the main roads and callejones, surveying in the area would be tactically facilitated. Secondly, because of the proximity of Rozo to Cali, the interviewers could be returned each night to their own homes. This would eliminate costly per diem expenditures.

Selection of the Research Population

Once the specific area of Rozo was selected, procedures identical to those established in Costa Rica were followed. That is to say that all of the houses within the line of sight of principal roads and callejones were surveyed. Approximately half of these were users, with the remainder being non-users of electricity. (Rather than discuss again these procedures, the reader is referred to the Selection of the Research Population in Chapter 3).

Demographic Characteristics

A total of 443 households are included in the survey research conducted in Colombia. A household is defined as consisting of all persons living in one dwelling regardless of ties of kinships or marriage. In some tables the total number of households shown is less than 443 because of non-responses.

Age of Head of Household

Data on the age of household heads was gathered for 430 respondents. This is a relatively old population (Table 53). Only 29.3 percent are under forty years of age, while 55.8 percent are fifty years old or older. Table 53 also presents data on age of head by the users categories. No important differences are revealed. Not only is the age distribution of USERS, INACCESSIBLES and NON-ADOPTERS similar, but their median age likewise is similar being 47.1, 50.3, and 47.0, respectively. Given the small differences in the medians, inaccuracies in age reporting and some missing cases, these findings are not meaningful, and it is reasonable to state that heads of households falling into the several user categories are essentially similar with regard to age.

Education of Head of Household

Data on the last year of school completed by household heads is presented in Table 54. Respondents who did not answer the question were included with those reporting no education, since the data indicated that these were probably trying to hide the fact that they had had no schooling. If any error is introduced, it is conservative in that schooling would be under-reported. One quarter (25.7 percent) of the heads either reported no education or did not answer the question. Another 30.7 percent reported only one or two years of schooling. Together this group can be viewed as functionally illiterate, and accounts for 55.4 percent of the total. Only 10.8 percent of the population had had five or more years of schooling. USERS as compared to INACCESSIBLES and NON-ADOPTERS are better educated (Table 54). The median number of years of schooling completed by USERS, 2.7, is substantially higher than the median for INACCESSIBLES and NON-ADOPTERS, which are very similar, 1.7 and 1.5, respectively. Furthermore, the proportion of USERS increases with educational attainment, from 44.7 percent among those household heads having one year of schooling or less to 80.0 percent

Table 53

Row Percentages and Numbers of Respondents in Categories of Age of the Head of the Household (AGE HEAD) and Median Age by Users Variable, Colombia

Users Categories	AGE HEAD Categories (Age in Years) 1 (less than 30)	2 (30-39)	3 (40-49)	4 (50-59)	5 (60+)	TOTAL	Median
USERS	60.5 (23)	56.8 (50)	47.7 (51)	53.9 (55)	47.4 (45)	52.1 (224)	47.1
INACCESSIBLES	15.8 (6)	19.3 (17)	22.4 (24)	25.5 (26)	26.3 (25)	22.0 (98)	50.3
NON-ADOPTERS	23.7 (9)	23.9 (21)	29.9 (32)	20.6 (21)	26.3 (25)	25.1 (108)	47.0
TOTAL	100.0 (38)	100.0 (88)	100.0 (107)	100.0 (102)	100.0 (95)	100.0 (430)	48.3

Table 54

Row Percentages and Numbers of Respondents in Categories of Education of the Head of the Household (ED HEAD) by Users Variable and Median Year of Schooling, Colombia

Users Categories	ED HEAD Categories (Years of Education) 1 (none, no information)	2 (1-2)	3 (3-4)	4 (5-6)	5 (7+)	TOTAL	Median
USERS	44.7 (51)	44.1 (60)	60.7 (88)	73.7 (28)	80.0 (8)	53.0 (235)	2.7
INACCESSIBLES	24.6 (28)	26.5 (36)	00.0 (29)	13.2 (5)	00.0 (0)	22.1 (98)	1.7
NON-ADOPTERS	30.7 (35)	29.4 (40)	19.3 (28)	13.2 (5)	20.0 (2)	24.8 (110)	1.5
TOTAL	100.0 (114)	100.0 (136)	100.0 (145)	100.0 (38)	100.0 (10)	100.0 (443)	2.1

of those having 7 or more years of schooling. The contrast between USERS and others is also revealed by a comparison of the proportion in each users category having completed three or more years of schooling. Fifty-two and eight-tenths percent of the USERS fall into this category, while only 34.7 percent of the INACCESSIBLES and 31.8 percent of the NON-ADOPTERS do so. It is evident, therefore, that electricity use is positively associated with educational attainment.

Occupation

The area of the Cauca Valley studied is dominated by sugar cane production. Small landholdings coexist with the large sugar estates. The small landholdings virtually without exception grow a variety of crops for household consumption and for sale. Sixty-eight and one-tenth percent of the population was classified as being either farm laborers, farm operators or farm administrators. The remainder fell into the categories of merchant, teacher, unemployed or other. Since this area is close to Palmira and Cali, two large cities, most teachers commute and only one was found residing in the study area.

Occupation is cross-tabulated by the users variable in Table 56. Smaller proportions of USERS are farm laborers than is the case either with INACCESSIBLES or NON-ADOPTERS. However, farm operators appear in approximately equal proportions among the three categories of the users variable. There is a sharp difference for merchants, almost all of whom are to be found among users of electricity. The adoption rates or the proportion of USERS to the total of those within reach of electricity lines is shown in Table 55.

Table 55

Percent of Users of Electricity of Those Within Reach of Electrical Lines by Occupational Categories, Colombia[1]

Occupation	Percent Adopting
Merchants	91.7
Farm Operators	69.3
Farm Laborers	59.3
Farm Administrators	57.1
Unemployed	78.9
Other	70.7

1. Based on data in the following table for USERS and NON-ADOPTERS.

Table 56

Row Percentages and Numbers of Respondents in Occupational Categories by Users Variable, Colombia

Users Categories	Occupational Categories							
	Farm Laborers	Farm Operators	Farm Administrators	Teachers	Merchants	Unemployed	Other	Total
USERS	29.8 (70)	29.8 (70)	1.7 (4)	0.4 (1)	9.4 (22)	6.4 (15)	22.5 (53)	100.0 (235)
INACCESSIBLES	48.0 (47)	25.5 (25)	3.1 (3)	0.0 (0)	1.0 (1)	6.1 (6)	16.3 (16)	100.0 (98)
NON-ADOPTERS	43.7 (48)	28.2 (31)	2.7 (3)	0.0 (0)	1.8 (2)	3.6 (4)	20.0 (22)	100.0 (110)
TOTAL	37.3 (165)	28.5 (126)	2.3 (10)	0.2 (1)	5.6 (25)	5.6 (25)	20.5 (91)	100.0 (443)

Twenty-two out of 24 merchants in the electrified zone had connected. The benefits of electricity for this occupational category are obvious. Farm administrators generally live in housing provided them by their employers and have little say over whether or not the house is electrified. This is also true, of course, of those farm laborers who live in housing supplied them by their employers. A higher proportion of farm operators are electrified than is true of farm laborers or farm administrators. The unemployed, whose occupations are unknown, have an unexpectedly high adoption rate of 78.9 percent. This is, in part, the consequence of a concentration of pensioners found in the area.

In-Migration

The study area has been settled and cultivated for centuries. New lands are not available and the cost of land is high. Consequently, population increase has lead to substantial out-migration over the years. This fact is reflected in the high mean ages of heads of households discussed earlier, since most out-migration is of young persons.

The place of birth of the heads of households interviewed is presented in Table 57. Only 10.9 percent were born outside of the departamento (state) in which they are residing. Only 38.9 percent were born outside of the municipio (county) in which they reside. More than half were born, and probably lived most of their lives, in the same district. They were, therefore, overwhelmingly born in rural areas. There is little variation in place of birth according to use or non-use of electricity.

When migration is viewed in terms of place of previous residence (Table 58), even smaller proportions are classified as migrants. Only 19.0 percent had had their last place of residence outside of the Department of Valle. The principal difference among user categories is in the higher proportion of INACCESSIBLES who had had their previous place of residence in the same district (77.6 percent), and the lower proportion of INACCESSIBLES who had had their previous place of residence elsewhere in the same municipio.

The length of time that the family has occupied their present home provides insight into the migration patterns of the population (See Figure 18). Two phenomena are immediately apparent: nearly half of the respondents have lived in the same house for at least a decade and there is little variation according to the various categories of the users variable.

As has been shown in this analysis, this population is one characterized by people who by and large have lived in the same area in which they were born, probably for most, if not all, of their lives and have lived in the same house for long periods of time. It is a remarkably stable population. There are no important differences in regard to the migration patterns between USERS, INACCESSIBLES, and NON-ADOPTERS.

Table 57

Percentages and Numbers According to Place of Birth of Heads of Households by Users Variable, Colombia

Users Categories	Place of Birth 1 (same district)	2 (elsewhere in same municipio)	3 (other Department of Valle del Cauca)	4 (other Colombia)	TOTAL
USERS	52.6 (122)	6.0 (14)	29.3 (68)	12.1 (28)	100.0 (232)
INACCESSIBLES	56.7 (55)	8.2 (8)	22.7 (22)	12.4 (12)	100.0 (97)
NON-ADOPTERS	49.1 (54)	13.6 (15)	30.0 (33)	7.3 (8)	100.0 (110)
TOTAL	52.6 (231)	8.5 (37)	28.0 (123)	10.9 (48)	100.0 (439)

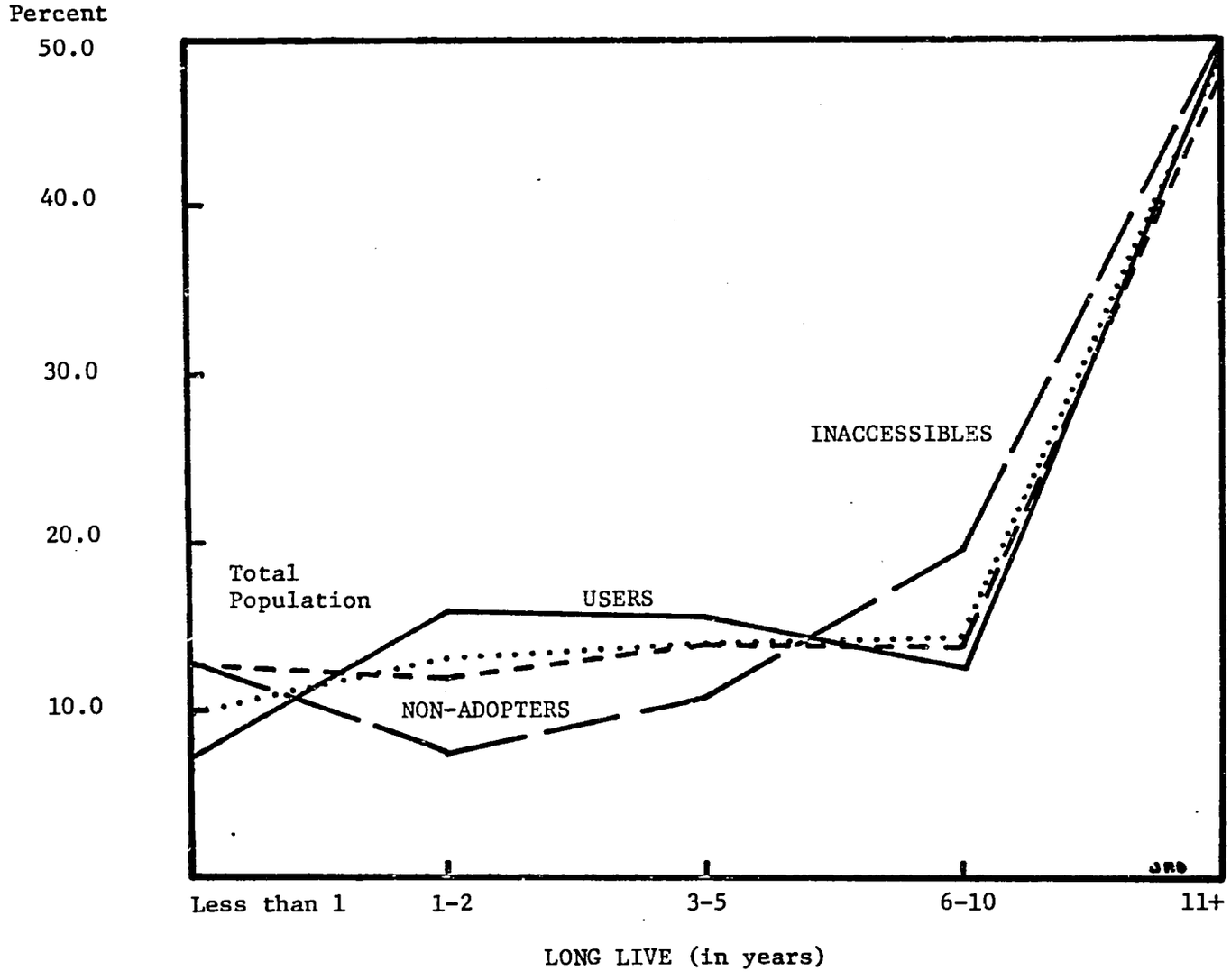
Table 58

Percentages and Numbers According to Previous Place of Residence of Heads of Households by Users Variable, Colombia

Users Categories	Previous Place of Residence 1 (same district)	2 (elsewhere in same municipio)	3 (other Department of Valle del Cauca)	4 (other, Colombia)	TOTAL
USERS	68.5 (140)	12.8 (26)	16.7 (34)	2.0 (4)	100.0 (204)
INACCESSIBLES	77.6 (66)	3.6 (3)	18.8 (18)	0.0 (1)	100.0 (95)
NON-ADOPTERS	64.2 (61)	15.8 (15)	18.9 (18)	1.1 (1)	100.0 (95)
TOTAL	69.5 (267)	11.5 (44)	17.7 (68)	1.3 (5)	100.0 (384)

Figure 18

Percentage of Total Population, USERS, INACCESSIBLES, and NON-ADOPTERS by Length of Residence in Present House (LONG LIVE), Colombia



Level of Living

The number of cases in each category of level of living is shown in Table 59. The total mean score is 3.808. Each category contains at least one-tenth of the households. Table 59 presents the level of living scale cross-tabulated with the electricity users variable. The Chi square level of significance for the distribution is less than 0.001, indicating the probability that this distribution occurred by chance is virtually nil. Kendall's Tau_c, a measure of the strength of association, is high, 0.5345. It also has a 0.001 level of significance. These measures and an inspection of the table reveal a strong positive association between electricity use and the level of living. The distribution of each of the classes of the users variable according to their level of living classification is shown graphically in Figure 19.

Both Figure 19 and Table 59 reveal a similarity between NON-ADOPTERS and INACCESSIBLES and a divergent trend for USERS. The line for USERS (Figure 19) rises steeply with the level of living, that for INACCESSIBLES drops. The proportion of NON-ADOPTERS increases between classes 1 and 3 of LEVEL but then drops precipitously matching the line for INACCESSIBLES. Of the 235 USERS, 194, or 82.6 percent fall into the upper half of LEVEL, while the corresponding percentages for INACCESSIBLES and NON-ADOPTERS are 27.6 and 27.3. There are no USERS in the lowest level of living class, but this class contains 24.5 percent of the INACCESSIBLES and 20.0 percent of the NON-ADOPTERS.

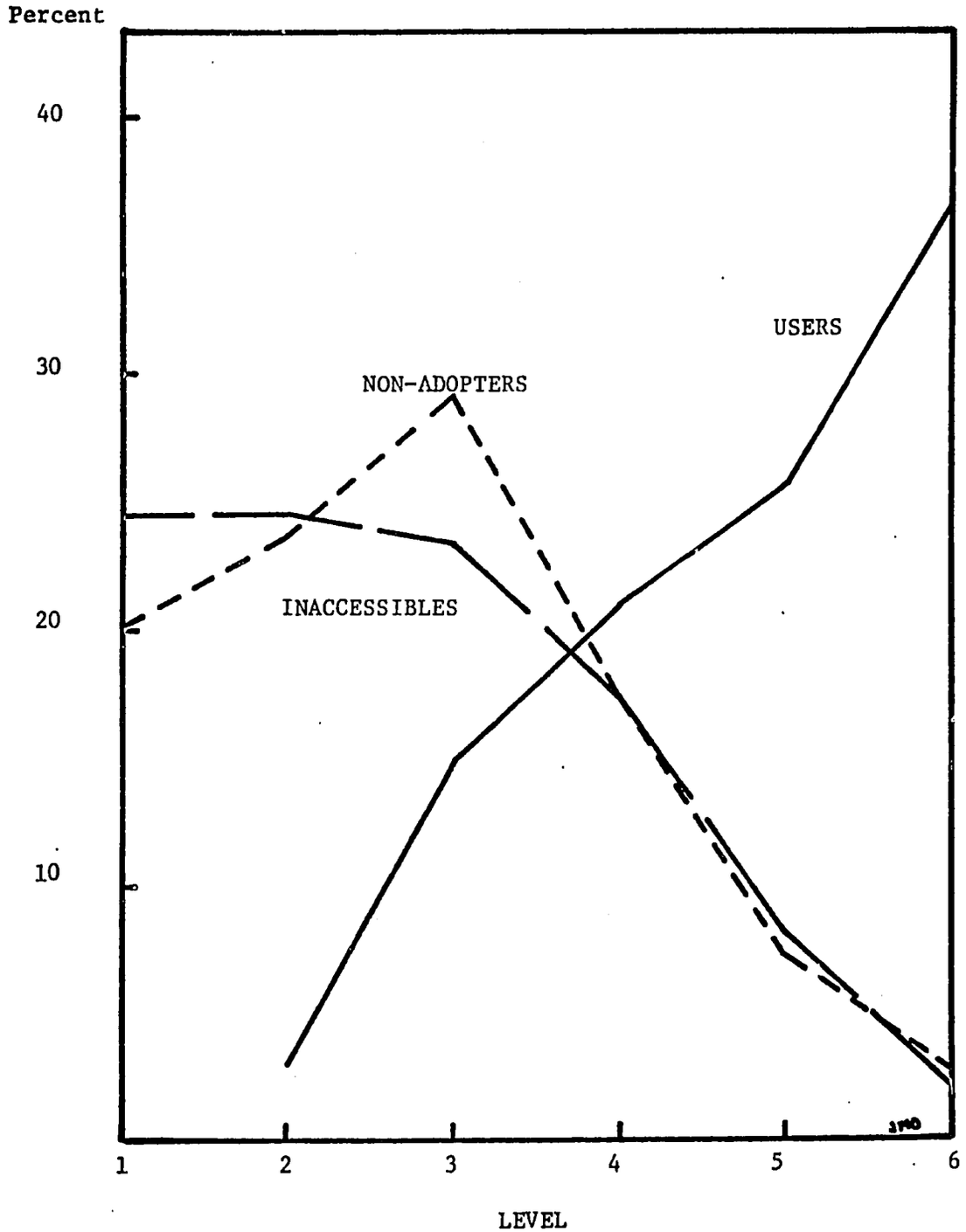
Table 59

Percentages and Numbers of Respondents in Level of Living Scale (LEVEL) Categories by Users Variable, Colombia

Users Categories	LEVEL Categories 1 (low)	2	3	4	5	6 (high)	TOTAL
USERS	52.0 (0)	12.3 (7)	38.2 (34)	57.6 (49)	79.0 (60)	94.5 (85)	53.1 (235)
INACCESSIBLES	52.2 (24)	42.1 (24)	25.8 (23)	20.0 (17)	10.5 (8)	2.2 (2)	22.1 (98)
NON-ADOPTERS	47.8 (22)	45.6 (26)	36.0 (32)	22.4 (19)	10.5 (8)	3.3 (3)	24.8 (110)
TOTAL	100.0 (46)	100.0 (57)	100.0 (89)	100.0 (85)	100.0 (76)	100.0 (90)	100.0 (443)

Figure 19

Percentages of Each USERS, INACCESSIBLES, and NON-ADOPTERS by Categories of Level of Living Scale (LEVEL), Colombia



It is apparent that the average USERS has a higher level of living than either the average NON-ADOPTERS or INACCESSIBLES. This is reflected by the arithmetic means of the LEVEL scores for each group. The score for USERS is 4.774 and those for INACCESSIBLES and NON-ADOPTERS, 2.663 and 2.764, respectively, which again shows the similarity of the latter groups with regard to their level of living. The t test scores for the difference between those means and their level of significance is shown in Table 60. These reflect the essential similarity between INACCESSIBLES and NON-ADOPTERS and the very significant differences between USERS and the other two categories.

Several conclusions can be reached from both analyses of LEVEL. USERS have a significantly higher level of living than either NON-ADOPTERS or INACCESSIBLES. The latter two groups have practically similar levels of living. The use of electricity is probably a factor, among others, contributing to the higher levels of living of users of electricity. Conversely, the non-use of electricity probably contributed to the substantially lower levels of living for NON-ADOPTERS and INACCESSIBLES.

Table 60

Scores of T Tests for Difference between Arithmetic Means and Levels of Significance for Categories and Combinations of Categories of Users Variable by Level of Living Scale (LEVEL) and Electricity-free Level of Living Scale (LEVELNOE), Colombia

Level of Living Scales	T Test	Level of Significance for Two-tailed Test
LEVEL		
USERS/NON-ADOPTERS	14.319	0.001
USERS/INACCESSIBLES	14.329	0.001
NON-ADOPTERS/INACCESSIBLES	0.545	None
USERS/NON-ADOPTERS and INACCESSIBLES	17.369	0.001
LEVELNOE		
USERS/NON-ADOPTERS	10.224	0.001
USERS/INACCESSIBLES	10.100	0.001
NON-ADOPTERS/INACCESSIBLES	0.002	None
USERS/NON-ADOPTERS and INACCESSIBLES	12.395	0.001

In an attempt to examine more closely the disparity in LEVEL between the USERS and the NON-ADOPTERS, a ratio between the total percentage of USERS by category of LEVEL and the same statistic for NON-ADOPTERS was calculated. The data are presented in Table 61. The percentage of

USERS increases steadily with increases in LEVEL. The percentage of NON-ADOPTERS increases from 20.0 to 29.1 between categories 1 and 3 but then drops to 2.7 for category 6 of LEVEL. The effects of these changes are reflected by the ratios. The value of the ratio varies directly with increases in the classification of LEVEL, moving from zero for category 1 to 13.407 for category 6. As a result, it can be stated that when comparing users of electricity with those who could but do not use electricity, the proportion of users increases directly with a rise in the level of living and that the reverse is true for non-users. Because the LEVEL scores used above are partly based on the use of electrical appliances, an electricity-free level of living scale, LEVELNOE, was devised (See Chapter II). To avoid a possible bias in the cross-tabulations used in the remainder of this presentation, LEVELNOE is used instead of LEVEL. The number of respondents classified in each class of LEVELNOE is shown in Table 62. The same positive relationship found between electricity use and LEVEL persists between electricity use and LEVELNOE. The distribution of the population according to LEVELNOE resembles a bell shaped curve. The middle category is the modal one, containing 121 cases or 27.2 percent of the total. As was the case with LEVEL, the Chi Square test shows that the probability of the relationships between LEVELNOE and the users characteristics occurring by chance to be no greater than 0.001, indicating that the probability that this distribution occurred by chance is exceedingly small. The degree of association is strong, reflected in a Tau_c of 0.4207 with a level of significance of 0.001.

Table 61

Percentages of USERS and NON-ADOPTERS by Categories of Level of Living Scale (LEVEL) and Ratios of percentages of USERS to NON-ADOPTERS, Colombia

USERS CATEGORIES	LEVEL Categories 1	2	3	4	5	6	TOTAL
USERS (percent-) ages)	0.0	3.0	14.5	20.8	25.5	36.2	100.0
NON-ADOPTERS (percentages)	20.0	23.6	29.1	17.3	7.3	2.7	100.0
Ratio of per- centages of USERS to NON-ADOPTERS	0.000	0.127	0.498	1.202	3.493	13.407	---

The distribution of USERS by LEVELNOE shown in Figure 20, resembles that of users by LEVEL. USERS predominate in the upper categories of LEVELNOE. Some 63.0 percent of them are in the upper two categories of LEVELNOE. The corresponding percentages for INACCESSIBLES and for NON-ADOPTERS are 19.4 and 20.9, respectively. Therefore, both classes of non-users are concentrated in the lower LEVELNOE categories.

The relationship between categories of users is similar whether LEVEL or LEVELNOE is compared. Using LEVELNOE, USERS have the highest level of living as shown by their mean score of 3.787. INACCESSIBLES and NON-ADOPTERS have nearly identical scores, 2.500 and 2.536, respectively. The relationship between electricity use and the level of living is shown when comparing the LEVELNOE scores of the USERS and of the NON-ADOPTERS (Table 63). The percentage of USERS by category of LEVELNOE is presented and the same is done for NON-ADOPTERS. Ratios of the percentages of USERS to NON-ADOPTERS were calculated and entered in the table. The importance of USERS vis-a-vis NON-ADOPTERS increases directly with increasing values of LEVELNOE. It can be concluded, therefore, that although both users and non-users of electricity are found in all levels of the electricity-free level of living scale, the relative importance of USERS varies in direct relationship to the level of living. The reverse is true for NON-ADOPTERS.

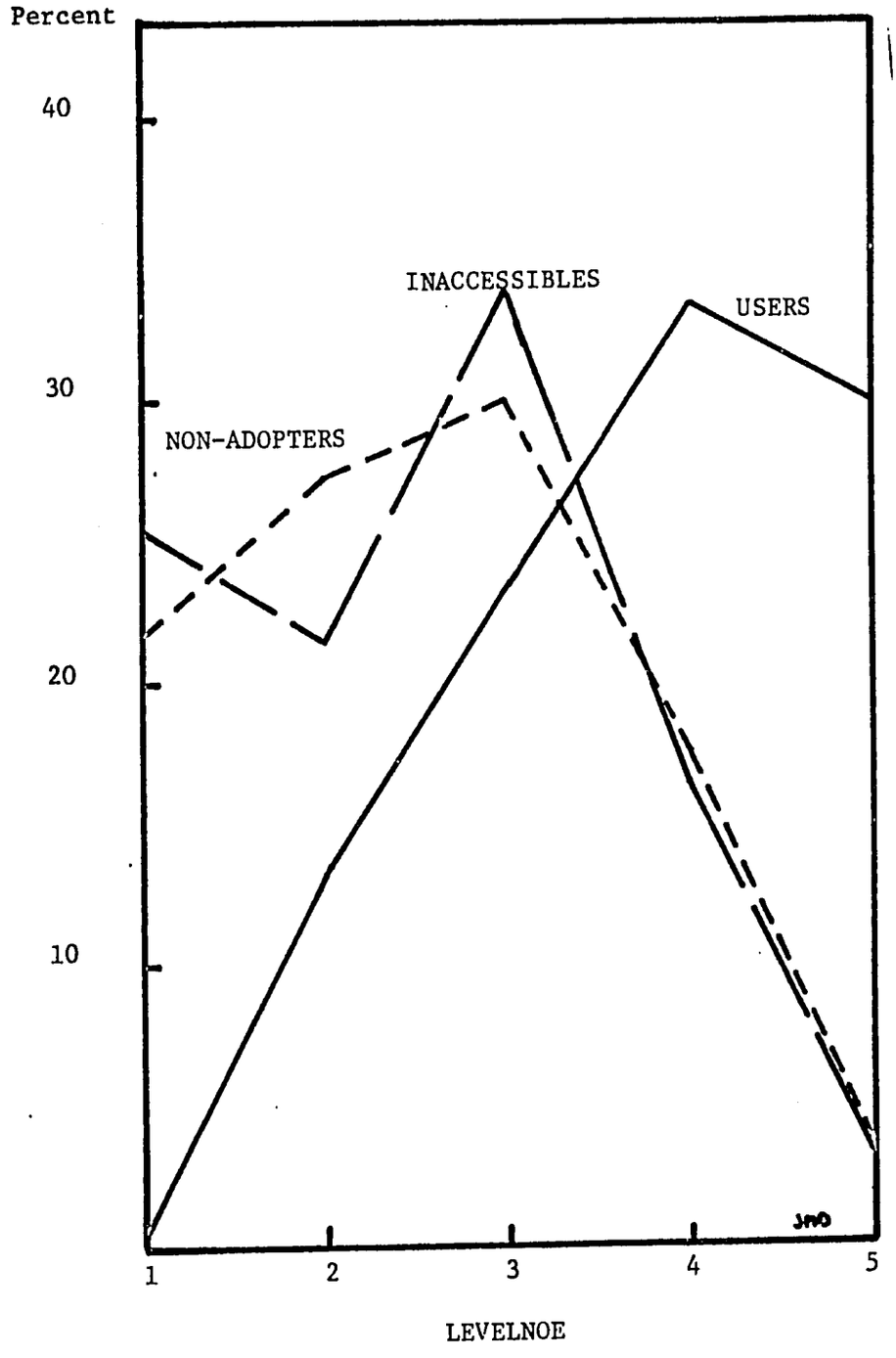
Table 62

Percentages and Numbers of Respondents in Electricity-free Level of Living Scale (LEVELNOE) Categories by Users Variable, Colombia

Users Categories	LEVELNOE Categories 1 (low)	2	3	4	5 (high)	TOTAL
USERS	2.0 (1)	37.8 (31)	45.4 (55)	69.0 (78)	90.9 (70)	53.1 (235)
INACCESSIBLES	50.0 (25)	25.6 (21)	27.3 (33)	14.2 (16)	3.9 (3)	22.1 (98)
NON-ADOPTERS	48.0 (24)	36.6 (30)	27.3 (33)	16.8 (19)	5.2 (4)	24.8 (110)
TOTAL	100.0 (50)	100.0 (82)	100.0 (121)	100.0 (113)	100.0 (77)	100.0 (443)

Figure 20

Percentages of Each USERS, INACCESSIBLES, and NON-ADOPTERS by Categories of Electricity-free Level of Living Scale (LEVELNOE), Colombia



In summary, evidence has been presented to support the contention that in Colombia there are demonstrable relationships between level of living and the use of electricity. Although both users and non-users of electricity are found in all of the categories of level of living, there is a strong positive correlation between the relative importance of users and increases in the value of the level of living category. The reverse is true for non-users.

Once again, however, the existence of this association does not demonstrate causality. Greater economic resources as reflected in size of farm within a given type of enterprise may affect the level of living as may education, indirectly, through other variables such as superior farming methods, and age which may be associated, for instance with improvements over time. Consequently these are used in the analysis which follows as control variables.

Table 63

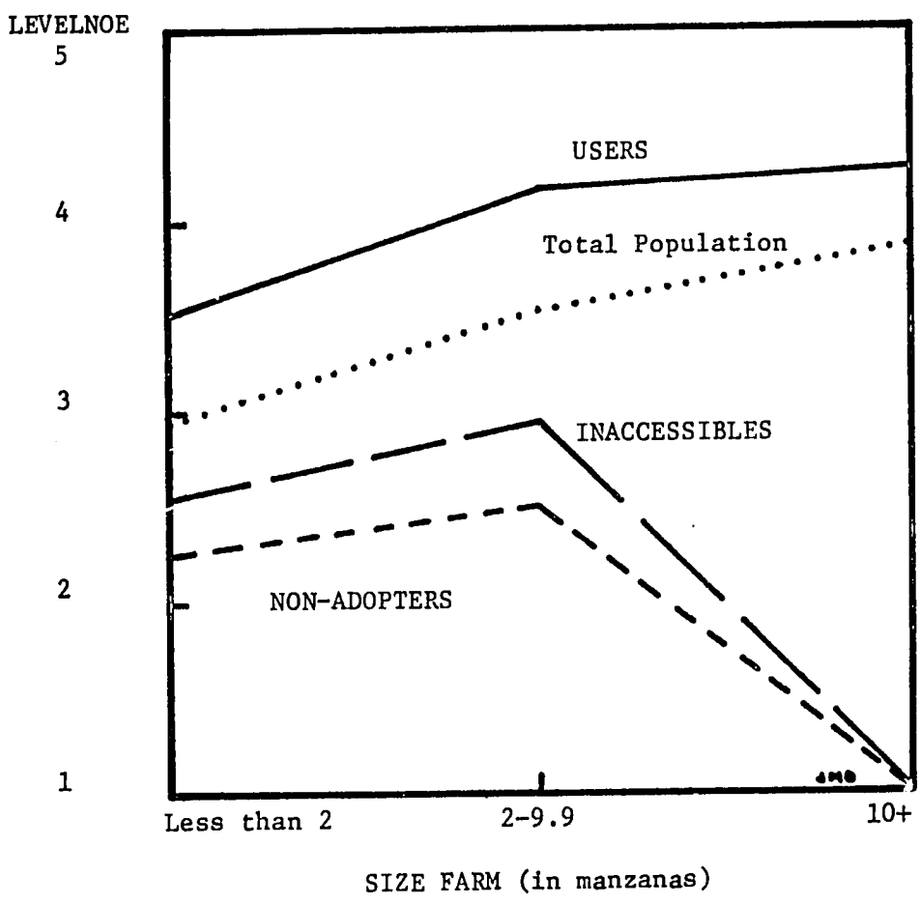
Percentages of USERS and NON-ADOPTERS by Categories of Electricity-free Level of Living Scale (LEVELNOE) and Ratios of Percentages of USERS to NON-ADOPTERS, Colombia

	LEVELNOE Categories					
	1	2	3	4	5	TOTAL
USERS (percentages)	0.4	13.2	23.4	33.2	29.8	100.0
NON-ADOPTERS (percentages)	21.8	27.3	30.0	17.3	3.6	100.0
Ratio of percentages of USERS to NON-ADOPTERS	0.018	0.484	0.780	1.919	8.278	--

Size of farm was used as a control variable and the data are graphically presented in Figure 21. The data compare all those respondents falling into each size of farm category, sorted by the users variable according to their electricity-free level of living. Thus, NON-ADOPTERS whose farm size varied from 2.0 to 9.9 hectares had a mean score on LEVELNOE of 2.5, INACCESSIBLES whose farm size varied between 2.0 and 9.9 hectares had a mean score on LEVELNOE of 2.9 and, finally USERS with farms ranging in size from 2.0 to 9.9 hectares had a mean LEVELNOE score of 4.2. It will be seen that the same holds true for the smallest farms, those less than two hectares in size. The comparison for farms of ten or more hectares has no meaning, since only one case each was found in this category for INACCESSIBLES and NON-ADOPTERS. These data demonstrate that USERS have a higher level of living than non-users regardless of the size of farm owned or operated.

Figure 21

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Size of Farm (SIZE FARM), Colombia



Education of the head of the household is viewed next by employing the same approach (Figure 22). All heads having no education are divided into users categories and compared with regard to their level of living. Thus, for instance, household heads that completed one or two years of schooling have a substantially higher level of living when they are USERS than if they are INACCESSIBLES or NON-ADOPTERS. The tendency is for LEVELNOE to increase with educational attainment. However, USERS enjoy significantly higher levels of LEVELNOE than do the other user categories, regardless of their educational attainment.

Finally, age is viewed in the same manner, used as a control variable to compare the LEVELNOE of persons in the several user categories (Figure 23). There is little relationship between age and LEVELNOE, unless it is a slight decline in LEVELNOE with advancing age. USERS, however, once again are revealed to enjoy substantially higher levels of living than either INACCESSIBLES or NON-ADOPTERS regardless of the age group into which they fall.

The foregoing analysis reveals that the USERS have a substantially higher level of living than INACCESSIBLES or NON-ADOPTERS even when age, size of farm and education of head are controlled. It seems to us possible, but unlikely, that were other controls introduced, the difference between USERS and others might be substantially reduced or eliminated. This exploratory study of the relationships between electricity use and social and economic variables while not showing beyond a doubt that electricity use results in high levels of living, does not, on the other hand negate that relationship. Until, therefore, some factor other than electricity use is shown to account for the higher levels of living of users of electricity, the positive effect of electricity use on level of living must be considered a possibility.

Satisfaction With Life Situation

Several hypotheses regarding the relationship between satisfaction with life situation and electricity use underlay this analysis as was the case with the Costa Rica data. First, that USERS would score higher on SIT PRES than either INACCESSIBLES or NON-ADOPTERS. (See Chapter II for a description of these variables and the satisfaction with life situation section for Costa Rica for a fuller discussion of the hypotheses). Second, that USERS would score higher on SIT PAST than NON-ADOPTERS or INACCESSIBLES. Third, that USERS would perceive a better future for themselves and for their children, scoring higher on SIT FUT. Fourth, if the preceding hypotheses are substantially true it would also be true that USERS would score higher on SIT TOT than NON-ADOPTERS and INACCESSIBLES.

Results of the cross-tabulation of the users variable and SIT PRES are presented in Table 64. The Chi square significance for this table is 0.002, indicating that there are only two chances out of a thousand that the distribution would have occurred by chance. Tau_c is 0.1606 with a significance of 0.0001. The table reveals a positive association between electricity use and satisfaction with present life situation. The transition from one SIT PRES category to another is not completely smooth due to the small numbers of cases occurring in categories 1 and 5.

Figure 22

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Education of Heads of Households (ED HEAD), Colombia

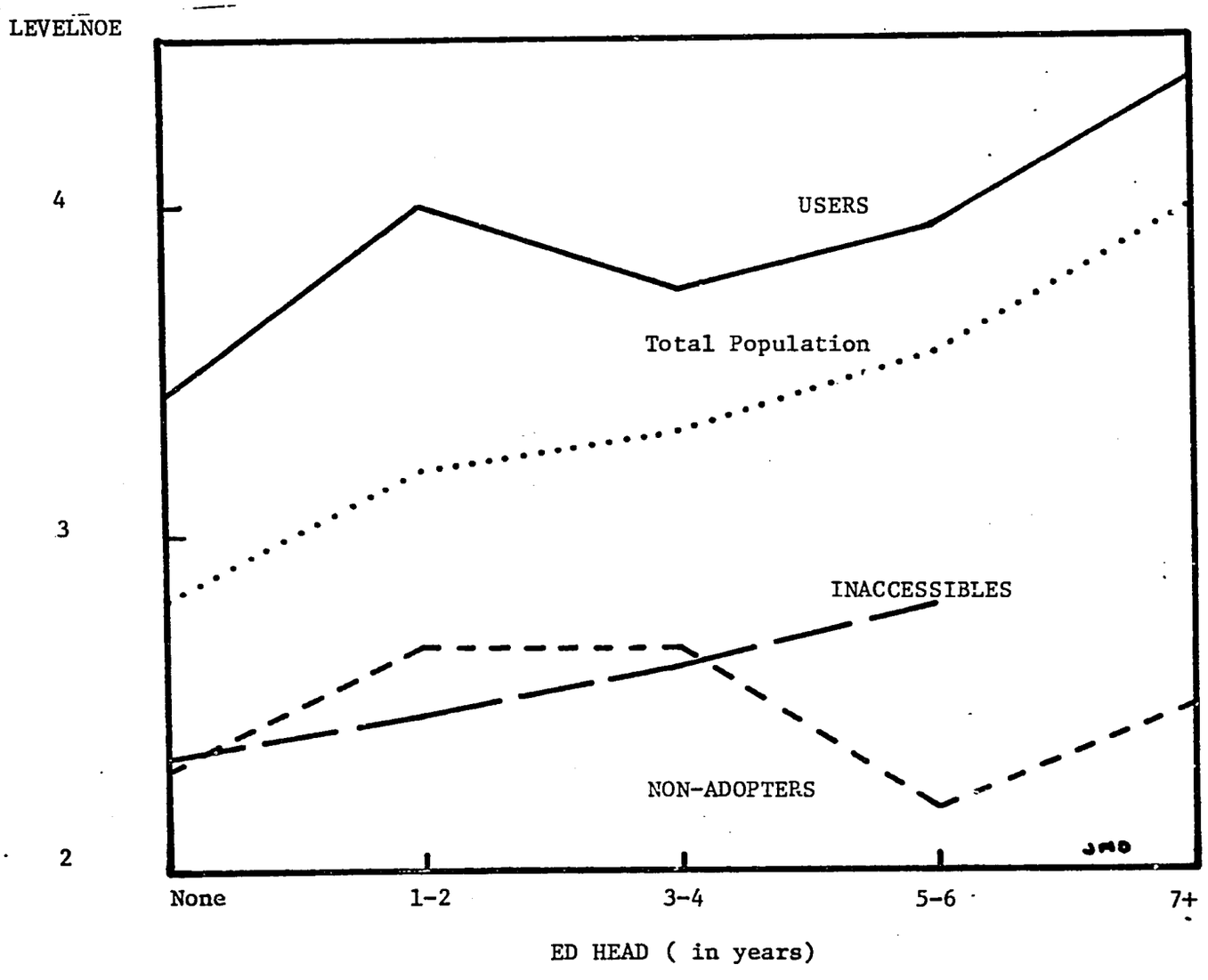
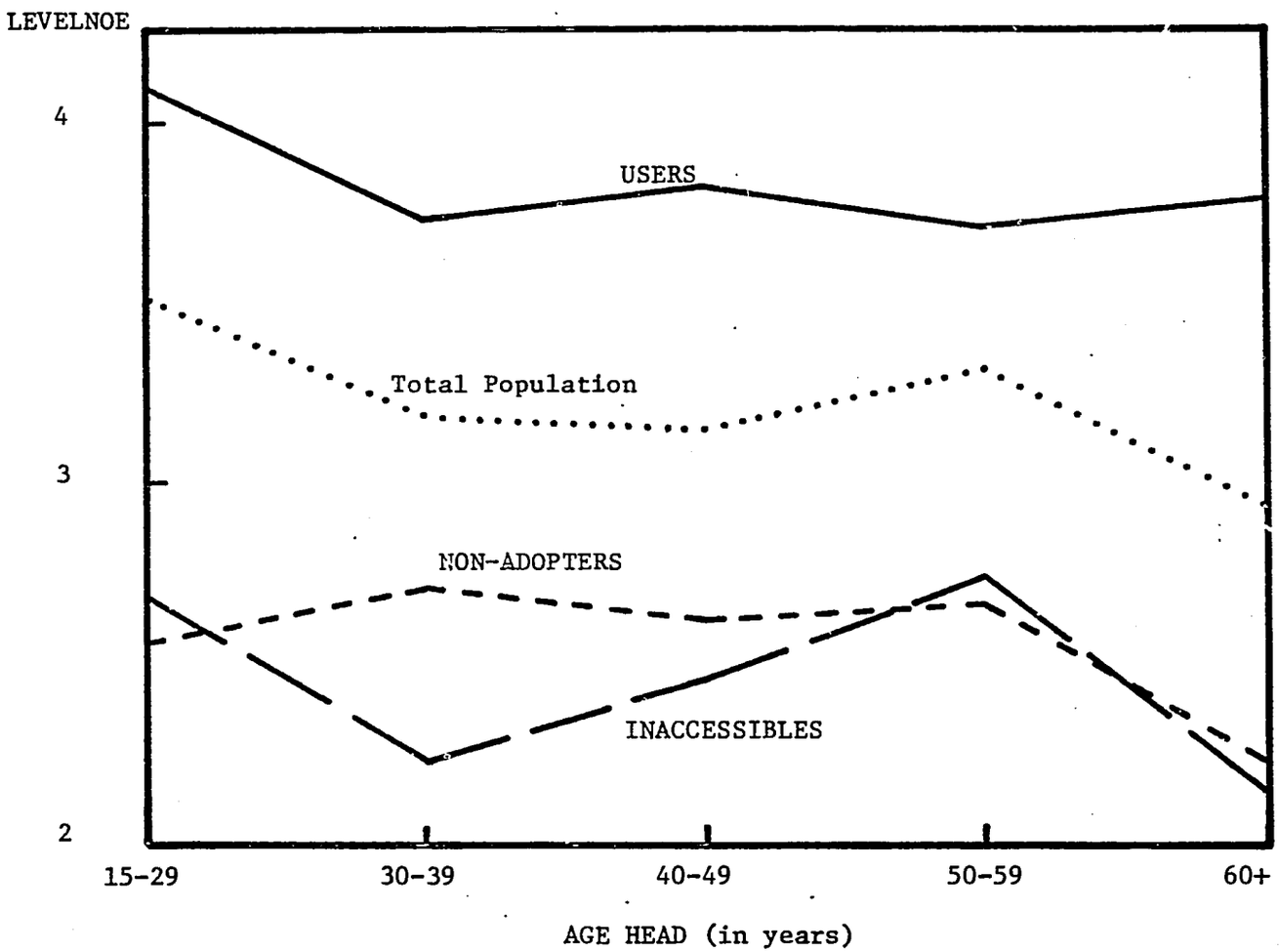


Figure 23

Mean Electricity-free Level of Living Scale (LEVELNOE) Scores for USERS, INACCESSIBLES, NON-ADOPTERS, and Total Population by Age of Head of Households (AGE HEAD), Colombia



When categories 1 and 2 and 4 and 5 are combined the percentage distribution is as indicated below and SIT PRES is seen to be positively associated with electricity use and negatively associated with both

	1-2	3	4-5
USERS	38.7	52.8	67.0
INACCESSIBLES	26.4	22.7	17.1
NON-ADOPTERS	34.9	24.5	15.9

categories of non-users. Although the modal category for each class of the users variable is "same" higher proportions of USERS, (26.7 percent) consider their present situation to be better or much better than that of their neighbors than of INACCESSIBLES (15.8 percent) or NON-ADOPTERS (13.1 percent). At the other end of the scale fewer USERS consider themselves much worse or worse off (18.5 percent) than either INACCESSIBLES (29.5 percent) or NON-ADOPTERS (24.5 percent). Once again the differences between NON-ADOPTERS and INACCESSIBLES are not generally great but a substantial difference exists between these groups and USERS.

Table 64

Percentages and Numbers of Respondents in Present Satisfaction with Life Situation Index (SIT PRES) Categories by Users Variable, Colombia

Users Categories	SIT PRES Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	41.2 (7)	38.2 (34)	52.8 (121)	69.2 (54)	50.0 (5)	52.2 (221)
INACCESSIBLES	5.9 (1)	30.3 (27)	22.7 (52)	16.7 (13)	20.0 (2)	22.5 (95)
NON-ADOPTERS	52.9 (9)	31.5 (28)	24.5 (56)	14.1 (11)	30.0 (3)	25.3 (107)
TOTAL	100.0 (17)	100.0 (89)	100.0 (229)	100.0 (78)	100.0 (10)	100.0 (423)

Mean scores on the satisfaction with life situation indexes by user categories are presented in Table 65. USERS have higher mean scores on each of the situation indexes than INACCESSIBLES or NON-ADOPTERS. The hypotheses stated at the beginning of this section are, therefore, supported. The differences, however, are not always great. INACCESSIBLES and NON-ADOPTERS have very similar scores. The significance of the differences between these means was calculated using the t-test for the differences between means. There is a statistically significant difference between the SIT PRES means of USERS as compared to NON-ADOPTERS and of USERS as compared to NON-ADOPTERS and INACCESSIBLES. The significance of the difference between means for SIT PAST, SIT FUT and SIT TOT is also presented in Table 66. For each of these SIT categories the significance of the difference between means is low with the exception of four instances in which the significance is at the 0.05 level or less. The greatest and most significant differences occur with regard to satisfaction with present life situation.

Table 65

Arithmetic Means for Respondents of Satisfaction with Life Situation Indexes for Categories and Combinations of Categories of Users Variable, Colombia

Users Categories and Combinations of Categories	Satisfaction with Life Situation Indexes SIT PRES	SIT PAST	SIT FUT	SIT TOT
USERS	3.072	3.035	4.076	3.639
INACCESSIBLES	2.874	2.747	3.879	3.429
NON-ADOPTERS	2.729	2.824	3.909	3.485
USERS and NON-ADOPTERS	2.960	2.967	4.023	3.590
NON-ADOPTERS and INACCESSIBLES	2.797	2.788	3.895	3.458
TOTAL	2.941	2.919	3.990	3.553

The results of the cross-tabulations of the users variable with SIT PAST, SIT FUT and SIT TOT are presented in Tables 67, 68 and 69. The Chi square level of significance for SIT PAST is 0.05, lower than that for SIT PRES. The strength of the relationship between electricity use and SIT PAST is not as strong as was the case for SIT PRES. Still, somewhat higher proportions of USERS (31.3 percent) consider themselves to be much better off than in the past, than INACCESSIBLES (24.2 percent)

Table 66

Scores of T Tests for Difference between Arithmetic Means and Levels of Significance for Categories and Combinations of Categories of Users Variable by Satisfaction with Life Situation Indexes, Colombia

Satisfaction with Life Situation Indexes	T Test Score	Level of Significance for Two-tailed test
SIT PRES		
USERS/NON-ADOPTERS	3.600	0.001
USERS/NON-ADOPTERS and INACCESSIBLES	3.562	0.001
USERS and NON-ADOPTERS/INACCESSIBLES	0.924	None
USERS/INACCESSIBLES	2.108	0.050
SIT PAST		
USERS/NON-ADOPTERS	1.917	0.100
USERS/NON-ADOPTERS and INACCESSIBLES	2.633	0.010
USERS and NON-ADOPTERS/INACCESSIBLES	1.941	0.100
USERS/INACCESSIBLES	2.419	0.020
SIT FUT		
USERS/NON-ADOPTERS	1.547	0.200
USERS/NON-ADOPTERS and INACCESSIBLES	1.960	0.050
USERS and NON-ADOPTERS/INACCESSIBLES	1.299	0.200
USERS/INACCESSIBLES	1.664	0.100
SIT TOT		
USERS/NON-ADOPTERS	1.838	0.100
USERS/NON-ADOPTERS and INACCESSIBLES	2.489	0.020
USERS and NON-ADOPTERS/INACCESSIBLES	1.850	0.100
USERS/INACCESSIBLES	2.283	0.050

or NON-ADOPTERS (19.4 percent). Conversely, a smaller proportion of the USERS consider themselves to be worse off or much worse off than of INACCESSIBLES or NON-ADOPTERS, the percentages being, respectively, 27.3, 42.1 and 34.2. An examination of the tabulation of SIT FUT reveals a similar pattern. The statistical association is weak, however, because of the concentration of cases in categories 4 and 5. The Chi square level of significance is only 0.336 and a Tau_c of 0.0803 reveals a weak association among the variables in the table. It is still true, however, that a greater proportion of USERS (79.6 percent) believe that they and their children will be better off or much better off in the future than either INACCESSIBLES (70.3 percent) or NON-ADOPTERS (73.7 percent). Table 69, containing the cross-tabulation of the users with SIT TOT contains no surprises. Although there is a positive relationship between electricity use and total satisfaction with life situation, it is weak (Chi square significance 0.05, Tau_c, 0.090. Proportionately more USERS (63.0 percent) score in categories 4 and 5 than do INACCESSIBLES (50.4 percent) and NON-ADOPTERS (53.5 percent).

Table 67

Percentages and Numbers of Respondents in Past Satisfaction with Life Situation Index (SIT PAST) Categories by Users Variable, Colombia

Users Categories	SIT PAST Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	34.4 (11)	47.6 (51)	53.4 (94)	64.9 (61)	47.6 (10)	52.8 (227)
INACCESSIBLES	37.5 (12)	26.2 (28)	18.2 (32)	19.1 (18)	23.8 (5)	22.1 (95)
NON-ADOPTERS	28.1 (9)	26.2 (28)	28.4 (50)	16.0 (15)	28.6 (6)	25.1 (108)
TOTAL	100.0 (32)	100.0 (107)	100.0 (176)	100.0 (94)	100.0 (21)	100.0 (430)

Table 68

Percentages and Numbers of Respondents in Future Satisfaction with Life Situation Index (SIT FUT) Categories by Users Variable, Colombia

Users Categories	SIT FUT Categories 1 (much worse)	2 (worse)	3 (same)	4 (better)	5 (much better)	TOTAL
USERS	50.0 (1)	41.2 (14)	46.7 (28)	53.2 (93)	57.7 (75)	52.6 (211)
INACCESSIBLES	50.0 (1)	35.3 (12)	23.3 (14)	19.4 (34)	23.1 (30)	22.7 (91)
NON-ADOPTERS	0.0 (0)	23.5 (8)	30.0 (18)	27.4 (48)	19.2 (25)	24.7 (99)
TOTAL	100.0 (2)	100.0 (34)	100.0 (60)	100.0 (175)	100.0 (130)	100.0 (401)

Table 69

Percentages and Numbers of Respondents in Total Satisfaction with Life Situation Index (SIT TOT) Categories by Users Variable, Colombia

Users Categories	SIT TOT Categories 1 (low)	2	3	4 (high)	TOTAL
USERS	33.3 (11)	48.5 (66)	57.6 (118)	54.2 (13)	52.2 (208)
INACCESSIBLES	42.5 (14)	22.8 (31)	19.0 (39)	29.1 (7)	22.9 (91)
NON-ADOPTERS	24.2 (8)	28.7 (39)	23.4 (48)	16.7 (4)	24.9 (99)
TOTAL	100.0 (33)	100.0 (136)	100.0 (205)	100.0 (24)	100.0 (398)

Given the fact that the association between electricity use and satisfaction with life situation is weak, although positive, it is not surprising that when control variables are introduced there are no consistent differences between USERS and the other two electricity use categories. Figures 24 through 27, graphically present the results of introducing size of farm, the electricity-free level of living scale, age and education of household head as control variables, against SIT TOT. A cursory examination of these graphs reveals the absence of any consistent pattern of differences between the SIT TOT scores of persons in the several user categories when the above mentioned control variables are introduced.

The strongest relationship was found between electricity use and satisfaction with present life situation. It is possible that were SIT PRES used as the dependent variable and controls introduced for age, education, LEVELNOE and size of farm that consistent differences would be found among the user categories.

Exposure to the Mass Media

The rationale lying behind this section is presented in the introduction to the mass media exposure section for Costa Rica. We will therefore, begin by immediately discussing the data obtained on this important variable in Colombia.

Figure 24

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Size of Farm (SIZE FARM), Colombia

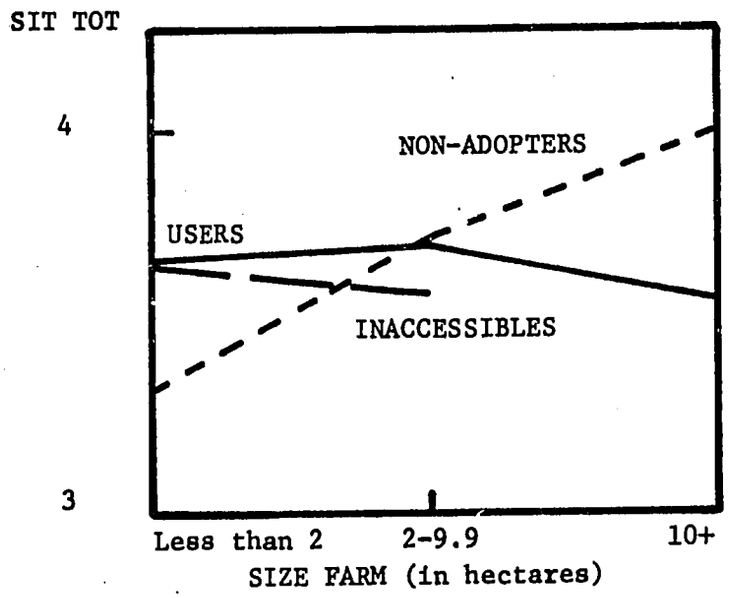


Figure 25

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Electricity-free Level of Living Scale (LEVELNOE), Colombia

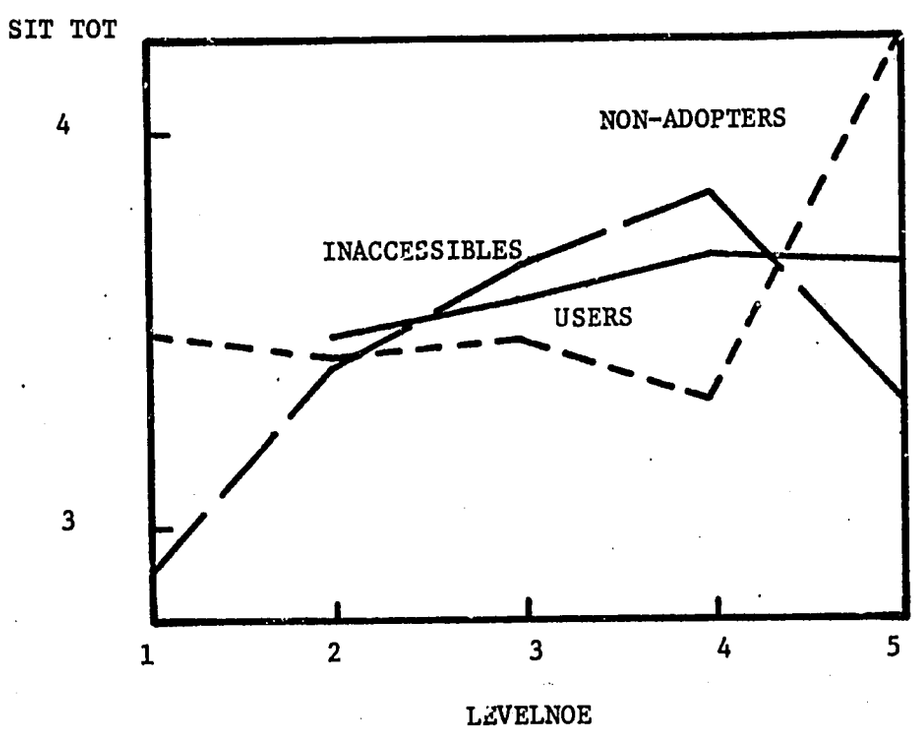


Figure 26

Satisfaction with Life Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Age of Head of Household (AGE HEAD), Colombia

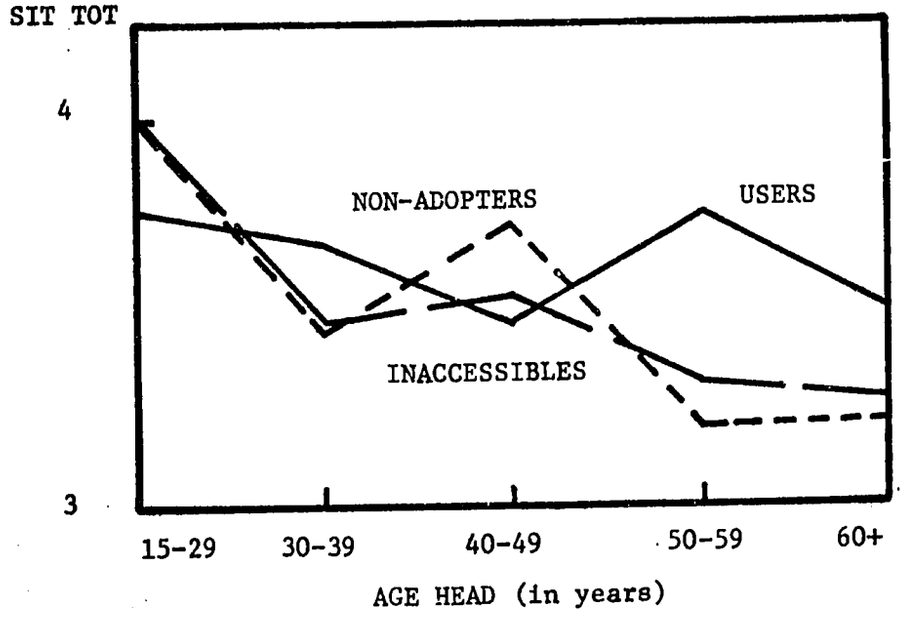
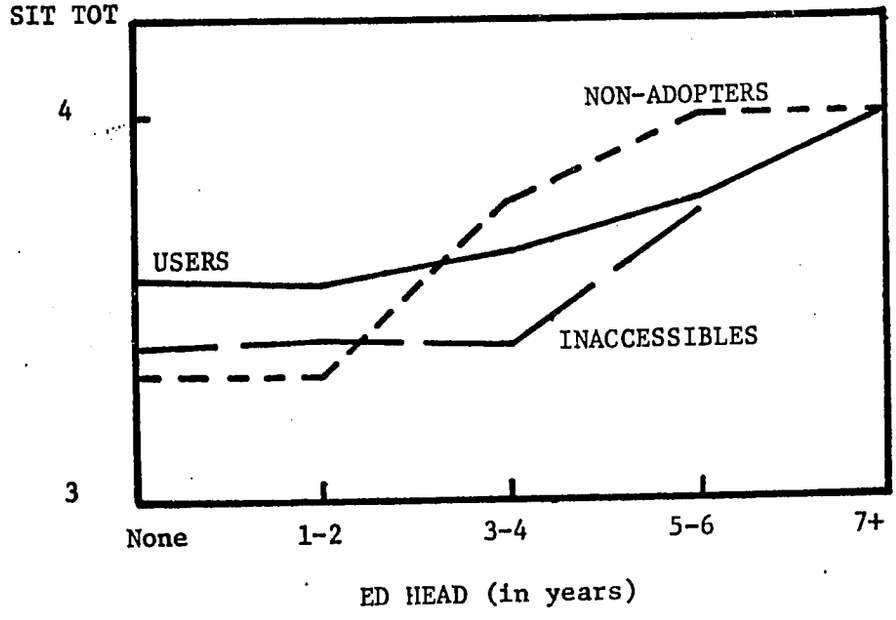


Figure 27

Satisfaction with Live Situation Total Score (SIT TOT) for USERS, INACCESSIBLES, and NON-ADOPTERS by Education of Head of Household (ED HEAD), Colombia



The study area lies well within the zone of influence of Cali, a major city whose population approximates one million. Partly, at least, as a result of this proximity the general level of exposure to mass media is high. Two national newspapers, El Tiempo and El Espectador are received in the area as is El Pais, a regional newspaper. The Radio Cadena Nacional, the national radio network, can be easily picked up on simple receivers and the Cali television stations penetrate the area without difficulty. In the 1960'S educational television was inaugurated. The generally high level of exposure to mass media is reflected by the following data: 326, or 74.3 percent of the respondents listen to the radio every day; over one-half, 51.6 percent watch some television; although only 28 respondents said that they owned a television set, 140 stated that they watched television in the home of a friend, many of whom probably live in the urbanized area of Rozo; magazine readership is low, only 15.4 percent, but nearly one-half of the respondents, 49.5 percent, read newspapers. In the discussion that follows, an index of mass media exposure (MMEI) is used. Its construction is explained in Chapter II.

Electricity use is positively associated with mass media exposure (Table 70). The proportion who are USERS falling into the several MMEI categories increases with an increase in the amount of exposure. The reverse is true for INACCESSIBLES. The negative relationship is not as strong for NON-ADOPTERS. If we view the data from the standpoint of

Table 70

Percentages and Numbers of Respondents According to Mass Media Exposure Index (MMEI) by Users Variable, Colombia

Users Categories	MMEI Categories 1 (low)	2	3	4 (high)	TOTAL
USERS	43.5 (30)	43.0 (46)	55.7 (59)	62.1 (100)	53.1 (235)
INACCESSIBLES	27.5 (19)	27.1 (29)	23.6 (25)	15.5 (25)	22.1 (98)
NON-ADOPTERS	29.0 (20)	29.9 (32)	20.7 (22)	22.4 (36)	24.8 (110)
TOTAL	100.0 (69)	100.0 (107)	100.0 (106)	100.0 (161)	100.0 (443)

the percentage of USERS, INACCESSIBLES and NON-ADOPTERS that are in level 3 and 4 combined, we again find that USERS are more highly exposed than the others. One hundred and fifty-nine or 67.7 percent of USERS are at levels 3 and 4 of the mass media exposure index, as compared to 51.0 percent of the INACCESSIBLES and 52.7 percent of the NON-ADOPTERS. The contrast is particularly great at the highest level of the MMEI, level 4. Forty-two and five-tenths percent of USERS score 4, while only 25.5 percent of the INACCESSIBLES and 32.7 percent of the NON-ADOPTERS do so.

The positive correlation of mass media exposure with the use of electricity is only in part due to the fact that two of the elements used to calculate the MMEI, exposure to radio and television, are related to electricity use. All television sets in the area are operated by central electric current. However, as noted above, most television viewers watch away from home. A high percentage, 87.8, of the respondents own radios. However, most of these radios, 77.4 percent are transistor models. One hundred and forty-seven of the USERS, or 62.6 percent do not own electric radios. Thus the influence of electricity on exposure to radio and television is not great. It is very probable that if the USERS who own electric radios did not have electricity in their homes, they would purchase transistor models and thus be exposed to radio messages anyway. The positive association between electricity use and mass media exposure (which also includes newspapers and magazines) must be explained by other variables. An examination of the relationships which exist between exposure to the mass media and level of living as well as satisfaction with life situation provides some additional insight into this phenomenon.

The results of the cross-tabulation of the MMEI with the electricity-free level of living scale (LEVELNOE) are presented in Table 71. This table reveals a strong positive association between mass media exposure and the level of living. Low levels of living are associated with low MMEI scores and the reverse is true of high levels of living. As indicated by the Chi square test the probability that the distribution would have occurred by chance is less than 0.001. Tau_c a measure of the strength of the association between the two variables is strong as indicated by a raw score of 0.2312, the level of significance being greater than 0.000.

The relationship between LEVELNOE and MMEI is probably circular. Increased levels of living may lead to increased media exposure which in turn could contribute to increased levels of living. As has been shown, there is a positive relationship between the use of electricity and level of living. The relationship found between mass media exposure and LEVELNOE would seem to indicate that exposure to the mass media is a companion phenomenon positively associated with the level of living.

Mass media exposure is also positively associated with satisfaction with life situation as shown in Table 72. No one who scored low on MMEI scored high on SIT TOT, whereas 9.4 percent of those scoring high on MMEI also scored high on SIT TOT. When categories 4 and 5 of SIT TOT are viewed in combination, 41.0 percent of those scoring low on MMEI fell into those categories of SIT TOT while the corresponding percentage for those who score high on MMEI was 71.8.

Mass media exposure is positively associated with both the level of living and satisfaction with life situation. Both of these, in turn, particularly the former, are positively associated with electricity use as is mass media exposure. The higher mass media exposure of USERS is, apparently, as much or more a function of higher levels of living of USERS as of electricity use per se.

Table 71

Percentage and Numbers of Respondents According to Categories of Electricity-free Level of Living Scale (LEVELNOE) by Categories of Mass Media Exposure Index (MMEI), Colombia

MMEI Categories	LEVELNOE Categories 1	2	3	4	5	TOTAL
1 (low)	34.0 (17)	17.1 (14)	17.4 (21)	9.7 (11)	7.8 (6)	15.6 (69)
2 (moderately low)	32.0 (16)	32.9 (27)	24.8 (30)	22.1 (25)	11.7 (9)	24.2 (107)
3 (moderately high)	14.0 (7)	22.0 (18)	23.1 (28)	31.0 (35)	23.4 (18)	23.9 (106)
4 (high)	20.0 (10)	28.0 (23)	34.7 (42)	37.2 (42)	57.1 (44)	36.3 (161)
TOTAL	100.0 (50)	100.0 (82)	100.0 (121)	100.0 (113)	100.0 (77)	100.0 (443)

Social Participation

A low incidence of formal social participation was found among those interviewed in Colombia. Only 40 respondents, 9.0 percent, indicated that they belonged to an organization, association, or cooperative. Of these, all but five stated that they belonged to but one organ-

ization. The joiners most frequently mentioned that they were members of community development committees (juntas de accion comunal) or project-specific organizations. These latter groups usually were constituted to promote water, electrical, or sewage services to definite areas.

Table 72

Percentages and Numbers of Respondents According to Categories of Satisfaction with Life Situation Total Index (SIT TOT) by Categories of Mass Media Exposure Index (MMEI), Colombia

MMEI Categories	SIT TOT Categories 1 (low)	2	3	4 (high)	TOTAL
1 (low)	15.2 (5)	22.8 (31)	12.2 (25)	0.0 (0)	15.3 (61)
2 (moderately low)	45.4 (15)	30.9 (42)	18.0 (37)	8.3 (2)	24.1 (96)
3 (moderately high)	18.2 (6)	20.6 (28)	24.4 (50)	33.3 (8)	23.1 (92)
4 (high)	21.2 (7)	25.7 (35)	45.4 (93)	58.4 (14)	37.5 (149)
TOTAL	100.0 (33)	100.0 (136)	100.0 (205)	100.0 (24)	100.0 (398)

Since only five people stated that they were members of a cooperative, it can be assumed that the cooperative movement has not made inroads in the area. Eighteen of the 40 enumerated as members were also officials of organizations. This seems to indicate that active participation in formal groups is largely limited to those in leadership positions.

Although membership in formal organizations is low, there is an indication that non-members do to some degree attend various types of meetings. Some 16.8 percent of the respondents attended at least one meeting during the previous year. The meetings included, in addition to those of formal organizations, gatherings at school activities and classes sponsored by public health authorities.

Because of the low degree of formal social participation, it was not deemed worthwhile to examine the differences which occurred between those in the three categories of the users variable.

The Lottery Questions

In an attempt to determine in what manner resources might be allocated and find out something about the aspirations of the respondents, two questions were asked regarding the use of money: (1) "If you were to win 3,000 pesos in the lottery what would you do with them?" (2) "If you were to win 15,000 pesos in the lottery what would you do with them?" Three thousand pesos is approximately 150 United States dollars while fifteen thousand is about 750 United States dollars. It was assumed that the difference in the amounts would influence allocations.

The results of the tabulation of these data by the users variable are presented in Tables 73 and 74. An examination of the 3,000 peso table reveals that home improvements are the preferred investment for this sum of money (24.6 percent), followed by savings (18.7 percent), and farm improvements (15.2 percent). At the 15,000 pesos level there is a substantial shift. Farm and home improvements both increase their relative share of the total and together account for 67.7 percent of anticipated investments. The respondents are more likely to save the smaller sum of money and more likely to invest the larger sum of money.

As might be expected it was primarily merchants who thought of investing in business. This then is a type of investment not equally available to all. Nearly every respondent, however, has the opportunity to invest in farm land and/or a house, to save, and to invest in his family and/or children.

Table 73

Responses to How Winnings of $3,000 Pesos in the Lottery Would be Expended by Categories of Users Variable, Colombia

Users Categories	1 (Farm)	2 (House)	3 (Business)	4 (Savings)	5 (Children)	6 (Family)	7 (Other)	TOTAL
USERS	15.4 (35)	22.9 (52)	7.9 (18)	18.1 (41)	2.7 (6)	11.0 (25)	22.0 (50)	100.0 (227)
INACCESSIBLES	13.0 (12)	20.7 (19)	9.8 (9)	22.8 (21)	5.4 (5)	16.3 (15)	12.0 (11)	100.0 (92)
NON-ADOPTERS	16.6 (18)	31.5 (34)	1.9 (2)	16.6 (18)	1.9 (2)	13.0 (14)	18.5 (20)	100.0 (108)
TOTAL	15.2 (65)	24.6 (105)	6.8 (29)	18.7 (80)	3.0 (13)	12.7 (54)	19.0 (81)	100.0 (427)

Table 74

Responses to How Winnings of $15,000 Pesos in the Lottery Would be Expended by Categories of Users Variable, Colombia

Users Categories	1 (Farm)	2 (House)	3 (Business)	4 (Savings)	5 (Children)	6 (Family)	7 (Other)	TOTAL
USERS	35.2 (79)	29.0 (65)	5.4 (12)	8.9 (20)	4.5 (10)	5.4 (12)	11.6 (26)	100.0 (224)
INACCESSIBLES	27.6 (26)	36.2 (34)	4.3 (4)	7.4 (7)	7.4 (7)	4.3 (4)	12.8 (12)	100.0 (94)
NON-ADOPTERS	34.9 (38)	43.1 (47)	3.7 (4)	5.5 (6)	3.7 (4)	1.8 (2)	7.3 (8)	100.0 (109)
TOTAL	33.5 (143)	34.2 (146)	4.7 (20)	7.7 (33)	4.9 (21)	4.2 (18)	10.8 (46)	100.0 (427)

In the abbreviated table (75) the essentially similar categories of farm and house and of family and children have been combined, business investments have been excluded and the percentages recalculated. For both hypothetical amounts won, farm and home investments are in the lead, and greater proportions of NON-ADOPTERS than of others would invest in farm and home corroborating the greater felt need for these improvements in this group discussed in the previous section. The increase in hypothetical winnings produces a dramatic shift away from all categories toward farm and home improvements. The shift is smallest for USERS, although substantial. USERS would, apparently, have a greater propensity to save the larger sum.

Services

The interview schedule revised for use in Colombia included three questions regarding service. The respondents were asked (1) "What thing or service do you need most to improve your life?" (2) "What ought the government do to improve this community?" and (3) "What services do you receive from the government?" The replies to these questions were coded and cross-tabulated with the users variable. The data relating to the first question are presented in Table 76.

Table 75

Allocations of Lottery Winnings of $3,000 and $15,000 Pesos and Percent Change (Excluding Merchants) by Users Variable, Colombia

Users Categories	Farm & Home	Savings	Family & Children	Other	TOTAL
		Winning $3,000			
USERS	41.6	19.6	14.9	23.9	100.0
INACCESSIBLES	37.3	25.3	24.1	13.3	100.0
NON-ADOPTERS	49.1	17.0	15.1	18.8	100.0
TOTAL	427	20.1	16.8	20.4	100.0
		Winning $15,000			
USERS	67.9	9.4	10.4	12.3	100.0
INACCESSIBLES	66.7	7.8	12.2	13.3	100.0
NON-ADOPTERS	81.0	5.7	5.7	7.6	100.0
TOTAL	71.0	8.1	9.6	11.3	100.0
		Percent Change			
USERS	+63.2	-52.0	-29.7	-48.5	
INACCESSIBLES	+78.8	-69.2	-49.4	00.0	
NON-ADOPTERS	+65.0	-66.5	-62.3	-59.6	
TOTAL	+66.3	-59.7	-42.9	-44.6	

The responses fell into six specific categories: improved housing, improvements on the farm, more money, more work, more services in general, and electricity; and into a residual category, "other". In general, there is surprisingly little disagreement when user categories are compared. Almost identical percentages of USERS, INACCESSIBLES and NON-ADOPTERS, for instance, gave answers which were farm related.

The sharp differences appear in housing which was mentioned by 27.6 percent of the NON-ADOPTERS versus 16.7 percent of the USERS and 14.4 percent of the INACCESSIBLES. That a higher proportion of NON-ADOPTERS than of USERS mentioned housing is not unexpected since NON-ADOPTERS scored well below USERS on the level of living scale. However, INACCESSIBLES also scored well below USERS on LEVEL and LEVELNOE. Furthermore, their scores were virtually identical to those of NON-ADOPTERS. Yet, very similar proportions of USERS and INACCESSIBLES mentioned housing. This discrepancy leads to the conjecture that the greater prevalence of felt needs regarding housing among NON-ADOPTERS is due to a demonstration effect in that they are surrounded by friends and neighbors whose levels of living are substantially higher than their own. INACCESSIBLES, on the other hand, reside in areas in which their friends and neighbors have levels of living similar to their own, so that a relatively small proportion of them expressed felt needs regarding housing. Since electricity contributes to the higher level of living of USERS, increased felt needs for housing improvements would appear to be a second order effect of electrification.

Table 76

Responses to Services Needed to Improve Life by Users Variable, Colombia

Users Categories	1 (Housing)	2 (Farm)	3 (Money)	4 (Work)	5 (Services)	6 (Electricity)	7 (Other)	TOTAL
USERS	16.7 (38)	12.3 (28)	26.0 (59)	8.4 (19)	15.9 (36)	3.5 (8)	17.2 (39)	100.0 (227)
INACCESSIBLES	14.4 (14)	12.4 (12)	21.7 (21)	8.2 (8)	12.4 (12)	14.4 (14)	16.5 (16)	100.0 (97)
NON-ADOPTERS	27.6 (30)	12.8 (14)	23.9 (26)	5.5 (6)	11.0 (12)	6.4 (7)	12.8 (14)	100.0 (109)
TOTAL	18.9 (82)	12.5 (54)	24.5 (106)	7.6 (33)	13.9 (60)	6.7 (29)	15.9 (69)	100.0 (433)

It was not unexpected that a higher proportion of INACCESSIBLES than of respondents in the other user categories would mention electricity. For each user category the item most frequently mentioned was money. Although the difference is not great a somewhat higher percentage of USERS than of INACCESSIBLES or NON-ADOPTERS mentioned money. Data on the uses to which money would be put are presented in the next section.

When asked what the government ought to do to improve the community (Table 77), once again proportionately more USERS referred to money (26.1 percent) than did INACCESSIBLES (15.3 percent) or NON-ADOPTERS (16.1 percent). The most frequently mentioned item was services such as water, sewage, electricity and improved roads, referred to by more than one quarter of all respondents. The need for services was felt especially by INACCESSIBLES, more than one-third of whom mentioned that item. This finding is consistent with their desire for electricity revealed by the data in Table 76. Items related to agriculture were mentioned by more USERS than by INACCESSIBLES or NON-ADOPTERS, a difference which may reflect the larger size of farms of USERS. Many owners of very small farms also work, as occasions arise, as agricultural laborers on nearby large landholdings. The work tends to be seasonal and irregular, so it is not unexpected that substantially greater proportions of INACCESSIBLES and NON-ADOPTERS than of USERS mentioned work. Interestingly, electrification was rarely mentioned as something the government ought to do to improve the community.

Table 77

Response to What Government Ought to Do to Improve the Community by Users Variable, Colombia

Users Categories	1 (Agri-culture)	2 (Work)	3 (Services)	4 (Mon-etary)	5 (Other)	TOTAL
USERS	14.4 (28)	19.5 (38)	21.0 (41)	26.1 (51)	19.0 (37)	100.0 (195)
INACCESSIBLES	7.1 (6)	32.9 (28)	35.3 (30)	15.3 (13)	9.4 (8)	100.0 (85)
NON-ADOPTERS	9.7 (9)	28.0 (26)	30.1 (28)	16.1 (15)	16.1 (15)	100.0 (93)
TOTAL	11.5 (43)	24.7 (92)	26.5 (99)	21.2 (79)	16.1 (60)	100.0 (373)

When asked what services are received from the government "none" was the overwhelming response. Nearly two thirds of all the respondents (61.4 percent) so replied (Table 78). Proportionately fewer of the USERS, however, thought that they received no services from the government than was the case with INACCESSIBLES and NON-ADOPTERS. Electricity was mentioned by 10 percent of all respondents (45) almost all of whom (43) were USERS.

Table 78

Responses to What Services are Received From the Government by Users Variable, Colombia

Users Categories	1 (None)	2 (Electricity mentioned)	3 (Other utilities)	4 (Other)	TOTAL
USERS	52.2 (116)	19.4 (43)	8.1 (18)	20.3 (45)	100.0 (222)
INACCESSIBLES	68.4 (65)	0.0 (0)	6.3 (6)	25.3 (24)	100.0 (95)
NON-ADOPTERS	74.5 (76)	2.0 (2)	9.8 (10)	13.7 (14)	100.0 (102)
TOTAL	61.4 (257)	10.7 (45)	8.1 (34)	19.8 (83)	100.0 (419)

Size of Farm

Because of the manner in which the research population was defined and selected, deliberately excluding from consideration the large landholdings which dominate the area, most of the farms surveyed are relatively small. Only 16 of the farm operators interviewed, or 6.1 percent, had more than ten hectares or approximately 25 acres. Slightly more than one-half, 51.6 percent, operated farms of less than two hectares while the remaining 43.5 percent operated farms of from 2.0 to 9.9 hectares (Table 79). Nearly equal proportions in each user category farm the land: 61.2 percent of the USERS, 60.2 percent of the INACCESSIBLES and 53.6 percent of the NON-ADOPTERS.

An examination of Table 79 reveals that electricity use is positively associated with size of farm. USERS tend to have larger farms than either INACCESSIBLES or NON-ADOPTERS. The proportions who are users in each SIZE FARM category increases with increases in the size of farm. USERS own 14 of the 16 farms of ten or more hectares. On the other hand, smaller proportions of USERS than of the other two categories own places having less than two hectares (See Table 80). The differences in user categories are reflected in the median farm size of USERS which is 2.3 hectares, while for INACCESSIBLES and for NON-ADOPTERS it is 1.6 and 2.0, respectively. The disparity in size of farm between the user categories is further revealed by Table 80, in which the ratios of the percentages of users to the other categories are calculated. The ratios reveal that when USERS are compared with either INACCESSIBLES or NON-ADOPTERS, USERS are proportionately under-represented in the small farm sizes and over-represented in the larger farm sizes, while the reverse is true for the two categories of non-users of electricity.

Table 79

Percentages and Numbers of Respondents in Size of Farm (SIZE FARM) Categories by Users Variable, Colombia

Users Categories	SIZE FARM Categories 1 (Less than 2 ha.)	2 (2-9.9 ha.)	3 (10+ ha.)	TOTAL
USERS	49.3 (65)	57.0 (65)	87.5 (14)	55.0 (144)
INACCESSIBLES	28.0 (37)	18.4 (21)	6.2 (1)	22.5 (59)
NON-ADOPTERS	22.7 (30)	24.6 (28)	6.2 (1)	22.5 (59)
TOTAL	100.0 (132)	100.0 (114)	100.0 (16)	100.0 (262)

Table 80

Percentages of USERS, INACCESSIBLES, and NON-ADOPTERS by Size of Farm (SIZE FARM) Categories and Ratios of Percentages of USERS to INACCESSIBLES and NON-ADOPTERS, Colombia

Users Categories	SIZE FARM Categories 1	2	3	TOTAL
USERS (percentages)	45.1	45.1	9.8	100.0
INACCESSIBLES (percentages)	62.7	35.6	1.7	100.0
NON-ADOPTERS (percentages)	50.8	47.5	1.7	100.0
Ratio of percentages of USERS to INACCESSIBLES	0.719	1.267	5.765	--
Ratio of percentages of USERS to NON-ADOPTERS	0.887	0.949	5.765	--

Power Consumption and Alternative Energy Sources

This section focuses on the energy related activities of the survey population in the Rozo area of Colombia. This includes the ownership of appliances and importance of electricity among those served from central station sources as well as an analysis of characteristics related to electricity consumption and alternative energy costs for both electricity users and non-users.

Use of Electricity

Appliance ownership among surveyed users of CVC electricity in the Rozo area is presented in Table 81. Data in the table reflect ownership of electrical appliances for household use only among 207 respondents (88 percent of all USERS). The remaining USERS utilized electricity for both household and commercial activities. Appliance ownership is based on the use of electricity from less than one to a maximum of 12 years for individual respondents. However, 72.2 percent indicated they had been using electricity for only two years or less. Only eight percent reported experience with electricity prior to the use of CVC power in their present location.

Table 81

Household Appliance Ownership for Surveyed Electricity Users, Colombia

Appliance	Percent Owning
Iron	86.9
Electric Radio[1]	41.0
Television	12.6
Refrigerator	12.1
Blender, Beater	11.6
Electric Stove	8.7
Record Player	3.8
Sewing Machine, Washer	1.9

1. May be slightly over-stated because of confusion with battery radios.

Table 81 demonstrates the usual substantial ownership of electric irons and apparent relatively extensive use of electric radios. However, the ownership of all other common household electrical appliances is extremely limited among these respondents. All respondents of course used electricity for lighting, with 42 percent utilizing six or more light bulbs; use of fluorescent tubes was limited.

The question of who benefits from the availability of electricity for appliances is approached in Table 82, where appliance ownership by occupation is presented. Data in this table indicate appliance ownership regardless of use for household only or for household and commercial purposes combined.

Table 82

Appliance Ownership by Occupation for Surveyed Electricity Users, Colombia

Occupation[1]	Percent Owning Appliance		
	Stove	Refrigerator	Television
Merchant	13.6	13.6	9.1
Farmer	15.3	20.8	16.7
Skilled Labor	10.0	15.0	10.0
Unskilled Labor, Peon	2.3	8.1	8.1
Unemployed	0.0	10.5	15.8

1. Only one teacher appeared among the electricity users surveyed.

Appliance ownership is generally low for all occupation classes with the percentage of unskilled laborers owning refrigerators and television sets at the bottom. Surprising, is the low percentage of merchants with the indicated appliances, since these data include both household and commercial use. While the farmer class shows the most substantial ownership of these applicances, the differences among occupation classes are not great, with the exception of unskilled labor. The unemployed class included primarily females supported by children or relatives. Thus the benefits of electricity obtained through the use of common household appliances was quite limited among all occupation classes in the surveyed area of Colombia.

The concentration of appliance ownership was similar to that in Costa Rica. While only 20 percent owned any major appliance, 19 percent of those owning at least one, owned all three. The combination

of refrigerator and television set was owned by 32 percent, while a stove and refrigerator or television set was common to approximately 22 percent of those with at least one major appliance.

With the limited ownership of appliances, it is reasonable to expect lighting to be the most significant perceived benefit of electricity among users. This is supported by the data presented in Table 83. In response to open-ended questions regarding what could be done with electricity that could not be done without it, the major problem of a prolonged power failure, and the most important use of electricity, these respondents consistently answered "lighting." The ability to use electric appliances (and specifically irons) placed a distant second. Consequently, it appears the use of electricity for appliances is not well established, possibly due either to a lack of knowledge or economic means for making appliance purchases by other than some 20 percent of the USERS.

Table 83

Major Use and Importance of Electricity Among Surveyed Electricity Users, Colombia

Do With Electricity That Cannot be Done Without It		Major Problem if Electrical Failure For One Month		Most Important Use of Electricity	
Function	Percent	Function	Percent	Function	Percent
Lighting	37.6	Lighting	48.5	Lighting	57.1
Appliances	20.8	Ironing	12.4	Ironing	25.5
Ironing	16.4	Various	12.4	Refrigerate	5.2
Various	13.7	No Problem	9.0	Radio	4.3
Refrigerate	4.4	No Water	6.9		

Central station electricity has actually been utilized in the majority of surveyed households for only a few years. Nevertheless, it does not appear that low initial appliance use will increase rapidly, since 92 percent of the USERS indicated they had no plans for future appliance purchases. If these responses are reliable, then no major increases in energy demand (or revenue) can be expected in the near future from the construction of these lines, except through additional connections along the existing lines. With the proximity of such urban centers as Palmira and Cali, it is reasonable to assume that most USERS are well aware of the potential application of electricity in the household. Consequently, promotional or educational programs

would seem to be of little value for increasing electrical use. Indications are that economic or other social factors result in limited appliance ownership and low electricity consumption in this area.

Turning to the non-users of electricity (NON-ADOPTERS and INACCESSIBLES), the expected uses and benefits were similar to those demonstrated above for current users. Less than two percent of the non-users had ever had electricity in their homes. Yet nearly 95 percent considered the availability of electricity an advantage. Both NON-ADOPTERS and INACCESSIBLES gave similar answers regarding the advantages of electricity as indicated in the following statements:

Stated Advantage	NON-ADOPTERS	INACCESSIBLES
Economy of electricity	52.0%	48.4%
One could live more comfortably	20.0	20.4
Useful for lighting	8.0	15.1
One could have appliances	7.0	4.3
Other reasons, varied	9.0	5.4

The primary use of electricity for household lighting purposes and the low electric rates combine to make the economy of electricity the major advantage perceived by non-users. Consistent with the demonstrated situation of current users is the low priority given to the use of household appliances by these respondents.

Alternative Energy Costs

To determine the actual economy of electricity as a household energy source, all respondents were asked to reveal their expenditures for candles and kerosene. The use of bottled gas was very rare among surveyed respondents and thus was not considered a common alternative. Firewood also was not considered in the cost comparison since family members supplied most households without incurring cash expenditures. The cost of electric service among USERS was determined from billing records in the CVC offices in Palmira. These comparative energy cost data are presented in Table 84.

Table 84

Expenditures for Alternative Household Energy Sources by Electricity Users and Non-Users, Rozo, Colombia

Users Categories and Energy Sources	Percent Using	Average Cost in Col. $ Per Month— (All Consumers)
USERS		
Candles	41.0	$ 3.76
Kerosene	81.3	39.12
All non-electric sources	—	42.88
Electricity[1]	100.0	15.20
Total USERS cost	—	Col. $58.08
NON-ADOPTERS		
Candles	98.1	21.65
Kerosene	82.7	31.61
Total Cost	—	Col. $53.26
INACCESSIBLES		
Candles	100.0	24.14
Kerosene	63.9	24.47
Total Cost	—	Col. $48.61

1. Based on average monthly household consumption of 40.0 kwh for 111 respondents who had electric service throughout 1972.

Clearly, a direct cost comparison such as that presented in Table 84 does not tell the complete story of any alternative energy source. Such factors as convenience and the availability, quality, and reliability of the energy source in relation to given functions must be considered. However, it is apparent from these data that the use of electricity (limited primarily to household lighting and for ironing) does not produce any substantial economic disadvantage for electricity users. In fact, if the total cost of household lighting is attributed to electricity and candles (the use of kerosene lamps was limited), then the comparative economic advantage to USERS, NON-ADOPTERS, and INACCESSIBLES is $18.96, $21.65, and $24.14, respectively. Examination of the data indicates that the higher total expenditures for energy among USERS results from a greater use of kerosene (to operate stoves). Consequently, it appears that because of the extremely low electricity rates in Colombia, this energy source provides a direct comparative economic advantage even when used only to meet minimal household energy needs.

Characteristics Related to Electricity Consumption

In addition to examining appliance ownership and alternative energy costs, analysis of electricity users among surveyed respondents in Colombia focused on characteristics related to levels of household electricity consumption. Results of this analysis are presented in Table 85. Experience with a similar analysis for Costa Rica as well as a general examination of the Colombian data indicated a two-level classification of electricity consumption would provide sufficient refinement. The analysis is limited, however, by a relatively small number of cases. Since electricity consumption is generally assumed to increase over time, it would not be appropriate to combine respondents with variable periods of electric use for this type of analysis. Among surveyed electricity users in the Rozo area, this resulted in the selection of 44 respondents with continuous electric service over a period of two years.

Table 85

Selected Characteristics of Surveyed Respondents by Levels of Electricity Consumption, Colombia

Characteristic	Units	Ave. Monthly Elect. Use 1972, kwh	
		0 - 40	41+
Observations[1]	No.	33	11
Ave. Age	Yrs.	49.0	54.2
Ave. Education	Yrs.	2.7	2.0
Those with Land	Pct.	66.7	100.0
Ave. Amt. Land	Plazas	2.6	4.4
Previous Use of Elec.	Pct.	0.0	9.0
Birthplace			
Same Neighborhood	Pct.	63.6	54.5
Cali	Pct.	9.1	0.0
Other, Cauca Valley	Pct.	24.2	36.3
Other, Colombia	Pct.	3.1	9.2
Occupation			
Merchant	Pct.	3.1	0.0
Farmer	Pct.	40.6	54.5
Skilled Labor	Pct.	3.1	9.1
Unskilled Labor, Peon	Pct.	40.6	27.3
Unemployed	Pct.	12.6	9.1

1. Total of 44 respondents with continuous electric service over a period of two years.

Results of the analysis presented in Table 85 show those in the low consuming group to be on the average somewhat younger and to have slightly more education. However, a greater percentage are in the unskilled labor categories and are less likely to own or use a piece of land. A substantial number in both groups had been born in the same neighborhood or in close proximity to their place of residence at the time of the survey. Previous experience with electricity was virtually non-existent. These results tend to contradict the similar analysis of electricity users in Costa Rica. The most obvious difference between the two survey areas which might account for the discrepancy in results is the extent of in-migration prevalent in the San Carlos area compared to the out-migration characteristic of the Rozo area. Undoubtedly other (unknown) factors are significant. The analysis for merely these two areas indicates a universal formula for predicting levels of household power consumption is indeed complicated.

In Table 86, the average monthly and annual change in household electricity consumption is presented for selected groups for which data were available over a uniform time period. The first section indicates the average change in consumption over a two year period for the respondents on which the characteristics analysis was based. While data for these respondents show a 22.3 percent increase between the first and second year, continuing increases of this magnitude are not likely. Similar data for 15 respondents with electricity over three years also shows a substantial increase after the first year followed by an actual decrease in electricity consumption in the third year. Finally, analysis of another small group of surveyed households with continuous electric service over a period of eight years demonstrates erratic shifts in electricity consumption.

The electricity consumption data for those with service over various time periods presented in Table 86 does not show any consistent pattern. However, in two of the three cases, a substantial increase followed the initial connection year. While these percentage changes are dramatic, the absolute change in electricity consumption is limited by the low average kilowatt-hour base. Because of the lack of time-series data, it is impossible to determine the factors responsible for these fluctuations in electricity use. However, these data do indicate a significant area for inquiry because of the importance of estimating potential demand and revenue for new system feasibility.

Table 86

Average Monthly and Yearly Household Electricity Consumption Over Selected Time Periods, Colombia

Year	Ave. kwh per Year	Ave. kwh per Month	Percent Change
Two Year Observations for 44 Households			
1971	397.48	33.12	—
1972	486.27	40.52	22.3
Three Year Observations for 15 Households			
1970	299.87	24.99	--
1971	402.00	33.50	34.1
1972	392.53	32.71	-2.4
Eight Year Observations for 25 Households			
1965	475.28	39.61	--
1966	449.76	37.48	-5.4
1967	440.16	36.68	-2.1
1968	440.68	36.72	0.1
1969	474.08	39.51	7.6
1970	533.52	44.46	12.5
1971	596.96	49.75	11.9
1972	562.24	46.85	-5.8

Overall from 1965 to 1972 = 18.3% increase or an average of 2.3% per year increase in household electricity consumption for those sampled.

Source: Compiled from billing records in CVC Palmira office for surveyed consumers.

Supplementary Interviews and Observations

As indicated in an earlier part of this section, the intensive survey of households in the Rozo area did not include the large haciendas. These enterprises were left to separate investigation because of the diversity and magnitude of their operations in relation to the actual or potential use of central station electricity. The selection of farms for these interviews was based on their proximity to a location along the primary roads around the intensive survey area. This procedure was utilized both to maximize the use of limited transportation facilities and to provide a more comprehensive evaluation of the impact of rural electrification in a given area. Interviews with the owners, managers, and workers of these enterprises and related agri-business people are reported on in this section.

The objectives of this case-study approach were to determine the various productive uses of electricity, specific examples of economic or other benefits or disadvantages of rural electrification, and the extent of alternative energy sources. However, before discussing the use of electricity for irrigation pumping and in dairy, poultry, and agricultural processing activities, it is appropriate to examine some characteristics of agricultural activities in the Cauca Valley which influence the farm use of electricity. These charactersitics include: absentee land owners, the scale of agricultural enterprises, payment for electrical connections, the proximity of large urban markets, and the lack of strong producer or cooperative organizations.

An immediate discovery from conducting farm interviews was that farm owners were generally not on their farms during the week. In relation to conducting the survey, this meant not only the farm manager had to be interviewed but also the owner generally had to be located to obtain complete information about the enterprise. More importantly, this factor was significant in relation to the use of electricity. Since the owners did not live on the land, they did not find it necessary to make CVC electricity available merely for the household purposes of managers or workers. (In a few cases a small gasoline or diesel generator was provided for the purposes of limited lighting and pumping water.) Secondly, it was apparent in some cases, that a result of absentee ownership was some confusion in the decision-making process. Most managers evidently did not have the knowledge or authority to suggest or make capital investment improvements on a farm, while some owners did not appear to be fully aware of the details of their agricultural operations. Consequently, considerable delay could result before the application of electricity or other technological innovations to productive functions. Many of the owners were also distracted by business or professional activities in Cali or other cities.

The majority of farms surveyed ranged in size from 100 to 1,000 plazas, with the larger operations run on a corporate basis and involved in integrated production and marketing functions. Productive activities included sugar cane, cotton, soybeans, and milo, with some dairy and beef cattle operations. Because of the extensive landholdings, electric distribution lines had to be strung some distance to service individual farmsteads. Furthermore, the general predominance of crop activities and related energy needs for irrigation pumping created the need for dispersed power lines.

Complicating the decision to use electricity on these farms was the CVC policy that farm operators were responsible for the total cost of connections from the nearest transmission line. An electrical contractor indicated the cost of such extensions was about US$2,500 per kilometer for materials and labor (excluding transformers). Credit was said to be available from the Agricultural Bank or from electrical contractors (for up to 60 days). All private connections were done by contractors approved by CVC and under plan approval and site inspection by CVC personnel. However, the substantial cost of constructing lengthy private distribution lines meant intensive use of electricity was necessary to justify the investment for most farm owners.

Another factor significant in relation to the farm or rural use of electricity in this area was the proximity of such urban centers as Cali and Palmira. Besides providing the amenities of an urban environment for wealthy farm owners, these cities were also central locations for the storage and processing of agricultural commodities. With the exception of sugar mills, only limited agricultural processing activities were observed in the rural area surveyed.

Finally, the lack of strong producer or cooperative organizations would appear to reduce the effectiveness of such potential electricity users as dairy farmers in influencing government policy toward their industry. Perhaps more importantly, the lack of such organizations eliminated the possibility of directed educational activities concerning the use of such technological inputs as electric energy. This was most apparent in comparison to educational activities of the milk producers cooperative in San Carlos, Costa Rica.

The influence of these characteristics or factors on the farm use of electricity in the Cauca Valley area surveyed indicate the importance of considering aspects beyond the individual enterprise level in feasibility or evaluation studies. Thus the comprehensive aspects of such studies should include land tenure arrangements, electric service charges, organizational institutions, and the proximity and influence of urban centers on agricultural production, processing, and marketing.

Irrigation

The use of electricity for irrigation pump motors was the primary productive use of electricity on surveyed farms. Irrigation, together with the favorable climatic conditions of the Cauca Valley,

permitted multiple cropping or year-round pasture. A few farms were able to cap artesian wells for irrigation purposes and some others drew limited quantities of water from diverted streams with the use of small gasoline or diesel operated pumps. However, the most common method for dependable irrigation was through the use of deep wells (100 to 180 meters) and diesel or electric pump motors.

The cost of drilling wells and constructing most other facilities for irrigation are the same regardless of the power source used for pumping water. Productivity increases from irrigation result from the application of water regardless of the energy source. Consequently, the relevant cost comparisons are the fixed and operating costs of the commonly used energy sources.

It is not possible to state definitively that electric motors are cheaper than diesel for all irrigation purposes because of the differing conditions prevailing in various countries and areas. However, the factors involved in determining which energy source is more economical in a given situation may be presented based on the experience of farmers in the Cauca Valley. These factors would include: original cost (including import duties, taxes, and restrictions), depreciation schedules, the availability and cost of fuel or electricity (including applicable demand charges for electricity), the availability of spare parts and repair facilities, the availability of skilled labor, cultivation practices, and the regularity of rainfall.

Among farmers surveyed in Colombia, as is probable in most all cases, the original cost of electric motors was considerably less than for comparable diesel units. In addition, the life of electric motors is normally 20 to 25 years compared to 12 to 15 years for diesel units. In most developing countries, these motive sources would be imported or at best only assembled in the country. Consequently, both would be subject to import delays, duties, and restrictions. In relation to operating costs, the comparative price of diesel fuel and electricity are the most obvious factors. However, the dependability of these energy sources and anticipated price changes must be closely examined. The cost of imported fuel is subject to world market conditions and foreign exchange policies, while the supply of hydro-generated electricity may be subject to weather conditions. The generally low incidence of operational failures together with low maintenance and repair costs are important factors in favor of electric motors. General maintenance and overhauls contribute substantially to the operating cost of diesel motors. The lack of skilled personnel can result in failure of or damage to diesel equipment and the lack of parts or mechanics may create substantial delays during critical irrigation periods. However, where irrigation needs are less critical due to cultivation practices or nearly adequate rainfall, diesel motors might prove more economical for limited use (especially when considering the fixed demand charge for electricity common to most distribution systems).

Among farmers surveyed in the Rozo area, opinions varied as to whether electric or diesel motors were a more economical energy source for irrigation purposes. The variation was generally due to the

applicability of the factors noted above to individual cases. An economist at one large sugar plantation estimated the fixed and operating costs of their diesel irrigation pump motors were less than for electric motors. This was based, however, on the fact that the enterprise had over 20 irrigation wells spread over extensive landholdings. With trained personnel, standby units, and their own repair facilities, this firm did not experience costly delays from breakdowns, lack of spare parts, and employee negligence, problems common to smaller enterprises with only a few wells and motors.

Many farm owners had changed or were in the process of changing from diesel to electric motors for their irrigation needs. They cited the advantages of electric motors as lower initial cost (including transformers and switches), lower maintenance cost, reduced labor input for operating the motors, and avoidance of delays in irrigating during critical periods while waiting for parts and repairs to diesel motors.

In areas such as Rozo where farm owners are responsible for the total cost of distribution lines on their farms, the cost of delivering electricity to the well head must also be entered in any comparative cost equation. Among farm owners surveyed, the cost of this construction (and especially transformers) was a definite factor in the still limited productive use of electricity. This suggests that alternative financing methods or more liberal credit arrangements would increase the farm use of electricity.

Dairy Farms

The use of electricity on dairy farms in the Rozo area provided one of the most interesting contrasts with the situation in San Carlos, Costa Rica. Despite the proximity of mass urban markets, dairy farmers in the Rozo area were switching from dairy to crop activities. This fact was attributed to the government controlled price for milk, rising land values and taxes, lack of security for dairy herds, fear of agrarian reform legislation, and lack of skilled labor. Consequently. dairy herds were being sold or reduced and where electric lines had previously been constructed, available electricity was not being used for milking equipment (and in a few cases such equipment had been sold).

A common complaint of dairy farmers was that the low profit margin in the industry did not permit them to make capital investments in electric milking or cooling equipment. Since there was no legal requirement of pasteurization, dairymen commonly milked only once a day and delivered the milk immediately to wholesalers or directly to consumers. Consumer acceptance of crude milk and the controlled price of this and pasteurized milk provided little incentive for better quality and increased efficiency through the use of electrical equipment on dairy farms. Those farmers who had experimented with electric milking equipment indicated they had problems finding and keeping workers capable of

operating such equipment. Such workers were apparently in demand in nearby Palmira or Cali and found the working environment and wages preferable in the cities. Finally, some farm owners felt that approaching agrarian reform legislation would look more favorably on land intensively exploited through crop production than through dairy or beef cattle activities.

Despite an apparent potential application of electricity in the dairy industry, factors often beyond the farm level reduced or eliminated this possibility. This situation demonstrates the care which must be taken in feasibility studies to examine all factors, both short and long range, which might possibly disturb the potential productive application of electricity on which a project area might be selected.

Poultry Operations

No large poultry operations were observed in the surveyed area around Rozo. However, since such enterprises have the potential for the productive use of electricity, it was decided to survey a few egg producers located near Palmira. Egg production of the firms visited ranged from 200 to 500 dozen per day. No other activities were engaged in by these specific enterprises so that chicks and all feed grains were purchased. However, some of the owners were involved in other business or professional activities.

All of the operations visited were using central station power, though electricity was not being utilized to the fullest extent possible. Most common uses were for water pumps, feed mixers, heat lamps for chicks, and security and general lighting. Electricity was not being used to provide a totally controlled environment for optimum production. Furthermore, eggs were generally marketed every two days and no cool storage facilities were used at the production site. Discussion with a hatchery manager and examination of a poultry industry survey indicated that while the enterprises visited were somewhat smaller than some others in the area, their basic operation was very similar. Apparently marketing problems and a substantial rate of producer turnover were chiefly responsible for the lack of greater technical sophistication in the industry.

Industry

The proximity of Palmira and Cali, established marketing, trade, and industrial centers, has resulted in little rural industrial activity. The major exception were sugar mills which were often situated in the midst of their raw material. A metal furniture manufacturing firm operating on a part-time basis was the only non-agricultural industrial concern in the survey area. The reason given by the owner for locating in a rural area was the tax incentive provided by local government.

Agricultural processing activities surveyed in the area included a milk pasteurizing plant and an ice cream plant. Production of pasteurized milk averaged about 40,000 bottles per day in January, far below plant capacity. A mixture for ice cream was also produced here and sent to Cali for further processing. Raw milk was supplied by producers throughout and beyond the Cauca Valley. This supply was declining, however, as some farmers went out of the dairy business and others sought higher profit margins through the direct sale of crude milk. The pasteurizing plant had utilized CVC electricity since its founding in 1961, though they also maintained a 75KW standby diesel power plant.

An ice cream processing plant in the area had also been using CVC electricity for some 10 years. The firm employed 30 workers and produced ice cream, yogurt, and butter. It was interesting to note that the farm on which this plant was situated had once been a dairy operation supplying milk for processing, but five years ago the owner had converted the farm to sugar cane and was now purchasing milk from other dairy farmers in the area. The reasons given for this change were those previously mentioned in the discussion of the dairy industry.

Conclusion

The present impact and potential of rural electrification for large farms and agri-business in the surveyed area of the Cauca Valley tend to be related to factors external to the individual farm or business decision maker. This is most evident in the dairy industry and related processing activities where a decline attributable to pricing policies, agrarian reform, and rising land values have diminished the potential productive application of electricity. Likewise, potential rural industrial and agricultural porcessing firms tend to locate in nearby urban labor and marketing areas.

The real value of rural electrification for irrigation pumping in this area has only recently begun to be realized. While the comparative economic advantage of electric over diesel motors must generally be evaluated on an individual farm basis, it is apparent that when such factors as maintenance costs, operating personnel, convenience, and dependability are considered, electric irrigation pumps will become more common than diesel units. The primary limitation at present appears to be the often substantial initial investment by the farm owner for construction of farm distribution lines.

These supplementary observations in Colombia thus indicate the significance which should be attached to comprehensive studies in evaluation or feasibility surveys of rural electrification projects.

Sevilla-Caicedonia Electric Cooperative

While primary study emphasis in Colombia was on a state-owned electric distribution system, an attempt also was made to evaluate effects on change of a cooperative electric distribution system. The electric cooperative studied is located in the municipios of Sevilla and Caicedonia in the Department of Valle. It was established by the Colombian Government with the technical assistance of the Corporacion Autonoma Regional del Cauca (CVC) and the financial assistance, including some foreign technical assistance, of the United States Agency for International Development.

Description of Area

The project area encompasses 743 square kilometers (287 square miles), an area almost five times as large as Washington, D. C. The Municipio of Sevilla with 557 square kilometers is three times as large as the Municipio of Caicedonia with 186 square kilometers.

Temperature in the area is considered moderate. Altitude in most of the project area is between 1,000 and 2,000 meters above sea level. The region is characterized by relatively high humidity and has an annual rainfall of 1,700 millimeters (66.9 inches) which is especially favorable for coffee growing. Rainfall is approximately the same in both municipios.

The Municipio of Sevilla is a mountainous area that varies in altitude from 1,100 to 3,500 meters. Only in three areas in the Municipio, La Astelia, La Estrella and El Venado, are there small valleys. The city of Sevilla is at 1,598 meters in altitude.

The average temperature in Sevilla is 18 degrees C. (64 degrees F.). Temperature variation throughout the year is slight. During the year there are two rainy periods and two dry periods. The first rainy period is in March, April, May and part of June. The second rainy period begins in September and lasts through October, November and the first part of December. The other months are the dry periods.

The Municipio of Caicedonia also is located in a rugged mountainous area. Some of the northern part of the Municipio of Caicedonia is less mountainous and more favorable to cultivated crops than any other sector in the project area. This is the area where most of the sugarcane is grown within the cooperative boundaries.

The altitude of Caicedonia is 1,100 meters and the average temperature is 26 degrees C. (79 degrees F.). Thus, the city of Caicedonia is lower than Sevilla and the temperature is higher. The rainy periods and the dry months are the same in Caicedonia as in Sevilla.

The ethnic composition of the population in Sevilla and Caicedonia is based on families that have migrated to the area from Antioquia. Their ancestry is of the old Spanish families that settled in the western part of the Department of Antioquia. They were known for their adventuresome

spirit and their desire for conquests. They reputedly had a strong love for work. The rural population of Sevilla and Caicedonia makes up some 40 percent of the municipio's total population.

Development and Organization

The Sevilla-Caicedonia (Se-Ca) Rural Electric Cooperative, according to the feasibility study, was developed "to electrify a region of intensive farming of coffee, bananas, oranges, yuca and related products" in the Cauca Valley. It was to serve the "needs of its consumers through a self-help project." The towns were "to serve as a nucleus so that power lines could be extended to its supporting farm and trade areas."

In November 1962 the United States Agency for International Development contracted with the National Rural Electric Cooperative Association to "provide technical assistance for the development of rural electrification, rural industries and community facilities in the developing countries." That same month, Louis B. Strong, an NRECA Rural Electrification Specialist, began an assignment in Colombia to conduct an initial investigation and organization of the cooperative area.

In his report Strong stated, "The Sevilla and Caicedonia areas, with fairly large concentrations of potential users of electricity and with the consumers presently receiving electricity paying a fairly high rate for very poor service, would seem to provide a good location for a pilot rural electrification project.

"This project would provide a pattern for treating larger rural towns supported by agricultural production and the farms around that town as a single project with electric rates at a level sufficient to support electrification in both the towns and the farms of the area."

Strong concluded that rural farms in Colombia, "could not be supplied as separate projects at rates comparable to that now being paid by urban users. So it is apparent that either:

"1. Farm users must pay considerably higher rates for electricity than city users.

"2. Some type of subsidy must be introduced into farm electrification.

"3. Town and farm users must be grouped together and given a composite rate.

"4. Or some combination of the above systems must be worked out."

It was apparent that if farm users were to pay higher rates for electricity than city users, rural residents would have to wait many years for electrification. Therefore, a combination of alternatives two and three were incorporated into the project.

Design of the distribution system was based on CVC standards and on specifications developed by the Rural Electrification Administration in the United States Department of Agriculture. The system as designed was expected to be sufficient to meet demand for 10 years after energization. It was assumed that any growth in demand in this period could be supplied by construction financed by accumulated margins.

Electric power for the rural electric cooperative was to be supplied by CVC through its grid system, using thermo and hydro energy. Concrete poles were to be used throughout the distribution system. The pole construction plant used by CVC is mobile and poles were to be constructed in the project area. Crossarms were to be obtained locally and constructed of Camino wood. This wood is considered to be of excellent quality and has been used for many years. All transformers were to be single phase.

On May 11, 1964, the United States Agency for International Development approved a loan request for $1,025,365. The remaining cost of the project was provided by CVC. Terms of the AID loan to the Government were for 35 years with a maximym grace period of 10 years and interest at 2 percent per year. The grace period began July 12, 1966.

The $1 million loan for construction of the Se-Ca Rural Electric Cooperative was processed by two other organizations before reaching the cooperative. The United States Agency for International Development made the loan to the Colombian Power Development Institute, Instituto de Aprovechamiento de Aguas y Fomento Electrico (Electraguas). Electraguas, as the borrower acting for the Colombian Government loaned the funds to the regional power authority, CVC. The CVC in turn loaned the funds to the cooperative and shortened the grace period from 10 years to five years.

The Se-Ca Rural Electric Cooperative was legally recognized as the Cooperativa Integral de Electrificacion Sevilla-Caicedonia on December 11, 1964. It, however, did not begin providing electric service in rural areas until the beginning of 1969.

Operational Plans

The cooperative is privately owned. Its governing body consists of (1) the Member's General Assembly, (2) the Board of Directors, and (3) the Board of Control or Audit Board.

The General Assembly, composed of the entire membership, is the highest authority. Direction and administration of the cooperative is vested in a Board of Directors. According to pre-organization plans, the board was to consist of six members elected by the General Assembly, including a president and secretary. Officers of the board were to serve for one year while all board members were to serve three year terms.

The manager is appointed by the Board of Directors. He has the direct management of the operations of the cooperative under the supervision of the Board of Directors.

The General Assembly also elects an Audit Board, composed of a president, a secretary and a general assembly member. The functions of this board include verification of audits and supervision of the administrators.

By-laws of the cooperative set forth in detail the manner in which the cooperative is to be operated.

The main office of the rural electric cooperative is located in Sevilla with a branch office in Caicedonia. Total personnel needed by the cooperative after energization was estimated in the loan application to be 29.

An agreement to establish an understanding of supplemental assistance by CVC to the cooperative was developed. The assistance was to be in the form of operation, maintenance, billing, collecting, accounting and engineering and technical service.

The agreement was to provide that as soon as the cooperative became financially able it would either pay CVC for these services or assume responsibility for such service itself.

Operational Problems

In 1972 CVC conducted a study of the Cooperative's operations and reported its findings in a document entitled, "Situacion Actual y Restruturacion Futura de la Cooperativa Sevilla-Caicedonia." The study and report were prompted by the apparent inability of the Cooperative to make loan repayments according to schedule. According to the CVC report, this situation developed as a result of the hiring of too many employees leading to excessive administrative costs, distribution of employees between Sevilla and Caicedonia, accounting procedures used by the Cooperative, increasing line losses, and the policy of Cooperative sale of electric appliances.

In order to remedy these problems, it was suggested that CVC have a greater involvement in the management of the Cooperative. CVC could also provide more direct technical assistance for design, construction, operation, and maintenance of the distribution system. Additional suggestions were that Cooperative members should contract with private firms for lengthy secondary extensions and that the appliance sales business of the Cooperative should be eliminated to avoid tying up capital in inventories.

A major problem facing the Cooperative was the need to repay the loan at the current exchange rate. Dollars to build the system had been borrowed in 1964 at an exchange rate of Col$13.50 per United States $1.00. The exchange rate in 1973 had increased more than 50 percent causing the Cooperative to pay back to CVC 150 percent of the equivalent Colombian pesos it had taken to build the system.

Membership and Rates

At the time of a field study in February, 1965, it was estimated that membership of the cooperative within three years after energization would total 9,000--1,700 would be rural and 7,300 would be urban. Actual energization was not until 1969; therefore, the system had been in operation approximately three years at the time of the second field study in February 1973. Membership at that time was 8,000, including 5,000 Cooperative members and 3,000 who became members when the Cooperative took over the private system existing in Sevilla. Approximately two-thirds of the members were urban and one-third were rural.

Members pay a cooperative membership fee of Col$50.00 per share, which is in accordance with pre-electrification plans. Actual membership of the Board of Directors in February, 1973 totaled 14. In February, 1965 the Cooperative was planning six members on the Board. Prior to November, 1971 the Cooperative provided free to each member up to 250 meters of line and a 3 KVA transformer. Any extension beyond 250 meters was paid for by the member. After November, 1971 materials were in short supply and the Cooperative began charging for all construction materials.

Electric bills are paid every two months by the consumers. Records are maintained by CVC at its central office in Palmira. There is a minimum charge of Col$14.80 for each member for each two-month period. This is equivalent to a consumer rate of 20 kWh per month, which was in accordance with the feasibility study.

The proposed retail rates in the feasibility study, however, were lower than the actual rates in effect at the time of the field study. The proposed retail rates ranged from Col$0.23 per kWh for city residential to Col$0.26 per kWh for rural residential. The rates in effect in February 1973 were: Residential--Col$0.37 per kWh (10 percent was added for rural consumers); Commercial--Col$0.37 per kWh; and Industrial--Col$0.224 per kWh plus Col$9.60 per KVA demand charge.

Each of the five panela (brown sugar) factories being served by the Cooperative had 100 KVA transformers. Two case studies indicate use of electricity by the sugar industries. One industry previously had used its own hydro-electric power plant. When electricity from the Cooperative became available, it began using power for a cane chopper and lighting for the owner's residence. The owner, however, retained use of a large water wheel to operate the extractor. After the juice was extracted, stalks were used to fire the boiler. The plant was in operation the year-round.

In the second case study, the owner was using Cooperative electric power for a 60 hp. motor to operate the extractor. Previously, he had used a diesel motor. Unlike the first case study the coffee farm was located on a hill and did not have access to

water power. About 150 hectares of sugarcane were required to keep the panela factory operating eight months per year. Three production lines were used to produce 1,000 double cakes of panela each month. Although the owner complained of the high cost of electric power, especially the demand charge for the 100 KVA transformer when the plant was idle, he recognized the economies and efficiencies of having an electric motor.

Purchase of Appliances

Fifty rural households in the municipios of Sevilla and Caicedonia were interviewed during the benchmark study in 1965. Respondents were asked what electrical appliances they intended to purchase after electricity became available. An attempt was made in February, 1973 to determine if the respondents had carried out those intentions.

Among the 50 households originally interviewed in February, 1965, only 20 could be located for follow-up data in February, 1973. Eleven of the 20, 55 percent, had used Co-op electricity for less than two years. An additional 20 percent still were not using electricity. The remaining 25 percent had used electricity for less than four years. The main reason for the delay in utilization of electricity was the length of time for implementation of the loan and the delay in construction of the distribution lines in the rural areas. Most of the respondents utilizing electricity had become consumers as soon as electricity became available. It is significant, however, that one-fourth of the sample were not using electricity although it was available.

In 1965 respondents were asked the number and type of appliances they anticipated purchasing within one year and three years after electricity became available. Those figures are compared with appliances actually purchased within the applicable specified time frame for 20 respondents in Table 87.

Respondents on the average tended to anticipate purchasing more of the common appliances, such as electric radios, electric irons, water pumps and washing machines, than were actually purchased. Anticipated purchases of lights and larger appliances, such as television sets and refrigerators were similar in number to actual purchases. Purchases of less common appliances, such as electric blenders, record players, heaters, and office equipment were underestimated.

Table 87

Anticipated and Actual Purchases of Electrical Appliances by 20 Rural Households in Colombia, 1965 and 1973

Electrical Appliances	Anticipated Purchase Number	Actual Purchase Number	Actual as a % of Anticipated Percent
Light bulb	427	384	90
Fluorescent tube	29	43	150
Radio	23	12	50
Iron	24	18	75
Television	6	6	100
Refrigerator	9	8	90
Stove	1	2	200
Washing machine	8	3	40
Sewing machine	1	1	100
Electric motor	18	2	10
Water pump	6	3	50
Other	6	17	280

Comments

Difficulty in locating households during the follow-up study indicate the tendency toward migration of the rural population. Although 20 of the original 50 households interviewed in February, 1965 were located, only 10 of the 20 interviews were conducted with the same person who had been interviewed 8 years earlier. The remaining 10 interviews were conducted with other members of the family or the Mayordomo who was operating the farm for the owner.

Consumption of electricity among the 10 households re-interviewed varied substantially. For example, one respondent in 1972 consumed less than 6 kWh. This was an exception, however, and records of most of the respondents showed an average monthly consumption of about 60 kWh. Some of the respondents were using well over 1,000 kWh per year--one respondent was averaging about 150 kWh per month.

Perhaps the most significant finding is the over estimation in purchases of electric motors. In 1965 the 20 respondents indicated they would purchase 18 electric motors, primarily for dispulping coffee and cutting sugarcane stalks for cattle feed. Actual electric motors purchased only numbered two. This indicates that productive use of electricity in the 20 rural households is not as great as was anticipated.

A major policy error apparently was made when it was assumed any growth in demand for power could be provided through construction financed by accumulated margins. The Cooperative has had to initiate a policy of requiring individual consumers to finance new construction. Margins have not been sufficient to make regular repayments of the loan--let alone finance construction to meet increased demand for electric power.

The number of Se-Ca members and electricity consumption by classification over a seven year period is presented in Tables 88 and 89. The number of residential consumers increased substantially over the years, in part due to the extension of distribution to the municipalities beginning in 1969. However, the increase in the number of commercial and industrial users was more limited and residential users remained a high percentage of the total. Data on annual electricity consumption by classification, Table 89, seems to indicate some inconsistencies in use or reporting, though these were official statistics of CVC.

Table 38

Number of SE-CA Consumers by Classification, 1965-71

Classification	Annual Average Number of Consumers						
	1965 No.	1966 No.	1967 No.	1968 No.	1969 No.	1970 No.	1971 No.
Residential	1,160	2,684	2,684	2,684	5,151	5,699	6,360
Commercial	2,594	1,172	1,172	1,172	1,134	1,162	1,201
Industrial	-	-	-	-	24	29	36
Other	-	-	-	-	96	110	110
Total	3,755	3,856	3,856	3,856	6,405	7,000	7,707
Residential as Percent of Total	30.9	69.6	69.6	69.6	80.4	81.4	82.5

SOURCE: Corporacion Autonoma Regional del Cauca (CVC), Division de Ingenieria Electrica, Informe Semestral, Estadisticas de Energic Electrica, Julio e Diciembre, 1971

Table 89

Electric Consumption by Consumer Classification, SE-CA, 1965-71

Classification	Annual Consumption (mwh) *						
	1965 mwh	1966 mwh	1967 mwh	1968 mwh	1969 mwh	1970 mwh	1971 mwh
Residential	5,127	4,104	3,447	3,553	2,908	3,028	4,208
Commercial	-	3,529	2,528	2,460	1,684	1,782	2,052
Industrial	-	-	-	-	138	360	274
Other	2,629	274	-	-	870	1,704	1,186
Total	7,756	7,907	5,975	6,013	5,600	6,874	7,720
Residential as Percent of Total	66.1	51.9	57.7	59.1	51.9	44.1	54.5
Average Load Factor	32.8	39.2	25.3	22.8	22.0	26.1	32.8

* Distribution in the municipalities of Sevilla and Caicedonia by SE-CA did not take place until 1969.

SOURCE: Corporacion Autonoma Regional del Cauca (CVC), Division de Ingenieria Electrica, Informe Semestral, Estadisticas de Energic Electrica, Julio e Diciembre, 1971.

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ABRIDGED SURVEY SCHEDULE

Name of interviewer_____ Questionnaire No._____

Date_____
Month Day Year

Name of nearest town_____

Distance from nearest town_____miles

This house or business is North_____ South_____ East_____or West_____

THE RESPONDENT AND FAMILY

Name of respondent_____

1. The respondent is:

Male head of household	Female head of household	Wife of head of household	Child of head of household
_____	_____	_____	_____

Other: Explain_____

I'd like to begin by asking you some general questions about you and your family.

2. Where were you born _____
State County Township

3. Have you always lived in this house? No_____ Yes_____ → 6

4. How long have you lived in this house? _____years

5. Where did you live before?

In the same state _____

In the same county _____

In the same township _____

Elsewhere, please specify where_____
State County Township

6. I'd like to ask some questions about your family and others who live in your house.

Relationship to Head of Household	Name	Sex M or F	Age	Marital Status	Last Year of Education	Occupation	Where does he live?
Head of Household							
Spouse							
Children who live in this house	1.						
	2.						
	3.						
	4.						
	5.						
	6.						
	7.						
Children who do not live in this house	1.						
	2.						
	3.						
	4.						
	5.						
	6.						
Relationship to head of the household of others who live in the same house	1.						
	2.						
	3.						
	4.						
	5.						
Dead Children (Note age at death)	1.						
	2.						
	3.						
	4.						

EXPOSURE TO MASS MEDIA

7. Do you have a radio? Yes _____ No _____

8. Do you listen to the radio? Never _____ → 12 Yes _____

9. How frequently do you listen to the radio?

Seldom _____ From time to time _____ Every day _____

10. Do you listen to programs that you consider worthwhile?

No _____ → 12 Yes _____

11. What are the name(s) of these program(s) _____

_____

12. Do you have a television set? No _____ Yes _____

13. Do you watch television? Never _____ → 18 Yes _____

14. How often do you watch television?

Seldom _____ From time to time _____ Every day _____

15. Generally where do you watch T.V.?

In your house _____

In a store or bar _____

In a friend's or neighbor's house _____

In a relative's house _____

Elsewhere, explain _____

16. Do you watch programs which you consider worthwhile?

No _____ → 18 Yes _____

17. What are the name(s) of the program(s)? _____

_____

18. Do you have magazines in the house? No _____ → 20 Yes _____

19. Which ones? _____

20. Do you read newspapers? No _____ → 22 Yes _____

21. Which ones? _____

EMPLOYMENT AND INCOME

Now could I ask some questions concerning your work.

22. How do you earn most of your income?

As a farmer laborer _____

As a farmer or rancher _____

As a farm administrator _____

As a teacher _____

As a merchant _____

As a store worker _____

Is a housewife _____

Is unemployed _____

Other, explain _____

23. Could you please tell me, how much do you earn?

Per week _____ Per month _____

24. Besides your main employment, do you have any other sources of income? No _____ → 26 Yes _____

25. What other sources of income do you have? (For example: work in a store or own a small plot of land)

    Please explain _____

I would like to ask you some questions about your business

26. What type of business is it? (For example: store, bar)

    _____

    Does not have business _____ → 28

27. Are you the: owner _____ manager or administrator _____ or

    an employee _____?

AGRICULTURAL INFORMATION

28. Do you have title to any piece of land which you use for farming or raising livestock? No _____ → 32 Yes _____

29. How many acres of land do you own? _____acres

30. Are you the sole owner of this land? No _____ Yes _____ → 32

31. Who else owns the land with you? A relative _____

    A corporation _____

    Other (explain) _____

32. Do you use land which you do not own for farming or raising livestock? (For example: rent land) No _____ → 35 Yes _____

33. How many acres do you use? _____acres

34. What land tenure arrangement do you have for the use of this land?

    _____

35. Are you a farm laborer? No _____ →38 Yes _____

36. Are you a permanent _____ or part time _____ farm laborer?

37. Where do you work and what specific type of farm labor do you do?

_____

_____

The following questions deal with your farm. Please include information on all the land you own and rent.

38. Is there pasture land on the farm? No _____ →40 Yes _____

Does not have agricultural land _____ →55

39. How many acres? _____acres

40. What are the three most important crops or products produced on the farm? (Answer below)

41. What acreage is devoted to these crops or products?

Crop or Product	Acreage and/or Production	Units (tons, bottles,etc.)
_____	_____	_____
_____	_____	_____
_____	_____	_____

42. Do you have livestock on the farm? No _____ →44 Yes _____

43. How many head do you have of

Milk Cattle _____

Beef Cattle _____

Hogs _____

Horses _____

Mules and Burros _____

Chickens _____

Others (Specify) _____

_____

44. During the past year did you irrigate? No _____ → 48 Yes _____

45. Which crops did you irrigate and what was their acreage?

Crops	Acreage
_____	_____
_____	_____
_____	_____

46. What type of irrigation did you use (explain) _____

_____

47. Did you use a pump?

No _____ Yes (explain type of pump) _____.

48. How many of your family members work on your farm?

None _____ → 50 Number _ _____

49. How much do they earn?

Weekly _____ Monthly _____ No Pay _____

50. How many hired farm laborers work on your farm?

None _____ → 52 Number _____

51. How much do they earn? Weekly _____ Monthly _____

52. What buildings and structures do you have on your farm?

None _____ Type (explain) _____

_____

_____

_____

53. What types of machinery and equipment do you have on your farm? (For example: tractor, milker)

None _____ Type (explain) _____

_____

_____

_____

54. During the past year did you contract for machinery or hired help to do special work on your farm?

No _____ Yes (explain) _____

_____

_____

USE OF ELECTRICITY: GENERAL

I am very interested in learning about the ways you use electricity. I am now going to ask you some questions about this.

55. How long have you been using electricity in this place?

Less than one year _____ 7-8 years _____

1-2 years _____ 9-10 years _____

3-4 years _____ 10+ years (indicate number)

5-6 years _____ _____

56. Previously, had you received electricity from another source?

No _____ → 58 Yes _____

57. From what source? _____

58. In your opinion, what things can you do with electricity that you couldn't do without it? _____

_____

59. What would be the major problems if your electricity failed for a month?_____

_____

60. For you, what are the most important uses of electricity? (If possible, list at least three uses)

_____

_____

_____

61. In addition to using electricity, what quantity of the following things do you use during one week and what do they cost? (Note the quantity, remembering that different measurements are used for different things)

	Quantity	Units (pounds bottles, etc.)	Unit Cost	Use (lighting, cooking, etc.)
Candles	____	____	____	____
Kerosene or Petroleum	____	____	____	____
Gas	____	____	____	____
Coal	____	____	____	____
Other (Specify)	____	____	____	____

62. Permit me to write down the number of the meter? (Write down the number of each meter and the consumption in KWH for the last month. It is very important to note correctly if the meter is for residential, commercial, or agricultural use).

	Number of Meter	Consumption	Month
Residence	____	____ KWH	____
Farm	____	____ KWH	____
Commercial	____	____ KWH	____
Other (explain)	____	____ KWH	____

63. The last time that you paid your electricity bill, how much did you pay? _____

64. Which of the following do you have, in your home or business?

Article	Home	Business	Used in both Home & Business
Lightbulbs (note number)	____	_____	_____
Fluorescent tubes (note number)	____	_____	_____
Electric Radio	____	_____	_____
Iron	____	_____	_____
Sewing Machine	____	_____	_____
Hot Plate	____	_____	_____
Stove	____	_____	_____
Refrigerator	____	_____	_____
Freezer	____	_____	_____
Television	____	_____	_____
Blender	____	_____	_____
Beater	____	_____	_____
Clothes Washer	____	_____	_____
Record Player	____	_____	_____
Fan	____	_____	_____
Water Heater	____	_____	_____
Pumps (note size)	____	_____	_____
Motor hp ____	____	_____	_____
Other (explain)	____	_____	_____

FARM USE OF ELECTRICITY

65. Besides using electricity in your house, do you also use electricity for anything on your farm? No _____ → 73 Yes _____

66. Do you use electricity for outside lighting?

No _____ Yes _____ How many bulbs _____

67. Do you use electricity for lighting any farm buildings?

No _____ → 69 Yes _____

68. In which buildings? _____

_____

69. Do you have electrically powered machinery or equipment on your farm?

No _____ → 71 Yes _____

70. What machinery or equipment? _____

_____

71. Is electricity useful on your farm? No _____ Why not _____

_____

Yes _____ How _____

_____

72. What do you consider to be the most important use of electricity on your farm? _____

_____ → 74

73. Why do you use electricity in your house but not on your farm? _____

_____

NON-USERS OF ELECTRICITY

I would like to ask about some of the things you use.

74. What quantity of the following things do you generally use in one week and how much do they cost? (Write down the quantity: Remember that different measurements are used for different things)

Article	Quantity	Unit (pound, bottles, etc.)	Cost	Use (lighting, cooking etc.)
Candles	_____	_____	_____	_____
Kerosene or petroleum	_____	_____	_____	_____
Gas	_____	_____	_____	_____
Coal	_____	_____	_____	_____
Other (specify)	_____	_____	_____	_____

75. Have you ever had electricity in this house? No _____ → 78 Yes _____

76. What was the source? (If a private plant, note size) _____

77. Why do you no longer have electricity? _____

_____

78. Do you believe that having electricity is an advantage or disadvantage?

Advantage _____ Disadvantage _____ Why _____

_____

79. In your opinion, what things could you do with electricity that you can't now? _____

_____

80. If you had the opportunity, would you use electricity?

In your house No _____ Yes _____

In your farm No _____ Yes _____

81. If you had electricity what electric appliances or machinery would you buy first? _____ _____ _____

LIFE'S SITUATION

Let's now talk about some different things (Ask the following questions. If the respondent answers "same" go on to the next question. If he answers "better" ask: "better or much better?" If he answers "worse" ask: "worse or much worse?").

	Much Better	Better	Same	Worse	Much Worse
82. Is your life's situation worse, better or the same compared to five years ago.	____	____	____	____	____
83. Is your life's situation the same, worse, or better than your father's.	____	____	____	____	____
84. In five years do you expect your situation in life to be better, worse, or the same as it is now.	____	____	____	____	____
85. In general, in comparison to your neighbor's situation is yours worse, better or the same.	____	____	____	____	____
86. Do you believe that the children of today when they become adults will have a life's situation which is worse, better or the same as yours.	____	____	____	____	____

SOCIAL PARTICIPATION

87. Do you belong to any clubs, associations, cooperatives or other organizations? No _____ → 91 Yes _____

88. Which organizations? _____

_____

_____

89. Have you been an officer in any of the organizations?

No _____ → 91 Yes _____

90. What positions in which organizations?

Position	Organization
_____	_____
_____	_____

91. Have you attended in the past year meetings of any club, association, cooperative or other organization?

No _____ Yes _____ Number Attended _____

92. Could you tell me, if you won $1,000 in a lottery how would you spend it? _____

_____

93. What thing or service do you need most to improve your life? (explain)

_____

_____

94. What should the government do to improve this community? _____

_____

95. What services do you receive from the government? _____

_____

MIGRATION

96. Do you intend to continue to live in the country?

No _____ → 98 Yes _____

97. Do you intend to stay here? No _____ Yes _____ → 100

98. Where would you like to move to? _____
State County Township

99. What work do you plan to do there? _____

_____

100. Would you prefer to stay in the country or leave?

Stay _____ Leave _____ Why (explain) _____

_____

101. If you moved, would it be important if your new house had electricity?

No _____ Yes _____ Why _____

LEVEL OF LIVING

(You should be able to fill out most of this section without questioning the respondent. Please mark the correct category and underline the part of the category which is most nearly correct. If you mark other, please explain)

102. How do you store water in your house?

1. Pots, jars _____
2. Earthen jar, pails _____
3. Barrels, kegs _____
4. Aqueduct (pipes) _____
5. Aqueduct (pipes) with tank and pump _____
6. Other _____

103. How do you receive water in the house?

1. Bring it by hand _____
2. Hand drawn from a well _____
3. From a well with a pulley _____
4. Hand pump _____
5. Pipes in the house _____
6. Other _____

104. How do you conserve perishable food?

1. None _____
2. Maintain food in a cool place _____
3. In jars or boxes _____
4. Icebox _____
5. Refrigerator _____
6. Other _____

105. What facilities do you have for cooking?

1. None, three rocks on the floor _____
2. Fireplace _____
3. Wood stove _____
4. Kerosene or petroleum stove _____
5. Gas or electric stove _____
6. Other _____

106. What do you use to clean your floor?

1. None _____
2. Broom made at home _____
3. Factory-made broom _____
4. Electric broom _____
5. Vacuum Cleaner _____
6. Other _____

107. What facilities do you have for washing clothes?

1. In the river _____
2. Washboard _____
3. Wash tub _____
4. Hand washing machine _____
5. Electric washing machine _____
6. Other _____

108. What sanitary facilities do you have?

1. None _____
2. An open air place _____
3. Latrine, wood floor _____
4. Latrine, cement floor or with running water _____
5. Toilet _____
6. Other _____

109. What means of transportation do you have?

1. None _____
2. Animal, Bicycle _____
3. Cart _____
4. Motorcycle _____
5. Jeep, Car, Truck _____
6. Other _____

110. What system of lighting do you use?

1. Candles, kerosene lamp _____
2. Fuel oil lantern _____
3. Gas or Kerosene lantern _____
4. Electric lightbulbs or fluorescent tubes _____
5. Electric lamps _____
6. Other _____

111. Prevailing material of front wall

1. Straw, waddle and daub ____
2. Pieces of wood, zinc, plywood unpainted ____
3. Wood or rammed earth ____
4. Painted wood or rammed earth ____
5. Brick ____
6. Other ____

112. Material of living room floor

1. Earth ____
2. Boards ____
3. Cement ____
4. Wood ____
5. Tiles, carpet ____
6. Other ____

113. Material of roof (Front part)

1. Straw ____
2. Cane, wood (uncovered) ____
3. Aluminum, zinc ____
4. Asbestos cement ____
5. Tile, shingles ____
6. Other ____

114. Facilities for washing dishes

1. None, wash in stream, river, or creek ____
2. Tub which has various uses ____
3. Tub used exclusively for dishwashing ____
4. Sink with drainage ____
5. Electric dishwasher ____
6. Other ____

115. Bathing facilities

1. River, creek, public facilities _____
2. Shower using gourd _____
3. Shower with cold water _____
4. Shower with hot water _____
5. Shower and bathtub _____
6. Other _____