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9. ABSTRACT

Examines both direct and secondary benefits of the proposed A.I.D.-assisted ten year rural electrification program in Pakistan. The various sections of this report discuss the project purpose, design and output, characteristics of the environment, environmental impacts of the project, adverse impacts, alternatives to the proposed project, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitments of resources. Based on the discussion of environmental impacts and their respective mitigation measures, the environmental impacts of the proposed project are considered acceptable. Electrified areas are not expected to suffer negative impact as these areas are capable of sustaining increased development based on their suitability criteria. Areas selected to be electrified under the program are those with agricultural and agro-industrial potential, availabiltiy of power from grid stations, high population density and the availability of rural infrastructure such as roads. These areas are not likely to be habitats for ecosystems on which the project would have a negative impact. Seismic factors will be considered in systems design in areas of pronounced seismic activity.

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ENVIRONMENTAL ASSESSMENT

RURAL ELECTRIFICATION PROGRAM

PAKISTAN

APRIL 1978

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INTRODUCTION

By their nature, rural electrification programs have a small potential for direct impact on the human environment. The secondary or indirect impacts of these programs, however, are estimated to be considerable. This assessment examines both direct and secondary benefits of the proposed AID-assisted ten year rural electrification program in Pakistan.

The major part of the Environmental Assessment was prepared by Vickie L. Traxler, Environmental Planner, under a USAID contract. Ms. Traxler's educational background includes a Master of Science from Colorado State University in Regional Resource Planning and a Bachelor of Science degree from Grand Valley State Colleges, Michigan, in Environmental Science. Her experience includes work on a highway impact study for Oceana County Michigan and Western Michigan Regional Shoreline Development Commission and special training in the preparation of environmental impact statements at Colorado State University.

In addition, Ms. Traxler prepared the Mission's Environmental Assessment for the Rural Roads project which was authorized in FY-1977, and is in the process of completing an Environmental Assessment for the Rural Clean Water program which is scheduled for authorization in FY-1978. Several members of the Mission staff worked with Ms. Traxler assisting her with some of technical description of the program and in reviewing her drafts and suggesting modification and additions.

PREFACE

The Environmental Assessment of the Rural Electrification Project will provide USAID and the Government of Pakistan with a comprehensive understanding of the reasonably foreseeable positive and negative environmental effects of the proposed project. Once identified, these impacts may be brought into the decision-making process in the same manner that traditional elements are considered. Note that an assessment is not a panacea for all of the project's problems but rather ensures a "common-sense" approach to problem solving efforts. An assessment proposes reasonable alternatives so that their respective impacts may be weighed and the best possible course of action determined. Environmental assessments identify appropriate protection and mitigation measures for negative impacts so that these may also be incorporated into the project design. The rural electrification environmental assessment fulfills the above objectives.

The environmental assessment for the rural electrification project draws its framework from the following guidelines: USAID "Environmental Procedures (Regulation 216.1-8)", World Bank Environmental, Health and Human Ecologic Considerations in Economic Development Projects, and USAID Environmental Guidelines Manual. Local experts were consulted for discussion of potential environmental impacts of the proposed project and mitigation measures for adverse impacts. Mr. Z. A. Mirza of World Wildlife Fund, Pakistan identified potential impacts on wildlife and wildlife habitat from the project. Assistance with soils, agriculture, forests, and wildlands came from Dr. M. Bashir and Dr. Muhammad Alim Mian, of the Soil Survey Directorate, Pakistan. Mr. Durrani, Director Rural Electrification Cell and the engineering consultant firms of NESPAK, FACE and ICE provided information concerning the proposed project areas.

I. PROJECT DESCRIPTION

A. Purpose and Output

The Rural Electrification Program is one of a cluster of proposed activities which support the Government of Pakistan's (GOP) strategy to promote the economic and social advancement of its rural population.

It is a ten year program to achieve wider, more equitable, more reliable and more productive use of electricity in selected rural areas of Pakistan. Up to twenty areas will receive electric power distribution under the program. The distribution systems assisted by this project will be less centralized, more service oriented, self-financing, and replicable on a national basis.

B. Design and Construction

The program will be implemented over a 10 year period with the initial tranchebegining in 1978 and obligations completed by 1983. Up to twenty project areas will eventually be electrified. Fourteen areas have already been tentatively chosen for study by the provincial governments of which feasibility studies have been completed for three and six more are under consideration.

The project consists of the installation of 11 KV primary system distribution lines, 400 and 230 volt secondary distribution lines, transformers, insulators, individual service connections and meters. Components of the project include wire conductors (steel reinforced aluminum cable), transformers, lattice steel poles, ceramic insulators, and meters. Approximately twenty feet of land will be required for line right of way. Grid stations will be supplied by WAPDA.

The major bulk of electric power is expected to come from hydroelectric sources (e.g. Tarbela Dam). No thermal generation plants or high voltage transmission lines will be constructed for the project.

II. DESCRIPTION OF ENVIRONMENT

Fourteen areas have been tentatively selected by the provincial governments of Pakistan for in-depth rural electrification coverage. Fourteen feasibility studies have been completed on three of the fourteen areas, Pindi Gheb, Dera Ghazi Khan and Nowshera Virkan. A total of fourteen such areas will eventually be selected.

As it is not possible to give a detailed description in this report, this section will give a brief description of the natural environment of Pakistan in general terms.

A. Description of the Provinces

Pakistan's four provinces roughly correspond to three distinct geographic regions. Baluchistan Province is a high desert plateau with a base elevation of 4-5000 feet. Less than five inches of rain per year favor the growth of xerophytic vegetative types except where the land is irrigated. Wind blown deposits (loess) are common among the soils of Baluchistan.[1/]

The North West Frontier Province includes parts of the high plains and the mountain ranges and foothills of the Himalayan system. The mountain systems of Pakistan are the result of geological recent lifting, folding, and faulting of old sedimentary rocks. The sedimentary rocks vary from shales, slates, sandstone and limestone. The high plains are the result of an ancient period of erosion, alluviation and loessal deposition, and rest on the structural depression of the Potwar Plateau. The Potwar and its associated landforms extend into Punjab Province. Vegetation varies but is generally heavier than elsewhere due to the increased rainfall ranging from 20 to 50 inches per year.[2/]

The Indus Plains (Sind and Punjab Province) consist of sand, silt, and clay alluviums hundreds to thousands of feet thick overlying old sedimentary rocks. The pedocal soils of the plains, high in calcium carbonate and low inorganic matter, have resulted from the gradual deposition of sediment from the River Indus and its five main tributaries, Ravi, Sutlej, Chenab, Jhelum and Beas. Rainfall ranges from less than 10 inches in

Sind Province in the south to 40 inches in the northern areas of Punjab Province. Although forests once covered most of the plains, due to extensive cultivation and low rainfall, existing vegetation consists of hardy grasses, bushes, and scrub trees.[3]

B. General Characteristics

The climate of Pakistan is characterized by scarce and irregular rainfall, low relative humidity and extreme temperatures. The relatively low rainfall falling mostly in high-intensity rainstorms, associated with a very high evapotranspiration rate determines an essentially arid region.[4]

The primary use of land in Pakistan is agriculture and grazing. At least 80% of Pakistan's agricultural land is irrigated in some form to supplement low rainfall. Runoff water from rainfall and surface water supplies most irrigation canals. Irrigation has transformed the Indus Basin into a highly productive agricultural area. However, the Indus Plain has a seaward slope averaging less than one foot per mile and improper irrigation practices and poor drainage have resulted in salinized and waterlogged lands in large parts of Punjab and Sind Provinces.[5]

Groundwater is a valuable resource. The irrigated plains of Punjab and Sind, extending from the edge of the mountains in the north and west to the Arabian Sea in the south, as well as parts of Peshawar and Bannu basins, are underlain by an extensive groundwater aquifer. The extent of the aquifer is of the order of 40 million acres, and it probably exceeds 1,000 feet in thickness under most of the area. About 14 million acres of the Indus plains are underlain by fresh groundwater, with less than 1000 parts per million (ppm) total dissolved solids; about five million acres have groundwater of moderate salinity with 1000 to 3000 ppm, and the remainder is very saline, containing more than 3000 ppm total dissolved solids.[6]

The total population of Pakistan is more than 75 million with an annual rate of increase of over 3%. Projections from the 1972 population census indicate that in 1977 the population densities of the various provinces were Punjab 530 people/square mile; NWFP 328/sq. mi.; Sind 288/sq. mi.; Baluchistan 20/sq.mi.

and the Tribal Areas were 268/sq. mi.[7]

During the 1960's the urban population increase was greater than any previous decade. Estimates predict that the country will be 2/3 urbanized by the year 2000. Despite this predicted trend, 74% of Pakistan's population was classified as rural in 1972. Nearly 55 million people live in rural areas and are directly or indirectly dependent on agriculture for a livelihood. About 50% of the total labor force is employed directly in crop and livestock production and nearly 20% in marketing and processing of agricultural service activities. In addition to its importance as an employer, the agricultural industry is the major foreign exchange earner, in a typical year accounting for about three fourths of the total value of exports.[8]

C. Fragile Ecosystems

Particular areas, landforms or geographic regions may be sensitive to increased development and in-migration because of the nature of the landform or certain forces of nature. These areas are described below.

1. Landforms with high erosion potential.

   These areas include hilly or mountainous regions with steep slopes, coastal and desert sand dunes with unstable soils, and young alluvial and loessal deposits lacking a developed soil profile. Erratic, intense rainfall and sparse vegetation act as severe erosive forces. Overgrazing, deforestation, cultivation and clearing of land for human settlement may exacerbate erosion problems.[9]

2. Areas with significant wildlife resources.

   Much of Pakistan's wildlife is subject to competition with man and his livestock, to loss of habitat and poaching. Areas with significant wildlife resources include the National Park, Forest and Game Sanctuary system. Other areas include inaccessible mountain or desert regions with low agricultural potential and, therefore, sparse human habitation.[10]

3. Areas with high flooding potential.

   Riverine and floodplain areas are frequently inundated during monsoon seasons. Concentrations of development in these areas would result in loss of life and property.

4. Zone of pronounced seismic activity.

   A zone of pronounced seismic activity passes through areas of Baluchistan, Kashmir, and NWFP. Loss of life and property may result from increased development in this belt.[11]

5. Forests and forested areas.

   Forested areas in Pakistan are generally at high elevations with difficult accessibility. Forest areas are coming under increased pressure due to increased population. Harvesting of fuel wood, overgrazing, cultivation and clearing of land for human settlement increase as population increases and can lead to deforestation and denudation of slopes. Deforestation and subsequent loss of soil cover and animal habitat is a serious problem in Pakistan.[12]

III. DISCUSSION OF ENVIRONMENTAL IMPACTS

The project will essentially service rural agricultural areas which are ecosystems significantly modified by man. Major components of those systems are man, and his associated infrastructure, the crops cultivated in the region, the topography and the climate, and those wild flora and fauna of the area able to adapt to a man-modified environment. The following discussion describes the environmental impacts likely to occur from the proposed rural electrification project.

The twelve criteria for project area selection are: availability of grid stations, population and population density, number of villages, number of houses, number of customers, land use, potential uses of electrical energy by consumers, miles of roads, access to industry and markets, capital requirements for the system, irrigation potential from tubewells and land ownership by small farmers. The project is not expected to have significant negative impacts because of these selection criteria and additional feasibility studies each area must undergo.

The nature of the project excludes any significant disruptive direct impact on the environment. However, the project may have some important indirect impacts.

A. Direct Impacts

Transmission lines will require a twenty foot right of way. However, the right of way does not preclude continued use for agricultural.

Transmission lines will alter the character of the natural landscape from a short distance perspective.

The economics of the project exclude sensitive ecosystems such as river beds, marshes, mountainous areas, etc., which would require extensive costly support structures and additional machinery for installation.

Installation of poles will necessarily require a small disturbance of soil with a localized and temporary impact. National Forest areas will not be electrified due to low density of population. Some removal of solitary trees may be necessary. Small amounts of grasses or bushes may be removed during pole installation. Trees may also require pruning so as not to interfere with line transmission. Disturbance of wildlife habitat except for small amounts of tree pruning and removal is expected to be temporary and minimal.

Construction, operation and maintenance of the rural electrification project will have direct effects on the economy of the area served as well as the country as a whole. During construction the acquisition of materials and machinery may increase business activity and stimulate the local economy through payments received by service industries. The project will also require employment of local day laborers.

Public safety is always a problem where unfamiliar technologies are introduced. Engineers and contractors responsible for the construction of rural electrification lines will take all safety precautions during work in project areas.

B. Indirect, Secondary Impacts

Electrification of a rural area has the potential to significantly increase development through increased agricultural and industrial activity. Increased production implies increased employment requiring increased housing, service and infrastructure facilities.

There are several possible development alternatives once electrification is underway in a rural area:

Scenario 1: Low Development Profile

This alternative consists mainly of household connections for illumination, radios and appliances. Existing diesel motors will be exchanged for electric motors, for example tubewell motors, diesel engines for rice husking, flour milling, etc. New development does not occur immediately. Over a 5-10 year period a few small industries, sawmills, smithys locate in some larger villages. Tubewells increase in number and more land is irrigated. Food processing industries increase accordingly. In-migration does not occur. New development absorbs available labor. Electrified tubewells for public water supplies become available.

Scenario 2: Moderate Development Profile

Moderate development will most likely be located in the vicinity of the market town. Here small industries will locate to accomodate the collective increased production of many villages. Industries included are listed in Table 2. Repair industries may also locate here. Excess population at the village level may migrate to the market town for employment. Service industries, housing, education, and health facilities are upgraded with electric machines and increase in number as population increases. In highly productive agricultural areas without canal irrigation, private tubewells may increase significantly in a short period of time. Electrified tubewells will also provide adequate water supplies for the village and market population.

Scenario 3: High Development Profile

Rural electrification produces immediate and intensive development under this alternative. Large factories locate in the rural areas and urbanization encroaches on adjacent productive agricultural land. In-migration strains services and infrastructure facilities (roads, utilities, education, health, etc.).

Of these alternatives, the project is expected to generate growth in most areas similar to Scenario # 1; that of low development. Market towns and areas with high agricultural growth potential (fertile soils with little or no canal irrigation) may undergo the moderate development described in Scenario # 2.

The following table lists those industries or businesses most likely to benefit by or increase from rural electrification:

1. Agriculture:	Irrigation from electrified tubewells in those areas with sufficient groundwater resources.
2. Food Processing Industries:	Flour and rice milling, sugar processing, oil seed extracting, etc.
3. Textile & Textile Related:	Electrified power looms especially.
4. Machine and Woodworking:	Smithy, furniture making, sawmills, repairing.
5. Cottage Industries:	Handicrafts, sewing, knitting, traditionally done in the home.
6. Refrigeration and Icemaking:	Keeno, mango, milk, other food preservation.
7. Mineral Development:	Rock sorting and crushing, limestone, gypsum, etc.
8. Small manufacturing operations:	Tanneries, ceramics, etc.

Motors used by these industries will usually be less than 10 horsepower. In small shops 3-5 horsepower is the average size motor currently used. Large textile operations, rice and flour milling machines, mining operations and tubewells may require from 10-15 horsepower.

It is not necessary to detail each industry's specific impact. However, the impacts will be discussed in more general terms according to certain factors.

Impact on Agriculture. Agriculture will most likely be affected by the installation of electrically operated tubewells. This increase may modify some ecosystems in currently irrigated areas. Type of crops grown may change or more crops may be produced in a given season. In those areas with significant amounts of canal irrigation small numbers of tubewells, increased installation of tubewells will assist in the control of waterlogging and salinity problems. Continuous pumping of tubewells will lower the water table which is the major factor in waterlogging and salinity problems. Food processing industries will benefit by the increased agricultural production and electrification. Therefore waste materials from these industries may increase also. Rice and flour milling wastes may increase. However, these wastes are currently utilized for fodder, fertilizer or other purposes.

Industrial Pollution. Industrial growth will be low to moderate. Therefore waste generated will also be low. As in most developing countries solid waste or scrap material is reclaimed and recycled for further use. Chemical wastes from tanneries, textile industries, etc. are contained in small private oxidation ponds. Electric power is relatively cleaner as a fuel than diesel power and would, therefore, decrease existing air pollution problems from diesel fuel sources.

Population Increases. There will be little in-migration to the project areas as a result of electrification. Market towns may experience in-migration from surrounding villages. Newly irrigated lands from tubewell installation will not bring in new farmers as the land is already being farmed. Requirements for housing, utilities, and other services will not increase dramatically in a short time but rather will occur in small dispersed amounts. Previous projects in other countries indicate a trend towards reduction in local birth rates shortly after electrification.

Public Health and Education. The rural electrification program will positively impact the public health and education facilities in a project area. Health centers will be able to provide patient care in the evenings and may purchase special equipment, especially refrigeration and heating. General education and technical institutions may procure special equipment for training.

Forests and Wildlife. Negative impacts on wildlife resources and forested areas from electrification may be caused by increased development activities. This negative impact, however, is a short term phenomenon. In the long term, authorities from various institutions in Pakistan state that electrification will be an ally of forests/and wildlife in remote areas. As the consumption of electric power increases and electric consumers include the electric heating and cooking ranges in their daily routine, these consumers would have less need for firewood. As a result, problems with deforestation and loss of wildlife habitat should decrease.

In general, economic impact is expected to be beneficial, while there is expected to be little negative environmental impact. As dealt with in the Social Analysis of the project paper, social and cultural impacts are expected to be largely positive.

IV. ADVERSE IMPACTS

A. Unavoidable Adverse Impacts

Unavoidable adverse impacts of the project include a temporary disruption of the soil for post holes and human activity. The poles will constitute a change of the landscape and associated scenic resources from a short distance perspective.

B. Avoidable Adverse Impacts and Mitigation Measures

1. Vegetation will be removed and the soil exposed to erosion during excavation and installation of poles.

Mitigation: Lines will be routed to by-pass trees except where necessary solitary trees may be pruned or removed. Only vegetation in the immediate area of the post hole will be removed.

2. Land in the right of way of conductor lines will not be available for crop production.

Mitigation: Only land immediately used by the post holes will be taken out of production. The remainder may be used for crop production and grazing.

3. The project will cause safety problems due to the unfamiliar and dangerous nature of electrical energy.

Mitigation: Most villagers are aware of this danger and experience has shown that they are careful around electric outlets. WAPDA employees who install service econnections explain to domestic consumers what little safety measures should be taken on a routine basis. Large motors are normally installed by skilled technicians and operated by knowledgeable persons.

4. Increased development and in-migration from electrification into a project area will result in destruction of fragile ecosystems.

Mitigation: None of the areas selected for electrification are likely to have fragile ecosystems that can be adversely affected by the program. Such areas fall out during the selection process for economic reasons (costly support structures and insufficient numbers and density of customers).

5. Electrification of a market town will immediately increase development activity by increased employment and production (i.e. housing, utilities, waste, generation, etc.).

Mitigation: Market towns in program areas are already electrified to some degree. Increased electric connections in those towns will not immediately result in a pronounced increase in activity that will have adverse environmental impact. The growth is expected to be rather gradual which would result in environmental accommodations and adjustments.

V. ALTERNATIVES TO THE PROPOSED PROJECT

A. No Project

The "no project" alternative implies continued consumption of other fuel sources and static social and economic levels of living. Electrical power has the potential to raise the living standard substantially. The "no project" alternative is considered unacceptable.

B. Increased Use of Other Resources

Electrical power is more cost-effective for lighting, heating, and power than the existing sources of kerosene lanterns, candles, wood, petroleum products, and animal power. Increased or even continued use of these other fuel sources would have severe negative impacts. Deforestation due to harvesting of wood as fuel is a problem throughout Pakistan. Increased use of petroleum products requires increased foreign exchange expenditures. Fodder for animals, used as a power source, consumes land which may be used for food crops. This alternative has a low benefit-cost ratio from a national resource perspective and is therefore unacceptable.

C. Small Village Generation Plants

This alternative requires higher levels of capital investment on an individual village basis, costly petroleum fueling products, and localized knowledge of electrical technology. Village generators may be cost-effective in mountain regions where transmission over mountain terrain is difficult and hydroelectric power potential abundant. However, small village generation plants do not fulfill the objectives of the Rural Electrification Program, i.e. to stimulate regional rural development.

VI. THE RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

The project will not sacrifice the productivity of the land resource over the long run. Lines require a maximum twenty foot right of way which will continue in use for agriculture.

The Tarbela Dam project is expected to provide a large portion of Pakistan's electrical energy requirements for over 75 years. The GOP has planned construction of other hydroelectric sources which will supply the project after that time.[13]

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The component structures of the project are not expected to require significant amounts of resource commitments. Steel will be required for poles and cable strength. Aluminum and copper will also be consumed. These materials can be dismantled and reused. The amount of resources used per area will vary according to the size of the individual area. The total amount of these resources that will be used is not known at this time.

VIII. SUMMARY AND RECOMMENDATIONS

Based on the discussion of environmental impacts and their respective mitigation measures, the environmental impacts of the proposed project are considered acceptable. Potentially adverse impacts include temporary disruption caused by pole installation and alteration of landscape horizon characteristics by electric wires and support poles. Electrified areas are not expected to suffer negative impacts as these areas are capable of sustaining increased development based on their suitability criteria.

The criteria used to select areas to be electrified under the program emphasize agricultural and agro-industrial potential, availability of power from grid stations, population density and the

availability of rural infrastructure such as roads. Areas that meet these criteria are not likely to be habitats for ecosystems on which rural electrification would have a negative impact.

In areas and zones of pronounced seismic activity, particularly in the Baluchistan and Northwest Frontier Provinces, systems design will take into consideration seismic factors. Engineering safegaurds will be built into the design of structural and electrical components of the systems.

FOOTNOTES

1/ Richard F. Nyrop, Area Handbook for Pakistan, pp. 66-74.

2/ Nyrop, pp. 66-74.
Nazir Ahmad, Groundwater Resources For Pakistan, pp. 19-22.

3/ Nyrop, pp. 66-74
Ahmad, pp. 19-22.

4/ FAO, "Soil Survey Project Pakistan", pp. 37-40.

5/ Nyrop, pp. 66-74.

6/ FAO, pp. 51-52.

7/ Nyrop, pp. 76-83.
Personal Communication with Mr. Manzur, Population, USAID.

8/ Nyrop, pp. 76-83.
USAID, Pakistan Development Data.

9/ FAO, pp. 72-86.
Eric P. Eckholm, Losing Ground, pp. 58-100.

10/ Conversations with World Wildlife Fund, and Directorate Soil Survey Pakistan.

11/ Nyrop, pp. 66-74.

12/ Eckholm, pp. 74-100.
Conversations with World Wildlife Fund and Soil Survey Directorate, Pakistan.

13/ Conversation with Harza Engineering.

BIBLIOGRAPHY

Ahmad, Nazir. 1974. Groundwater Resources of Pakistan. Lahore. 295 pp.

Akhtar, Dr. S.M. 1975. Economic Development of Pakistan. Publishers United, Lahore.

Denton, Dr. Frank. Phillipine Rural Electrification Social Analysis. Asian Development Bank.

Eckholm, Erice P. 1976. Losing Ground. World Watch Institute, W.W.Norton, and Co., Inc.

Fikri Associated Consulting Engineers (FACE). "Feasibility Study for Pindi Gheb". 1977.

Food and Agriculture Organization of the United Nations. 1971. Soil Survey Project, Pakistan. Soil Resources of West Pakistan and Their Development Possibilities. Rome. AGL:SF/PAK 6, Technical Report 1. 167 pp.

Government of Pakistan, Planning Commission. January 1976. Draft Fifth Five Year Plan / 1976-81.

International Bank for Reconstruction and Development, IDA. El Salvador: Costs and Benefits of Rural Electrification. Research Working Papers. 1975. P.U. Report No. RES 5.

International Consulting Engineers. (ICE) 1977. "Feasibility Study for Nowshera/Virkan."

National Engineering Services Pakistan. 1977. "Feasibility Study for Dera Ghazi Khan."

Nyrop, Richard F. 1975. Area Handbook for Pakistan, 4th ed. US Government Printing Office. 455 pp.

United States Agency for International Development. September 1974. Environmental Assessment Guidelines Manual.

USAID. January 1977. Pakistan Development Data. Islamabad, Pakistan.

USAID. Capital Assistance Paper Bolivia. Rural Electrification. AID/DLC/P 2013. 1973.

USAID. August 1977. Bangladesh Project Paper Rural Electrification. AID/DLC/P2232.

University of Florida, Center for Tropical Agriculture. 1973. An Evaluation of Effects on Economic and Social Changes in Costs Rica. For USAID.

World Bank. May 1974. Envrionmental Health and Human Ecologic Considerations in Economic Development Projects 142 pp.

Xavier University. 1975. Phillipines: A Summary Report of Principal Findings on Rural Electrification Impacts. Research Institute for Mindanao Culture. Rural Western Misamis Oriental Province.