Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits

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Preface

This report results from a collaborative study undertaken by the Institute for Development Policy and Management Research Foundation, Inc. in Manila, Philippines and the World Bank. The study was initiated in response to concern that existing methods for evaluating the benefits of rural electrification in developing countries often overlook many informal benefits. An earlier effort (Benefits Assessment in the Power Sector), which conducted case studies in Malawi and Bolivia, found that rural electrification affects both rural living standards and quality of life. These studies clearly showed rural residents' satisfaction and dissatisfaction with electricity service, but were somewhat weak in applying quantitative value to these concepts.

The current study, which complements much ongoing work, considers the quantitative value of electrification for rural consumers. One of its major strengths is that it moves beyond existing methods for evaluating rural electrification projects. The main fieldwork consisted of conducting an energy survey involving 2,000 electrified and non-electrified households selected from four rural electric cooperatives on the island of Luzon, Philippines. Complementing this work was development of a benefits assessment framework commonly used in environmental economics. The multidisciplinary research team included economists, sociologists, and other social scientists.

It was discovered that qualitative data related to rural people's strong desire for electrification can be used to support more quantitative analysis, thereby linking the electrification benefits that rural households value most to larger social processes—an important step in evaluating policies and options for developing countries. This work can provide a framework for future studies on the socioeconomic impact of rural electrification in developing countries.

Acknowledgments

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During the course of this study, many representatives of the Philippine government generously shared their time with both the local and international teams. Special thanks go to staff members of the National Statistics Office, National Electrification Administration, and Department of Energy, who were especially supportive during the various phases of the study. We also acknowledge the valuable contributions of Harry S. Pasimio, Walfredo P. Belen, Arleen R. Villoria, Cristina M. Bautista, Edsel L. Beja, Jr., Michael H. Tavas, Leo T. Tay, and Elisa S. Bernardino. We are indebted Karl Jechoutek for his review of draft versions of this report. Finally, we are grateful to Marilou P. de Guzman and Salinas S. Llanes (local team members), Lilitz Cardenas and Thelma Rutledge (World Bank team) for their administrative assistance throughout the project, and Norma Adams, who edited this report.

Abbreviations and Acronyms

ACCFA	Agricultural Credit and Cooperative Financing Administration
ARMM	Autonomous Region of Muslim Mindanao
CAR	Cordillera Autonomous Region
EA	Electrification Administration
ILO	International Labor Organization
LPG	liquefied petroleum gas
MERALCO	Manila Electric Company
MORESCO	Misamis Oriental Rural Electric Service Cooperative
NCA	National Capital Region
NEA	National Electrification Administration
NPC	National Power Corporation
NSO	National Statistics Office
PV	photovoltaic
REC	rural electric cooperative
USAID	United States Agency for International Development
VRESCO	Victorias Rural Electric Service Cooperative

Units of Measure

ha	hectare
KgOE	kilogram of oil equivalent
klm	kilolumen
km	kilometer
kv	kilovolt
kW	kilowatt
kWh	kilowatt hour
l	liter
mt	metric ton
MW	megawatt
MWh	megawatt hour
TWh	terawatt hour

Currency Equivalents, 1998

US$ 1 (dollar) = P41 (Philippine Peso)

Executive Summary

Introduction

1. Rural electrification is often a preferred program for promoting equity and economic development in poor countries. In most parts of the world, electricity is considered a modern source of energy, essential to development, and areas without access are far less developed than those with it. Electricity benefits rural areas in many ways, including improving business and farm productivity, enhancing convenience of household tasks, and providing a more efficient form of household lighting. Most people agree that the availability of electricity has at least the potential to improve quality of life and increase economic activity. Even so, some believe that the benefits of rural electrification programs have been disappointing. This study was initiated, in part, to develop methods for evaluating conflicting views toward rural electrification.

2. The study's principal objective was to develop a practical method by which to measure the benefits of rural electrification, including those that previous studies had classified as "unmeasurable." This method involved both formal and informal techniques of data collection; quantitative and qualitative methods of analysis; and attention to such concepts as quality of life, effects on education, and other key components of social development. A review of rural electrification in Asia by the Operations Evaluation Department of the World Bank concluded that methods previously used to capture such benefits were generally inadequate (World Bank 1994). While previous World Bank assessments provided policymakers much important information, conventional engineering, management, and cost studies simply failed to produce the data needed to address critical policy issues.

Relevance of the Approach

3. While there is consensus that rural electrification is eventually critical to a country's development, policy formulations require that its benefits be expressed in quantitative—preferably monetary—terms. Such measures of benefits serve a variety of purposes. First, benefit (and cost) numbers provide objective criteria for choosing between electrification projects or between electrification projects and those of other sectors, such as roads or public health. Second, knowledge of the types and scale of benefits that access to electricity provides rural areas can help determine the most appropriate project size (e.g., a massive grid project or a smaller-scale photovoltaic program). Third, the scale of societal benefits can help determine appropriate pricing policies and whether subsidies are needed. This study found, for example, that willingness to pay for electricity service is high, especially compared to the cost of providing service to rural areas. This suggests that, with appropriate financing, subsidies can probably be reduced more than was originally thought. Finally, quantitative benefit numbers are essential for drawing any objective conclusions about the economic efficiency of proposed projects—that is, whether social objectives could be achieved using fewer resources and how the benefits of rural electrification projects might compare to those of other projects.

4. To serve these policy needs, it is important to measure benefits quantitatively; however, it is also important to include as many potential benefits as possible in the analysis. While previous World Bank studies acknowledged that electrification contributes broadly to societal well-being, many of the benefits recognized were not quantified. The focus of these measurement tools, generally those benefits reflected in lower costs of energy services, was too narrow for this purpose. By using a broader set of tools, this study has made it possible to estimate certain electrification benefits previously considered unmeasurable.

Report Overview and Findings

5. This report begins by examining reasons for developing methods to measure so-called "hard-to-measure" benefits of rural electrification. The theoretical approach builds on and is consistent with previous World Bank efforts to evaluate the benefits of rural electrification. Key to this approach is the widely-held view that electricity is an input to the production of outputs that contribute directly to household well-being; that is, electricity is desired not for its own sake, but for its ability, along with appliances, to produce goods and services that are more directly desired.

6. To apply this method, the study collected survey data from four regions located on the island of Luzon in the Philippines. Each region is contiguous and has a rural electric cooperative that distributes electricity to homes and businesses. About 28% of households in the sample of cooperatives lacks electricity. Not surprisingly, these households are much poorer and somewhat less educated than their electrified counterparts. However, they express similar preferences for many of the things electricity can provide, such as better lighting. In fact, both electrified and non-electrified households spend about the same proportion of their monthly income on lighting services. The four regions vary considerably in terms of their average income, degree of industrialization, and other socioeconomic factors. However, compared to many other developing countries, the general population is wealthier and better educated, which may partially explain the country's high benefit estimates.

7. The socioeconomic effects of electrification reported in this study are based on analysis of the survey data. Critical to the analysis and its subsequent use in calculating benefits in monetary terms is the separation of electricity from the many other factors that affect socioeconomic outcomes, such as income, level of education, and the returns to household investment in education. Besides the focus on educational returns, the analysis also includes the effect of electrification on entertainment, time spent performing household chores, health, and home-business productivity. Results are presented in terms of the hypothetical gain in benefits that would accrue to a typical non-electrified household were it to obtain a connection to the grid system. These results are not based on simple cross-sectional comparisons, which might be biased because households with electricity are, on average, wealthier and better educated than poorer ones. Instead, the results are based on models that contain constant household characteristics, such as income and education.

8. The major conclusion of this study is that the benefits of electricity are derived from a variety of sources, some of which overlap. Thus, it would not be meaningful to sum these estimates over *all* benefit categories, since double counting would likely result. For example, education benefits may result largely from better lighting, which makes improved reading and longer homework hours possible. Education is also linked to having access to

improved, inexpensive communication sources, such as grid-powered radio and television. However, one could assume that the non-lighting benefit categories are reasonably independent of each other. Under that assumption, the total benefit of providing electricity to a typical, non-electrified Philippine household would be $81-150 per month, depending on the household's number of wage earners and whether it runs a home-based business. Table E-1 summarizes the principal benefit estimates from improved or lower-cost services to a typical rural household.[1]

Table E-1: Summary of How a Typical Household in Rural Philippines Benefits from Electricity, 1998

Benefit category	*Benefit value (US$)*	*Unit (per month)*
Less expensive and expanded use of lighting	36.75	Household
Less expensive and expanded use of radio and television	19.60	Household
Improved returns on education and wage income	37.07	Wage earner
Time savings for household chores	24.50	Household
Improved productivity of home business	34.00 (current business), 75.00 (new business)	Business

9. Finally, the study suggests future research and analytical needs. One key conclusion is that it is possible to measure benefits traditionally considered intangible in monetary terms. In addition, the benefit estimates appear consistent with more conventional ones, particularly those based on cheaper costs, and therefore greater levels, of electric lighting. Furthermore, the benefits appear substantial, even for low-income populations. Finally, given the amount of money currently invested in rural electrification, the methodological approach is feasible and affordable for developing countries.

Implications for the Bank

10. While this study has used particular analytical techniques to assess many proposed governmental policies, they have not been widely applied to the assessment of rural electrification programs. Thus, this report represents a preliminary, pioneering effort. Undoubtedly, the estimates will become more refined with more experience and better data.

11. Even in its role as a pilot study, this report reaches an overall conclusion that appears reasonably robust. The strong desire of most developing countries for electrification can be quantified in monetary terms. Even if the preliminary Philippine benefit numbers

[1] To avoid double counting, the above estimated range does not include the lighting benefit shown in Table E-1. The estimate also assumes at least one wage earner per household. With no wage earners, the lower estimate drops to $44 per non-electrified household.

exceed what would be representative of many developing countries, they do raise the real possibility that, in the long term, benefits will outweigh the costs of extending electricity service, even for the poorest populations. If that is the case, the Bank should focus on overcoming the high initial costs of newly implemented programs. While subsidies may be necessary to overcome first-cost problems arising during the capital-expansion phase, this study's results suggest that long-term subsidies are unnecessary because of rural residents' willingness to pay the costs of electricity service.

12. The practical implications of this study's results in the Philippines, as well as similar findings from studies in other developing countries, suggest that such benefit assessments be applied in all potential World Bank rural electrification programs.

1

Introduction

1.1 Rural electrification is often the preferred program for promoting equity and development in poor countries. Several reasons account for this. First, electricity is perceived as a modern source of energy, essential to development. In most parts of the world, areas without electricity are far less developed than those with access. In rural areas, electricity serves many purposes. It can improve business and farm productivity, ease the burden of household tasks, and provide more efficient lighting for rural families. Most people agree that electricity potentially can improve quality of life and increase economic activity.

1.2 Nonetheless, deciding to service rural households with electricity can prove expensive. Before making this decision, program costs and benefits should be carefully weighed. This process, like other policymaking processes, requires information on the *economic efficiency* of the intended project, the project's effects on *equity*, and the project's *effectiveness*. Economic efficiency ensures that the project will not waste scarce economic resources; equity ensures that the project's costs and benefits will be distributed fairly among those affected; and effectiveness (of management, financial viability, technical feasibility, and compatibility with social and political norms) ensures that the project's goals will be attained.

1.3 This report focuses on the development and application of techniques to estimate economic benefits, some of which traditionally have been characterized as "difficult to measure." Benefit information, when combined with cost data, is central to assessing economic efficiency. While the principal goal is to estimate rural electrification benefits in monetary terms, information on equity and effectiveness has not been overlooked. In fact, attaining project efficiency goals not only requires estimating benefits. The factors that affect efficiency are interconnected with those that affect equity and effectiveness. For example, benefit estimation depends critically on estimated demand for electricity. But electricity demand depends heavily on income and its distribution among households—an equity issue. The benefit measure is also affected by the relationship between price and cost. Deciding to subsidize the cost of electrification for equity purposes necessarily affects the benefit-cost comparison. Similarly, ineffective projects that are poorly designed and managed have higher costs than more effective projects; such ineffectiveness, in turn, affects efficiency. In short, formal economic efficiency analysis is only one component of project evaluation, and, in many cases, may not be the most important one. Thus, it would be unwise to analyze economic efficiency in isolation.

Study Objective

1.4 This study aims to develop a practical method for assessing the benefits of rural electrification, including some benefits previously classified as unmeasurable. As a result, the method involves both formal and informal techniques of data collection; quantitative and qualitative methods of analysis; and focus on quality of life, educational effects, and other relevant factors. Since benefits go hand-in-hand with quality of service and type of electricity delivery, the study attempts to measure the effects of such delivery mechanisms on project benefits. As a secondary outcome of the study, electricity distribution companies may be able to measure their service's benefits more accurately. In turn, improving customer service, often overlooked in the past, may become a significant goal of power development in developing countries.

1.5 One contentious part of the rural electrification debate centers on justifying the level of productive and social benefits in program areas, given the relatively high cost of building distribution networks or renewable energy systems. The assumed benefits may not be well documented, and the question is whether they appear in any type of formal analysis (Mandel et al. 1980). For two decades, many have questioned the assumed level of benefits of rural electrification (Schramm 1993; Barnes 1988; Foley 1990). Providing rural families a few light bulbs may not have the dramatic effect that electricity planners or politicians anticipate.

1.6 Obviously, many other research needs are involved in rural electrification and socioeconomic development. These include forecasting load and connection growth rates accurately, which can help estimate the costs of connecting rural communities; identifying complementary conditions that enhance the productive uses of electricity; and examining the conditions under which centralized grid or decentralized alternatives are chosen. Much of this research involves questions of cost rather than of socioeconomic impact. By contrast, this study focuses principally on the development of methods to measure the socioeconomic impact of rural electrification. These methods can apply to both grid and off-grid renewable energy systems.

1.7 In formal cost-benefit comparisons, it is often tempting to overlook benefits that are difficult to quantify in monetary terms. However, the resulting underestimation could have unfortunate consequences for project evaluation. First, projects that are economically efficient may be judged as inefficient because their so-called intangible or subjective benefits (such as improved health, security, or education) are evaluated as lacking economic value. While analysts have long recognized the potential importance of such benefits for socioeconomic development, they have puzzled over how to evaluate this importance (Wasserman and Davenport 1983). Rural populations may place a higher value on benefits that are more difficult to quantify, such as lower-cost lighting; cheaper irrigation pumping; and other benefits that reduce costs to consumers, farmers, and shopkeepers. Of course, lower-cost lighting can affect health, education, and other factors that influence quality of life; thus, care needs to be taken not to double count such benefits in any evaluation. If society is willing to pay for these benefits, they should be included in the cost-benefit calculation.

1.8 Deciding that these benefits are important but that the project analysis should consider them only in an informal, non-quantifiable way runs the risk that they will weigh too heavily in the overall project evaluation. But projects should not have to depend on the ability of proponents to exaggerate or dramatize potential benefits. The hard-to-measure benefits can be included in project or policy evaluations.

1.9 Over the past 30 years, researchers have developed many techniques for quantifying intangible benefits of projects and policies. Psychologists and sociologists, for example, have developed measures of such concepts as "job satisfaction," "motivation," and "well-being." Economists, especially environmental economists, have taken a further step by developing techniques for measuring these and other similarly abstract concepts (such as "recreational enjoyment" and "housing satisfaction") in monetary terms. While not all techniques are relevant to the full spectrum of rural electrification benefits, their application may substantially increase the number of such benefits that can be considered for cost-benefit comparison.

1.10 The ultimate purpose of this work is to provide policymakers better, more relevant information. This goal dictates the need for both quantitative and qualitative data. By necessity, much of this work depends on survey instruments that assemble information in quantitative terms; however, the qualitative messages embodied in these numbers may be of equal importance. The study design recognizes that the final decision on a rural electrification project involves the judgment of policymakers. Even with respect to the efficiency issue, it is highly unlikely that decisions will rely totally on arithmetic comparisons of costs and benefits. Therefore, it would be foolish to suppress benefit information that is relatively qualitative in nature because of the inability to obtain reliable estimates in monetary terms. A better approach is to include as much relevant information as possible on the benefits of electrification.

Potentially Misleading Shortcuts for Measuring Benefits

1.11 The World Bank's previous methods for estimating benefits relied heavily on demonstrated *expenditures* and *cost savings*—concepts that focus on relative energy prices and associated outlays for the same level of energy service. Most early project appraisals used the tariff as the measure of the per-unit benefit of rural electrification (see Chapter 2). Reliance on the tariff was justified by hypothesizing that, if people are willing to pay for electricity service, then they will place a value on it that is at least as high as the tariff. In addition, using outlays or revenues makes it easy to quantify benefits; however, the level of consumer outlays can be a misleading measure of benefits. Since the consumer could have used these outlays for other purposes, such as food consumption or shelter, the outlays do not represent *net* benefits of electricity consumption. Moreover, use of the tariff as a benefit measure is especially misleading if the tariff is subsidized, in which case social benefits would depend arbitrarily on the degree of subsidization.

1.12 As a next step, the cost savings over alternative forms of energy, such as diesel-engine generators and kerosene lighting, were added to projected revenues to determine a total benefit. However, as indicated below, such cost savings are inappropriate measures of benefits. Indeed, such "savings" can be either positive or negative, depending on elasticity of demand (percentage change in demand in response to a percentage change in price). Thus, despite the modifications, benefit measures depending on the tariff and apparent cost savings may not capture the full, underlying measure of value to the consumer and society. A more relevant measure of net benefit is *consumer surplus*: the value of the service to consumers above what they pay for it. (See Anderson [1975] and Pearce and Webb [1985] for a discussion of this issue.)

Better Understanding Between Power Company and Consumers

1.13 Not insignificantly, this study generates information that can foster a better understanding between power companies and their consumers. In developing countries, power companies too often lack a consumer orientation. Generating ever-increasing amounts of power to meet growing demand often means ignoring customer relations. The beneficiary assessment method generates data on customers' perception of the service provided by the power company, as well as the power company's perception of customer-related problems. Although this study does not focus directly on this topic, it is hoped that the information generated will facilitate electricity delivery that is decentralized and uses renewable technologies, in addition to benefiting large power companies.

Better Methods for Assessing Development Outcomes

1.14 Previous estimates of rural electrification's benefits were often based on consumer cost. However, cost estimates alone are not particularly relevant for estimating benefits because they fail to reflect the full spectrum of general development benefits that rural electrification makes possible. Rather than focus narrowly on financial issues provided by cost data, this study's approach considers the full breadth of services provided by electricity. For example, while consumers do benefit from the less expensive lighting provided by a light bulb, as compared to a kerosene lamp, they also benefit in terms of adult and child literacy. Similarly, availability of electricity may lead farmers to increase irrigation, resulting in higher farm income with less seasonal variation. Understanding the relatively complex linkages between rural electrification—as well as other infrastructure, including roads and schools—and development outcomes is essential to understanding electrification's benefits for a project, region, or country.

1.15 In recent years, international donor agencies and other development organizations have increasingly emphasized development outcomes, such as poverty reduction, income generation, and improved quality of life—an emphasis more closely aligned to the benefit-estimation techniques advocated in this study. The approach first identifies the development outcomes of rural electrification, including any synergies with other infrastructure, and then finds ways to assess the value of those outcomes in monetary terms. Though not an easy exercise, it is necessary in order to evaluate how electricity fits within the context of other development priorities. For example, having electricity in a home, which enables children to study in the evenings, may play as great a role in raising educational levels as does having a school in a community. In fact, studies have shown that some types of social infrastructure are complementary rather than competing. In Peru, for example, it was found that the combination of electrification and schools has a greater effect on educational achievement than does each factor considered independently (World Bank 1999). Such complex interdependencies are not reflected in isolated cost or financial data. Thus, this study aimed to design and implement a method for improving valuation of benefits derived from rural electrification. Specifically, it estimated the monetary value of benefits derived from electricity services in terms of better opportunities for education, health, entertainment, comfort and convenience, and productivity, as well as the cost benefits of providing a less expensive means of lighting.

Organization of This Report

1.16 To achieve the study's stated goal, the authors begin by summarizing earlier methods used to measure the benefits of rural electrification and compare these with the new approaches taken in this study. (The conceptual and theoretical frameworks that underpin the study and the research methods used are presented in Appendices A and B, respectively.) Next, they present a brief history of rural electrification in the Philippines and profile the four regions and provinces surveyed. They then describe the socioeconomic characteristics of the households sampled and survey responses to electrification—attitudinal, physical, and behavioral—and present the quantification of electrification benefits. (Descriptive statistics from the surveys and sample questionnaires developed for the study are presented in Appendices C and D, respectively.) Finally, they summarize the study's empirical findings and offer conclusions and recommendations for future assessments.

2

Traditional Versus New Approaches for Estimating Benefits

2.1 The term *new approaches* does not refer to new methods for estimating the benefits of rural electrification. Rather, it refers to new ways of applying well-established methods taken from resource and environmental economics. Current development emphasis on complementarity of programs makes such new approaches more relevant to rural electrification. This means that a rural electrification program, combined with an education program, may have greater benefits than either program alone. Compared to previous approaches, this study's new approach can better measure such development outcomes, making it more relevant to understanding electricity's contribution to the overall development process.

2.2 This chapter begins by examining the underlying assumptions about benefit estimation methods. This is followed by a brief review of how methods for estimating the benefits of rural electrification evolved. Finally, this study's approach to estimating benefits is summarized.

Underlying Assumptions

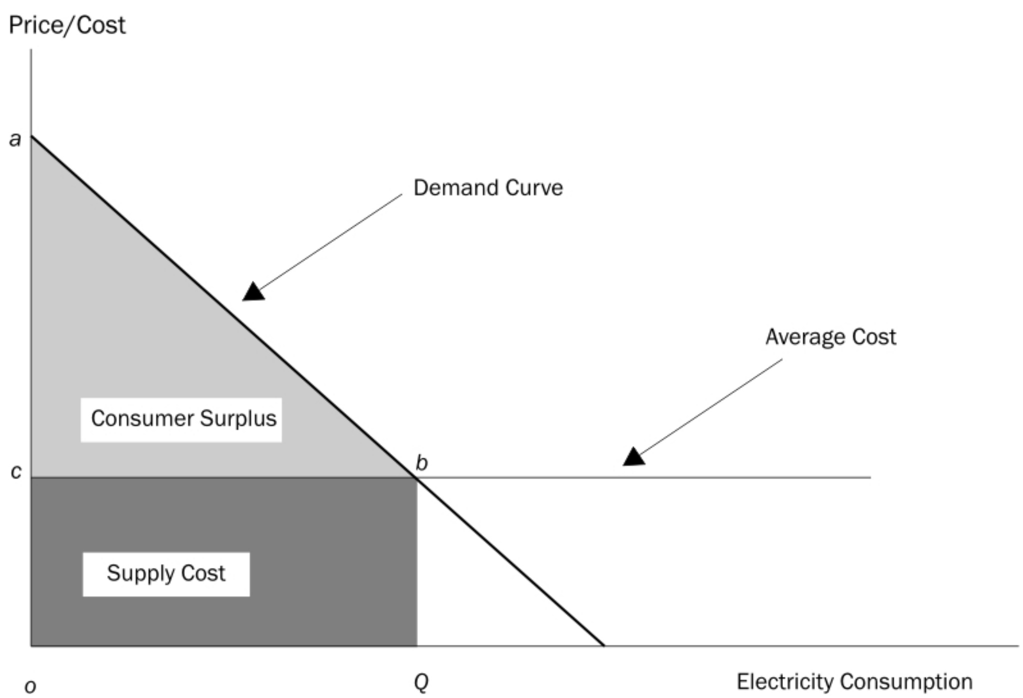
2.3 In principle, to estimate rural electrification benefits, one needs to calculate the difference in benefits enjoyed by each household with and without electrification. Summing these benefits—equivalent to the household's willingness to pay for electrification—over all households without electricity would yield the total (private) benefits for the population of households.[2] It is, of course, impossible to observe these households when the purpose of the exercise is to estimate the benefits of *prospective* policies to bring electricity to rural populations.[3] The traditional method is to estimate, using electricity consumption data drawn from a sample of all households, the benefits for a *hypothetical* household undergoing electrification.

[2] In addition, a society may gain public benefits from rural electrification. One typical example is street lighting. Its social benefits are not reliably measured by summing each beneficiary household's willingness to pay since each household, which benefits from its neighbor's willingness to pay, has an incentive to understate its own willingness to pay.

[3] It is also impossible to observe such "with and without" benefits using cross-sectional data generated by the types of surveys used in this study.

2.4 If one could observe the quantity of electricity that households demand for all electricity prices and for all levels of consumption (including a zero-level), then these benefits could be estimated by the area under a *demand curve*.[4] A demand curve indicates, for each level of consumption, the amount the household would be willing to pay for that level of consumption. Assuming that this willingness to pay is at least equal to the benefit received, the demand curve provides a measure of household benefit for each level of consumption. In particular, the *gross* benefit to the (hypothetical) household from a pre-electrification demand of ***0*** to a post-electrification demand of ***Q*** is well approximated by the area under the demand curve, ***0abQ*** (Figure 2.1). This area can be divided into two components: *consumer surplus* (triangle ***abc***) and *supply cost* of level ***Q*** (rectangle ***0cbQ***).[5] Since the consumer must spend ***0cbQ*** (and thus lose any benefit this money could have commanded for other goods and services), the benefit of ***0cbQ*** is exactly offset. Thus, the *net* benefit is simply the consumer surplus (area ***abc***). This net benefit should be compared to costs for the analyses of the economic efficiency of potential electrification projects.

Figure 2.1: Hypothetical estimation of rural electrification benefits



2.5 While this method appears relatively straightforward, its application raises four issues. First, it is nearly impossible to observe the demand curve for a wide range of electricity prices, particularly the inherently non-observable prices faced by households without electricity. To use the above method, it would be necessary to extrapolate price-

4 Other approaches depend more on estimating underlying utility functions, not just demand curves; however, even these approaches require the ability to observe alternative consumption levels at alternative prices. *See* Freeman, 1994.

5 It would be an exact estimate of benefit only if any income effects caused by the fall in price for electricity were zero. Such income effects are often assumed as negligible.

quantity observations from households with electricity to the zero price-quantity point corresponding to position ***a*** in Figure 2.1. Such an extrapolation would require heroic assumptions about the shape of the demand curve.

2.6 Second, the above method assumes that the demand curve is independent of income. A more reasonable assumption is that the demand curve will shift upward and to the right as income increases; that is, at any given electricity price, a wealthier household will likely consume more than a poorer one. In addition, as the price of electricity falls, the consumer effectively experiences an increase in income since a certain amount of money becomes available for other consumption. Traditional approaches to applying the above method to project assessment often ignore such effective changes in income relative to price changes either because a project's size relative to overall income is negligible or because they consider income changes irrelevant to project analysis. However, ignoring the potential effects of income changes when evaluating rural electrification projects is problematic. After all, a principal argument for such projects is that they are a key to raising rural incomes.

2.7 Third, the above method assumes that the demand curve is independent of changes in the price and consumption of goods or services that may complement or substitute for electricity. The demand curve could be expected to shift outward if complements to electricity consumption—such as electric appliances—were to become less expensive. Conversely, the curve could shift inward if substitute fuels were to become cheaper.

2.8 Fourth, the area under the demand curve estimates only *private* household benefits; however, electrification also yields *public* benefits, such as electric street lighting or electrified community health centers. By definition, even if only one household chooses to purchase a public good, many households can enjoy its benefits. Thus, such households' willingness to pay for these goods falls well below their worth to them.

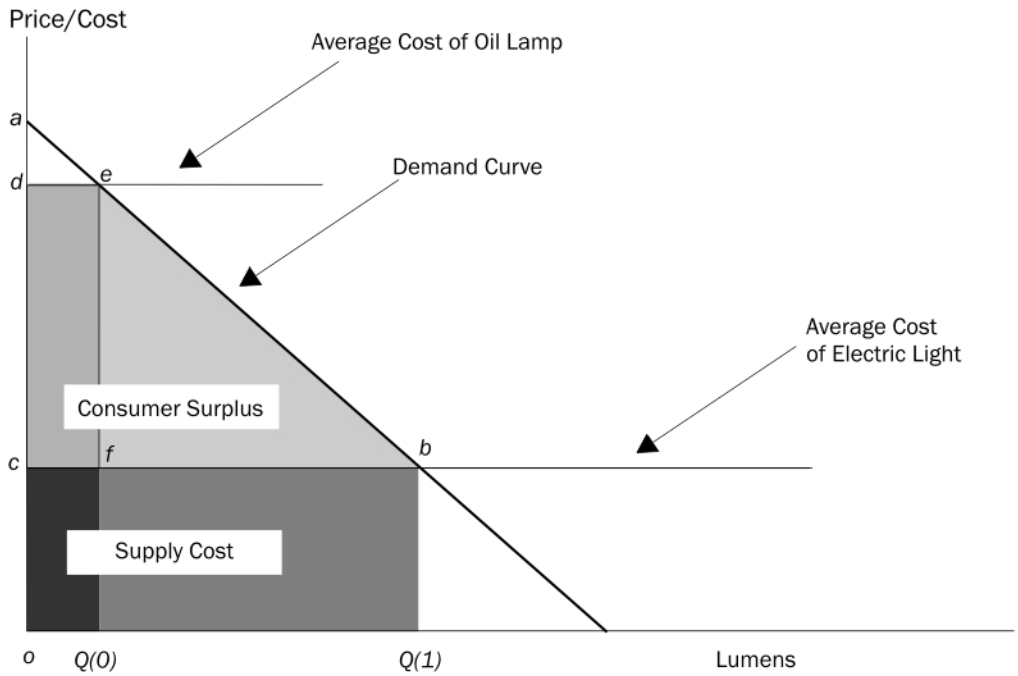
Previous World Bank Approaches

2.9 Two previously used World Bank approaches to estimate electrification benefits address the first issue described above, only partially address the second, and neglect the third and fourth (World Bank 1989). Both approaches assume that the demand for electricity is a *derived demand* arising from the demand for other goods or services for which demand curves are easier to measure. Thus, electricity is demanded not for its own sake but because it serves to lower the cost of other goods and services. For example, electrification lowers the costs of satisfying a household's demand for lighting, raising the possibility of estimating benefits as the area under the demand curve for lighting. Electrification also lowers the costs of satisfying farmers' demand for irrigation. In this case, benefits could be measured in terms of this cost savings.

Demand for lumens

2.10 The first approach is illustrated by Figure 2.2, which shows a demand curve for lighting, measured as lumens. The assumed source of lighting for an unelectrified household is the oil lamp—an expensive source of lumens compared to the electric bulb. As a result of the high average cost, only ***Q(0)*** units are consumed. For an electrified household, consumption increases to level ***Q(1)*** because of the decrease in average lumen cost. However, since this demand curve indicates the willingness to pay for lumens, there is a *net* benefit over what lumens cost the consumer (***c***) for every consumption level less than ***Q(1)***. Accordingly, there is a net gain in benefit, which is approximated by triangle ***feb*** plus rectangle ***cdef***; their sum equals the final net consumer surplus (triangle ***cab***) minus the initial consumer surplus (triangle ***dae***).

Figure 2.2: Benefit estimation derived from demand curve for lumens



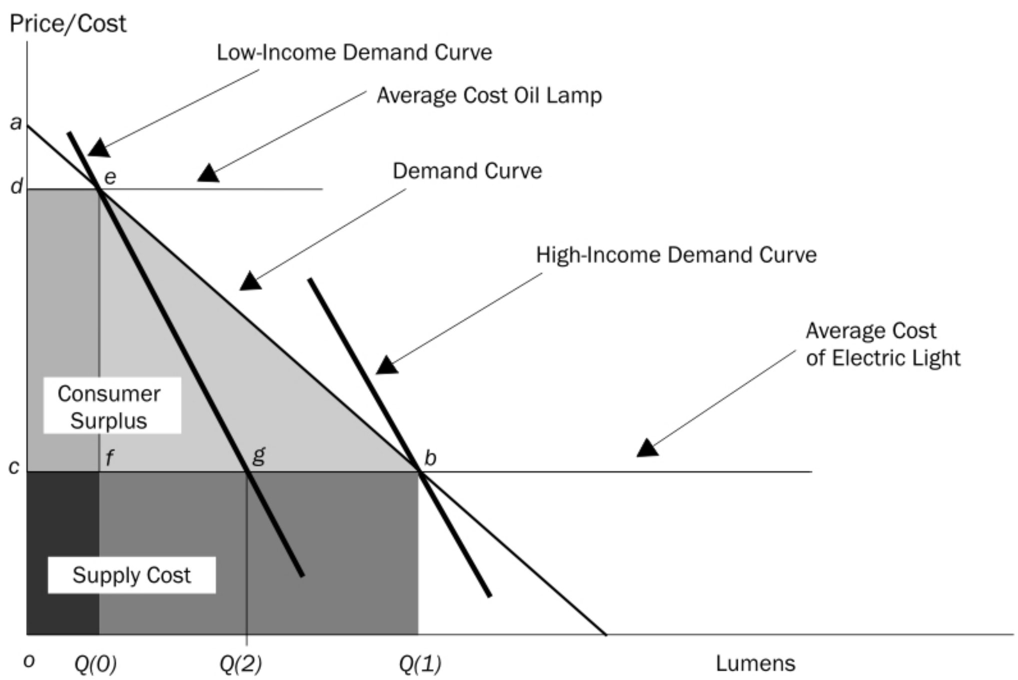
2.11 The analysis used in this approach does not depend on *why* lumens are more costly initially and cheaper later. It assumes that lumens are costly initially because of reliance on a high-cost source, such as oil or kerosene. The higher assumed cost could be for any reason, such as the high cost of electricity (as would come from total reliance on batteries). This approach would work if one could observe differences in lumen consumption as a result of *any* reason for differences in lumen cost. It should also be noted that the estimated consumer surplus depends on two factors: 1) difference between the per-unit costs before and after electrification and 2) differences in lumen consumption as a response to this cost difference. Previous World Bank studies have indicated that even very poor households in developing countries have demonstrated a high willingness to pay for lumen consumption and have increased this consumption substantially in response to the much lower costs associated with electrification (Fitzgerald, Barnes, and McGranahan 1990). Thus, observation of high benefit estimates would be expected.

2.12 This approach is straightforward in that it observes household lumen consumption for various lighting sources, ranging from oil lamps to electric bulbs. The average lumen cost for these sources of lighting is easily estimated. The analysis, however, makes some important assumptions. First, even with many observations of lumen consumption, the estimation of the demand curve requires the analyst to assume its functional form. Often, a linear form is assumed (Figure 2.2); while convenient, it may be far from reality. The more observations, the better the chances that the linear assumption can be relaxed.

2.13 Second, the approach assumes that the source of lighting has no effect on lumen demand. Rather, it assumes that, at the same cost and lumen output, a household would have no preference in choosing between a light bulb or an oil lamp. That the oil lamp is dirty, foul-smelling, and more dangerous would have no effect on choice. Thus, this assumption allows for a major simplification in specifying lumen demand. Even if parameters could be identified to measure the effects of dirt, odor, and physical danger on lumen demand, a large number of lumen consumption observations—enough to reflect the use of all types of lighting appliances—would be required.

2.14 Third, this approach assumes that both rich and poor share the same demand function—an assumption that also underlies the previous approach (Figure 2.1). However, if wealthier households were willing to pay more for their lumens at all levels of consumption, their demand curves would be higher than those of poorer households (Figure 2.3).

Figure 2.3: Lumen demand with high- and low-income demand curves



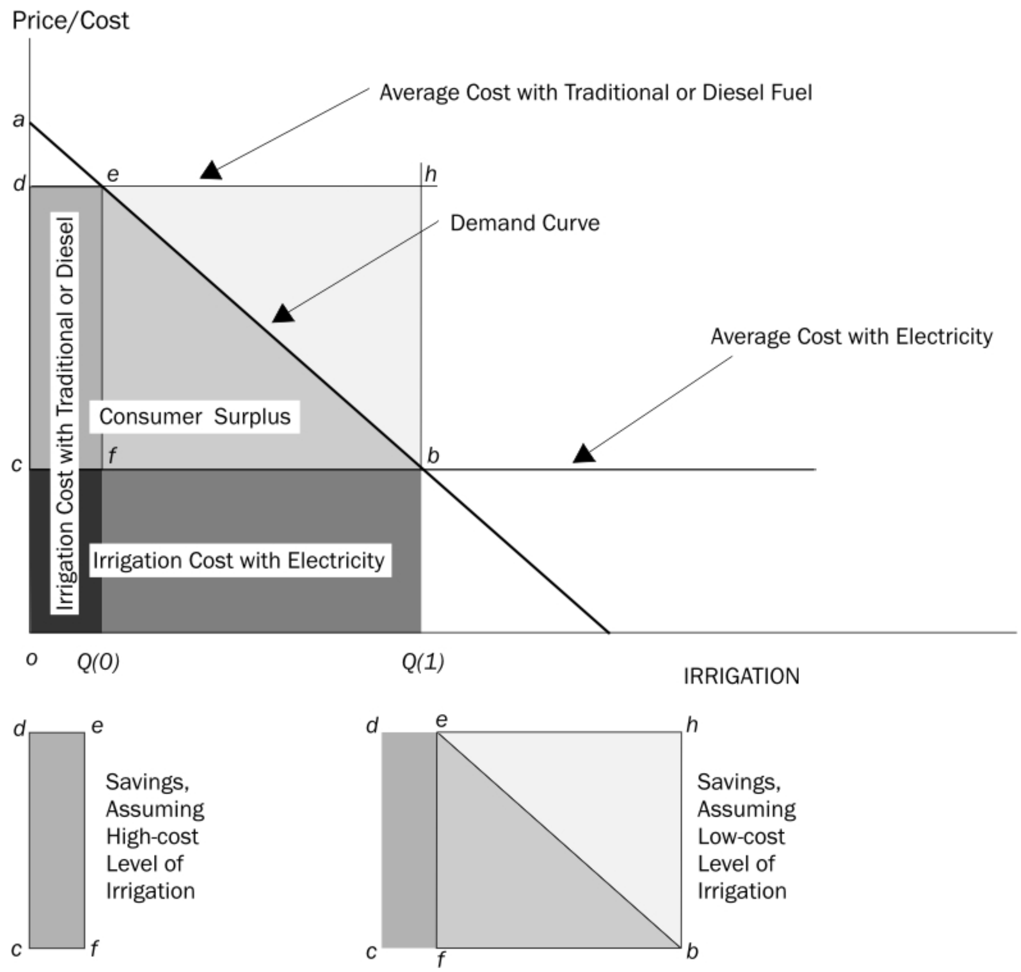
2.15 If low-income households had the lower demand curve as shown, then the effect of electrification would be increased demand only to level ***Q(2)*** *for these households* and not the previously assumed level ***Q(1)***. If the purpose of the analysis is to estimate the benefits of electrification to households without electricity, then the estimation (using consumer surplus as the estimator) might be too high by an amount represented by triangle ***geb***. However, this conclusion assumes that the demand curve for low-income households remains static even as they become electrified—in particular, income effects could be ignored. It might be more accurate to assume that, as low-income households gain access to electricity, their demand curves for lumens might begin to approximate the higher demand curves of households that gained access earlier. If so, then the original demand curve, while not totally representative of either low- or high-income households, might represent an average. In this case, the previous estimate of benefit (triangle ***feb***) might be a good estimate after all.

Cost savings

2.16 As noted above, another commonly used measure of electrification benefits, especially for agricultural households, is the cost savings that electrification makes possible, particularly for irrigation. A typical error is to compare the before-and-after costs of irrigation and assume they will decrease after electrification. Such a comparison is of interest only if the level of irrigation remains constant. If the level increases, costs will either rise or fall, depending on the elasticity of demand for irrigation. If demand is inelastic, the lower unit cost of electrification will yield lower total costs. Conversely, if demand is elastic, the lower unit cost of electrification will yield higher total costs.

2.17 In reality, cost savings, even correctly estimated at fixed levels of irrigation, can only approximate the true gain in benefits from electrification, which is best estimated by the consumer surplus triangle (***feb***) (Figure 2.4). There are two cost-savings measures: one that assumes the (lower) pre-electrification level and a second that assumes the (higher) post-electrification level. As Figure 2.4 shows, neither measure duplicates true consumer surplus—the former measure is too low while the latter is too high. The degree of overestimation or underestimation cannot be ascertained without knowing the irrigation demand curve. Of course, if this curve were known, the correct benefit measure could be calculated directly, and the analyst would not need to use cost-savings estimates.

Figure 2.4: Cost savings as an estimate of electrification benefits



Applying New Approaches to the Philippines

2.18 As indicated previously, the earliest World Bank approach to estimating the benefits of rural electrification simply involved estimating likely expenditures for electricity service as total consumer benefits. This was later modified to include savings that resulted from switching from kerosene to electric lighting and from diesel fuel to electricity. Then, about a decade ago, consumer surplus, as described above, was adopted to estimate benefits for households, as well as retail shops and businesses that used electricity mainly for lighting. While these approaches had their strengths, one common weakness has been their failure to measure more intangible benefits, such as improved health, education, or quality of life.

2.19 This study attempts to include such difficult-to-measure benefits in the assessment process. However, this task is not strictly theoretical, but is necessarily grounded in empirical investigations of rural electrification's effects. To accomplish this task, it was decided that a case study should be conducted in the Philippines, where 60% of the rural population has been electrified, thanks to the country's long-standing, extensive rural electrification program.

2.20 This study's approach is an extension of the derived demand approach that the World Bank used previously to estimate electrification benefits. As mentioned above, it is assumed that electricity is not in demand for its own sake but because it satisfies demands for other goods and services at lower costs. It differs from past approaches principally in that many of the goods and services from which demand for electricity is derived are not bought and sold in conventional markets, as are lumens. Therefore, their demand curves are not as easily estimated. In fact, the benefits from non-marketed goods and services must be estimated using a variety of indirect techniques borrowed mainly from environmental cost-benefit literature.

2.21 The approach assumes that electricity is a key input to generating the following goods and services that directly benefit households:

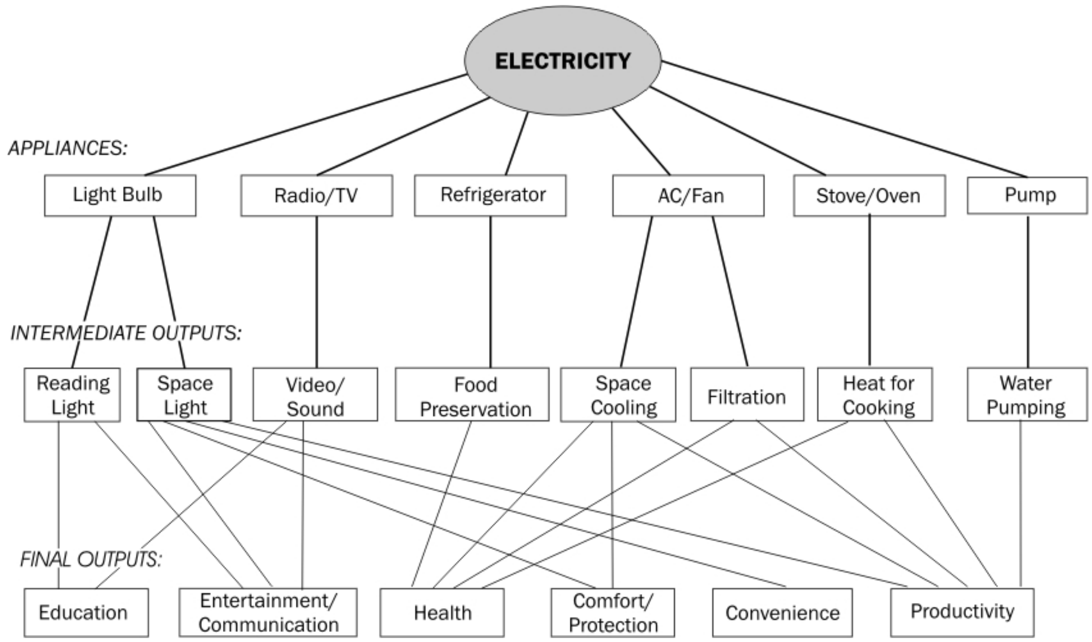
- education,
- health,
- entertainment and communication,
- comfort and protection,
- convenience, and
- productivity.

2.22 Figure 2.5 illustrates the relationship between electricity and the appliances it powers (inputs) and the above-listed goods and services it helps generate (outputs). The general method for evaluating the benefits of electricity can be outlined as follows:

2.23 ***Determine a measure or "metric" for each of the final outputs***. For most final outputs, the metric is relatively straightforward. For example, education can be measured by years of schooling, entertainment by hours of watching television or listening to the radio, health by morbidity or mortality rates, convenience by time saved, and productivity by output or production. Determining a metric for comfort or protection, however, may be more difficult. Protection could be measured by crime statistics but "softer" measures, such as household members' responses to questions about their feeling of security and comfort, may have to suffice.

2.24 ***Observe differences in final outputs between electrified and non-electrified households***. This step requires a carefully designed survey of households. (This study's survey is discussed in detail in Chapter 4.)

Figure 2.5: Relationship between electricity use and energy services



2.25 ***Estimate the effect of electrification on the observed differences in final outputs***. In most cases, final outputs are affected not only by electrification but by other factors, including income. Therefore, at a minimum, the survey responses must be cross-tabulated by these other factors in order to observe the partial effect of electrification. Because of the complex role other variables play, cross-tabulated data may be inadequate to identify electrification's effect, and use of multivariate statistical techniques may be necessary.

2.26 ***Estimate households' willingness to pay for increments in final outputs resulting from electrification***. The precise method for estimating what a household is willing to pay for increases in final outputs resulting from electrification depends on the final output under consideration. For example, willingness to pay for increased education could be reasonably estimated by the increase in household income resulting from this education. The relationship between education and household income has been extensively researched. In fact, empirical studies of this relationship exist in the Philippines. Similarly, willingness to pay for improved health could be estimated by reduction in medical costs, fewer work days missed because of illness, and the perceived value of decreases in mortality, often estimated by increases in earned income but, more properly, by the value of increases in age-adjusted life expectancy as revealed by wage differentials between risky and less risky jobs (See Freeman, 1994). Estimates of these health benefits exist in the Philippines as well.

2.27 With respect to increases in convenience (measured, for example, by the reduction in time to collect fuelwood or fetch water), willingness to pay could be measured by the opportunity cost of time to the household; that is, the value to the household of the time made available by electrification for doing things other than laborious chores. This opportunity cost is, in turn, often proxied by the wage rate.

2.28 The benefits of observed increases in productivity (for example, in agricultural output per hectare of farm households) might best be measured by the market value of the increased output. On the other hand, benefits from increased access to entertainment could be estimated by the cost of purchasing the entertainment elsewhere; that is, the benefit of watching a movie on television could be measured by the cost of a movie ticket.

2.29 Finally, when it is possible to estimate demand curves for final output (for example, the demand for lumens), the conventional World Bank technique should be used. Similarly, if the savings in the household's cost of producing various marketed outputs are readily measured, cost savings can also be used as a measure of benefits. In both cases, the limitations of these estimates, as discussed above, should be noted.

2.30 The above procedures may fail to yield quantitative estimates of willingness to pay or benefits for all classes of final outputs. This is especially likely in cases where it is difficult to define a good metric. For example, it may not be possible to measure precisely the "feelings of security" that arise as a result of turning on an electric lamp at night. Furthermore, household response data may not be as relevant when the final output is a public good, such as community street lighting. In these cases, policymakers must rely on more qualitative information. For this reason, the Philippine survey contains a number of attitude questions that reveal qualitative responses to electrification benefits. In addition, the household survey is supplemented by a community survey in order to address the public-goods benefits.

Rural Electrification Subsidies and Benefits

2.31 Ideally, the calculations of electrification benefits require that the household price of electricity cover only the average cost of providing electricity to the household. In fact, these prices are probably slightly below-average costs because of capital subsidies, which are common in the Philippines. In any event, the Philippines has a policy of cost-covering prices (after subsidies for some of the capital costs of line extension to areas without electricity), and prices are high compared to other Asian countries. As a result, this study's estimates are likely to be only slightly higher than the true social benefits.[6]

2.32 As subsidies are quite common in electricity markets, it is reasonable to ask how they affect the true social benefits of electrification. Suppose that social benefits were correctly calculated based on actual average costs. How would a subsidy that served to lower costs to the electricity consumer affect true social benefits? While it may seem surprising in view of their popularity, subsidies generally tend to reduce the net social benefits of electrification. Of course, from the consumer's point of view, there would be an apparent gain in consumer surplus for the household in response to the lower price. However, the subsidy is not without costs to society as a whole since the full costs of providing electricity have to be covered. Thus, if electricity customers end up paying less for what they consumed before the subsidy, production elsewhere in the economy has to be reduced to cover costs previously borne by electricity consumers. This reduction in production will offset any apparent gain in benefits. Moreover, because of the lower subsidized price, electricity consumption will likely

[6] The overestimate is probably minor since operating costs, the largest costs component, are not subsidized in the Philippines.

increase over pre-subsidy levels. It can be shown that, as a result of increased electricity consumption, the costs of the subsidy will be somewhat larger than the apparent gain in consumer surplus for electricity consumers. For this reason, the subsidy will likely result in a net reduction in benefits to society as a whole.[7]

2.33 Given that subsidies tend to reduce net social benefits (that is, they are economically inefficient), why are they so common? The reason is that they have an important role to play with respect to two other policy features: equity and effectiveness. Subsidies are often used as a practical way to offset the effects of low income. Although it may be more efficient economically to help the poor by effecting income transfers though taxation-expenditure policies, these are often unpopular politically. Price subsidies are far less visible. Thus, they permit the attainment of equity goals in a reasonably effective manner. The resulting loss in economic efficiency may be a small price to pay to achieve overall social objectives.[8]

Conclusion

2.34 This study's approach is to develop ways of measuring the outcome of rural electrification by measuring improvement in energy services. The ability to read during evening hours may improve rural education and business productivity. Radios and televisions can provide access to information and entertainment. And use of electric fans may increase comfort and improve health by reducing incidence of insect bites. The researchers do not claim that these are the benefits. Rather, they show that these are the *types* of benefits that should be measured before placing a monetary value on them. Explaining why this is so is the goal of the following chapters.

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7 This argument assumes that resources for electricity production come solely from domestic sources—even if the financing for the production comes from foreign sources, such as World Bank loans. If the resources for electricity production did not compete for other domestic resources, there could be "free" subsidies yielding net benefits.

8 Electricity subsidies are used occasionally to encourage enough short-term production to realize any economies of scale. Known as Hoteling subsidies, they can be economically efficient; however, once optimal market size has been obtained, they should be eliminated in order to maintain economic efficiency.

3

The Philippine Context for Rural Electrification

3.1 The Philippines is ideal for assessing rural electrification's benefits. The country has a long history of rural electrification, which facilitates the evaluation of long-term benefits. In addition, it is relatively easy to compare electrified and non-electrified households in the Philippines, given that only 60% of the rural population has electricity. Furthermore, the nation's government is committed to rural electrification, despite problems of implementation.[9] All three factors make the Philippines an excellent choice for assessing the benefits of electricity for rural people.

3.2 This chapter aims to provide a historical and geographical perspective on the study's results. Four rural electric cooperatives (RECs), each representing a separate province on the island of Luzon, were selected, based on their geographical spread and program effectiveness. The cooperatives range from the highest to the lowest classification, based on statistics reported to the National Electrification Administration (NEA). An overview of the country's history of rural electrification is presented first, followed by a brief description of the four selected provinces.

Historical Overview

3.3 Electricity was first introduced in the Philippines in 1890. In the decades that followed, private companies were largely responsible for development and control of electricity supply, while the government regulated installation. In 1936, the National Power Corporation (NPC) was created to develop the country's hydroelectric resources. By 1969, out of a total generating capacity of 1,750 megawatts (MW), the NPC contributed 585 MW, the Manila Electric Company (MERALCO) (the largest private supplier) provided 990 MW, and private companies supplied the remaining 175 MW.

3.4 In 1960, the Philippine government declared total electrification of the country as a national policy objective and created the Electrification Administration (EA) to implement it. To encourage private-sector participation, the government awarded private companies franchises to set up local distribution systems in rural areas. These private companies sourced power either by generating their own or by making bulk purchases from the NPC.

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[9] The current regime is committed to achieving total electrification within the next decade; however, given the difficult terrain of this island nation, such a goal may be overly ambitious.

3.5 By 1969, the Electrification Administration (EA) had helped to establish 217 small systems, each with fewer than 500 kilowatts (kW) of capacity, throughout the country. However, technical and financial problems caused many of these systems to shut down. Thus, by the early 1970s, only about 18% of the Philippine population had access to electricity.

3.6 Despite these early problems in implementing the total electrification policy, new efforts were begun. A 1966 study funded by the United States Agency for International Development (USAID) recommended that the country institute a rural electrification program based on the REC model used in the United States. As a result, two pilot projects aimed at adapting the U.S. model to Philippine conditions were initiated—one in northern Mindanao, known as the Misamis Oriental Rural Electric Service Cooperative (MORESCO) and the other on the island of Negros in central Visayas, known as Victorias Rural Electric Service Cooperative (VRESCO). With the passage of the National Electrification Act in 1969, the RECs were designated the country's primary electricity distribution system; and the NEA, which replaced the EA, was set up as the implementing agency.

3.7 The second phase of the rural electrification program planned for the establishment of 36 RECs, each covering a franchise area of about 100,000 people. These RECs were to act as self-governing distribution agencies operated by buying bulk electricity from the NPC. The NEA was granted power to establish and oversee the RECs, to make loans, acquire physical property and franchise rights of existing suppliers, and borrow funds to implement national electrification.

3.8 Involvement of local communities was a key element in the planned rural electrification program. By using the cooperative approach, the program could devolve management to the local level, whereby local communities could actively participate in the system. However, the Philippines had a history of cooperative failures. During the 1950s, loans to the Agricultural Credit and Cooperative Financing Administration (ACCFA) and water-user associations were misused and went unpaid. Despite this poor record, the RECs were viewed as the best way to distribute electricity to rural areas.

3.9 The NEA defined the franchise area of each REC, paid for the construction of the distribution network, and devolved ownership to the RECs, which then assumed responsibility for paying the costs of construction. The RECs were responsible for running, maintaining, and expanding the local electricity system. The tariffs they collected were to cover all operational costs and loan repayments to the NEA.

3.10 During the 1970s, the rural electrification program expanded quickly as a result of strong government support and financial assistance from international banks and donor agencies (Denton 1979). By 1980, 120 RECs had been established, servicing more than one million customers. With such rapid expansion, however, major problems soon emerged and began to escalate. By the mid-1970s, the strict criteria initially used to establish and operate the RECs were abandoned. The RECs could now be established in non-viable areas, were managed within a culture of political patronage and political pressure, and were charged unrealistically low tariffs, insufficient for covering their costs. Payment collection levels were poor and electricity systems were poorly maintained. Such problems continued and worsened during the 1980s.

3.11 Concurrently, international-agency grants and loans declined, and financial losses for both the NEA and the RECs were substantial. Cooperative customers began to default on their REC loans. In turn, failure of the RECs to repay their NEA loans became widespread, with the average efficiency of NEA collection declining to 36%. As a result, the NEA went bankrupt in 1989.

3.12 In response, the Philippine government and the World Bank carried out a joint review of the rural electrification program (World Bank 1989). This assessment found that most RECs faced operational and financial challenges. Only 22 (18.8%) of the 117 RECs were categorized as well managed and commercially viable; 24 (20.5%) as within reach of commercial viability; and the remaining 71 (60.7%) as needing substantial remedial action or beyond rescue.

3.13 The World Bank report concluded that:

> The problems are so pervasive that they cannot be addressed by simple solutions; rather, the government will need to implement an integrated program to revitalize the sector. That program should have three essential components: (a) a comprehensive restructuring of the sector's core institution, the National Electrification Administration; (b) a broad program of institutional reform, featuring some financial restructuring of the 117 Rural Electric Cooperatives that are responsible for distributing electricity to smaller urban centers, towns, villages and rural areas nationwide; and (c) a thorough refocusing of operational practice and investment priorities. (World Bank 1989).

3.14 As a result of this review, the government and the NEA introduced financial restructuring of the subsector, institutional and policy reforms, and stricter accountability for RECs. Major steps were taken to reorganize and de-politicize the RECs. Nearly half of all REC general managers were replaced; some RECs merged to become more viable organizations; and, in 1990, a new tariff formula was introduced to make the RECs more financially viable.

3.15 Despite such reforms, several RECs continue to face financial and management problems. Privatization of the NPC and the RECs are among the provisions in the Omnibus Bill currently being deliberated in the legislature. These issues have been under discussion for several years.

Profile of Sample Provinces

3.16 The Philippines is administratively divided into the National Capital Region (NCR), Cordillera Autonomous Region (CAR), Autonomous Region of Muslim Mindanao (ARMM), and 13 other regions. Regions are divided into 73 provinces, which are subdivided into cities and municipalities. The lowest administrative level is the *barangay* (rural village or urban district), of which there are more than 34,000 nationwide.

3.17 Households comprising the study sample were selected from four, geographically disparate provinces on the northern island of Luzon: Mountain Province in the CAR (.13 million people), Nueva Ecija in central Luzon (1.31 million people), Batangas in southern Tagalog (1.66 million people), and Camarines Sur in the Bicol[10] (1.43 million people).[11] The populations of all four provinces are predominantly rural, ranging from 91% in the Mountain Province to 65% in Camarines Sur. Nueva Ecija has the highest proportion of urban residents (39%), followed by Camarines Sur (35%) and Batangas (27%). The Mountain Province has the lowest population density (62.3 per sq km), while Batangas has the highest (523.9 per sq km). The population densities of Camarines Sur and Nueva Ecija are just over half that of Batangas (272 and 285 per sq km, respectively.) (See Map, IBRD 31134.)

3.18 As Table 3.1 illustrates, the four provinces encompass a wide range of socioeconomic characteristics. As might be expected, the Mountain Province, which has the largest rural population, also has the highest proportion of residents working in agriculture-related occupations (69.7%) and primary industries (80.1%). More urbanized provinces tend to have a greater proportion of people employed in non-agricultural occupations or tertiary industries (63.4% and 44.6% of residents in Camarines Sur and Nueva Ecija, respectively, are in non-agricultural jobs). Batangas is the exception. Although its proportion of urban residents is less than that of Camarines Sur or Nueva Ecija, it has the highest proportion of residents employed in non-agricultural occupations (71.%) and tertiary industries (70%).

10 Referred to as Bicolandia on Map of the study survey areas (IBRD 31134).

11 Note that tables throughout chapters 4-6 use province names to substitute for those of the RECs. For the specific names of and territories serviced by the RECs, see Map (IBRD 31134).

Table 3.1: Profile of the Four Provinces Studied, 1998

Indicator	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*
Total population	130,755	1,505,827	1,658,567	1,432,598
Average annual growth rate (%)[1]	2.2	2.6	2.2	1.75
Number of households[1]	25,430	300,345	318,539	265,030
Average household size	5.12	5.01	5.2	5.4
Proportion rural population	91.0	61.0	73.0	64.8
Population density (per sq km)[2]	62.3	285.0	523.9	272.0
Average annual per-capita income[3]	16,578	23,286	20,590	13,090
Literacy rate	81.5	97.8	96.5	96.3
Occupation (%)				
Agriculture	69.7	43.7	25.3	36.3
Non-agriculture	19.5	44.6	71.7	63.4
Household population (15 years and older), by industry (%)				
Primary	80.1	48.8	28.	57.9
Secondary	2.0	11.0	23.	8.8
Tertiary	17.7	40.0	70.	33.1
Infrastructure access (% households)				
Electricity	30.3	67.4	71.8	45.1
Potable water	76.3	65.6	83.2	60.2
Sanitary toilet facilities	13.6	64.6	54.5	60.1
Ownership of appliances, communication devices, and vehicles (% households)				
Radio	59.5	65.0	66.1	63.7
Television	3.1	42.4	43.2	15.1
Refrigerator	3.1	15.7	22.1	10.5
Telephone	0.4	1.0	1.7	1.2
Motor vehicle	1.9	11.1	7.5	4.2
Ownership of housing unit (% households)	91.9	93.0	87.6	87.1

Source: National Statistics Office, 1993
[1] National Statistics Office, 1995
[2] National Statistics Office, 1998
[3] National Statistics Office, 1997

3.19 Camarines Sur has the lowest population growth rate (1.75%), but the largest household size (5.4). The population growth rates of the Mountain Province, Batangas, and Nueva Ecija are 2.2%, 2.2%, and 2.6%, respectively; while the average household size for these three provinces is 5. All four provinces have relatively high literacy rates, ranging from 81.5% in the Mountain Province up to 97.8% in Nueva Ecija. (Compared to other developing countries, the Philippines has high rural literacy rates.)

3.20 Access to infrastructure, including electricity, potable water, and sanitary toilet facilities, is generally higher in more urbanized provinces. Appliance ownership, including televisions and refrigerators, is highest in Batangas and Nueva Ecija. Ownership of radios is relatively high in all four provinces, ranging from 59.5% in the Mountain Province to 66.1%

in Batangas. Housing ownership is highest in Nueva Ecija (93%), followed by the Mountain Province (91.9%).

3.21 The types of energy the RECs use indicate both their level of development and access to modern fuels. For example, households in Camarines Sur have the lowest annual, per-capita income (P13,098), while households in Nueva Ecija have the highest (P23,286). Batangas households average P20,590 per capita, while those in the Mountain Province earn a much lower P16,578. As Table 3.2 shows, in the Bicol (where Camarines Sur is located), only 15.2% of households use liquefied petroleum gas (LPG); 90.6% use kerosene, 77.4% use fuelwood, and 36.1% use biomass residue. Fuelwood use is also heavy in the CAR, where the Mountain Province is located. These findings are consistent with well-known results that households in low-income regions generally have less access to such modern fuels as electricity and LPG.

Table 3.2: Types of Energy Households Use, by Region, 1995

	Household use (%)			
Energy type	*CAR*	*Central Luzon*	*Southern Luzon*	*Bicol*
LPG	50.8	54.3	51.8	15.2
Kerosene	63.2	69.3	74.5	90.6
Fuelwood	77.3	55.1	56.6	77.4
Charcoal	14.0	38.4	42.2	35.0
Biomass residue	3.7	7.2	21.6	36.1

Note: Households may use more than one type of energy.
Source: Department of Energy, 1995

Conclusion

3.22 The four RECs selected for this study sample demonstrate regional and provincial diversity in their socioeconomic and electricity-service characteristics. Figures from other studies presented in this chapter confirm that the goal of a diverse study sample has been achieved. In the next chapter, the authors examine the results of the household survey conducted as the basis for this study.

4

Household Characteristics of the Four Provinces

4.1 Characteristics of the households surveyed in this study reflect the varying levels of socioeconomic development found in the four selected provinces, as well as the geographic diversity among their respective regions. This chapter presents the results of the household survey conducted in the four provinces. In turn, these results form the basis for subsequent discussion about the effects of rural electrification and their valuation.

Regional Diversity in Household Composition

4.2 For each of the four provinces, a sample of 500 households was surveyed, for a total of 2,000 households. The authors developed a series of weights, based on each province's total number of households, so that the characteristics of those surveyed would approximate the attributes of the provinces' total populations. Thus, for example, the 500 households surveyed in the Mountain Province represent 19,302 households (Table 4.1). The socioeconomic characteristics of the surveyed households were adjusted according to these weights to represent the total population of each province.

Table 4.1: Distribution of the Weighted Sample Households, by Electrification Status, 1998

No. of households	*Province*				*Total*
	Mountain Province	*Nueva Ecija*	*Batangas*	*Camarines Sur*	
Non-electrified	6,112	12,948	5,122	31,621	55,803
Electrified	13,190	63,805	86,025	39,035	202,055
Total households	19,302	76,753	91,147	70,656	257,858

4.3 The average household size for the four provinces is 4.92 (Table 4.2). Camarines Sur has the largest size, with an average of 5.12 household members, followed by Batangas (4.89), Nueva Ecija (4.87), and the Mountain Province (4.56). These averages approximate the average family size for the four provinces, ranging from 5 in Nueva Ecija to 5.12 in the Mountain Province. The largest proportion of households with 4-5 members is found in Batangas (40.66%), followed by Nueva Ecija (39.60%), and the Mountain Province (32.20%). Camarines Sur, with only 29.90% in the 4-5 member size, has the largest proportion of households, with 6-7 members (26.29%). The Mountain Province has the largest proportion of one-person households (10.69%), followed by much smaller proportions for Camarines Sur (2.83%), Nueva Ecija (2.39%), and Batangas (1.55%).

4.4 Household members 15 years or older were considered adults, while members younger than 15 years were considered children. According to this classification, established by the International Labor Organization (ILO), households in the sample have an average of 2.52 adults and 1.78 children (Table 4.3). Although the figures do not vary greatly across the four provinces, Nueva Ecija and Batangas have a relatively higher mean adult population (2.72 and 2.60, respectively), compared to the Mountain Province and Camarines Sur (2.17 and 2.28, respectively).

Table 4.2: Household Distribution (%), by Household Size, 1998

No. household members	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All house-holds*
1	10.69	2.39	1.55	2.83	2.84
2-3	23.93	24.83	25.65	25.84	25.33
4-5	32.20	39.60	40.66	29.90	36.76
6-7	22.36	23.26	21.02	26.29	23.23
8 or more	10.82	9.92	11.12	15.13	11.84
Average household size	4.56	4.87	4.89	5.12	4.92
Valid N	19,302	76,753	91,147	70,656	257,858

4.5 The level of education attained by household members is still modest, with few having reached the tertiary level (Table 4.3). Although many people have completed elementary school, the numbers drop off sharply afterwards. Across the four provinces, approximately three members per household have completed elementary school, while only one household member has completed high school.

Table 4.3: Household Composition: Age and Education, 1998

Household composition	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Age					
15 years and older	2.17	2.72	2.60	2.28	2.52
5-14 years	1.45	1.13	1.15	1.51	1.27
Younger than 5 years	0.46	0.42	0.43	0.72	0.51
Educational level completed					
College	0.68	0.72	0.72	0.51	0.66
High school	0.93	1.44	1.33	1.07	1.26
Elementary school	2.80	2.42	2.69	2.94	2.69

Characteristics of household head and spouse

4.6 Household heads are generally middle aged (their average age is 47.54 years) and have at least a primary level of education. The average number of years of schooling is about 7.22 years, indicating education to the first year of high school. Household spouses, on average, are four years younger than household heads (their mean age is 42.96) and have an average of 7.44 years of education, slightly more than the household head. Men head 87% of households, while women head only 12%. A relatively larger proportion of households are headed by women in the Mountain Province (16%) and Batangas (15%), compared to Camarines Sur (12%) and Nueva Ecija (9%) (Table 4.4).

Table 4.4: Characteristics of Household Head and Spouse: Age, Education, and Gender; 1998

Characteristic	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Average age (years)					
Household head	49.05	47.87	48.86	45.07	47.54
Household spouse	43.13	43.95	43.55	41.10	42.96
Average level of education completed (years)					
Household head	6.17	7.46	6.99	7.57	7.22
Household spouse	6.69	7.75	7.26	7.52	7.44
Gender of household head (%)					
Female	16	9	15	12	13
Male	84	91	85	88	87
Weighted sample	19,302	76,753	91,147	70,656	257,858

4.7 Agriculture is the predominant occupation of household heads in all four provinces. In the Mountain Province and Nueva Ecija, 76.66% and 59.55%, respectively, of all household heads are farmers, foresters, or fishers. In Camarines Sur and Batangas, the percentages are lower (46.65% and 36.22%, respectively) (Table 4.5). These relatively high percentages reflect the fact that 64% of the national population depends on agriculture as a major income source.

Table 4.5: Percentage of Households, by Occupation of Household Head, 1998

Occupation of household head	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Govt. official, corporate exec., manager, or supervisor	2.31	1.88	3.83	5.06	3.44
Professional	4.19	3.04	3.36	3.88	3.47
Technician or assoc. professional	1.06	2.16	1.70	3.27	2.22
Clerk	0.71	---	0.24	0.60	0.30
Service, shop, or market sales worker	1.48	7.66	12.19	4.50	7.80
Farmer, forester, or fisher	76.66	59.55	36.22	46.65	49.59
Trader	0.71	1.35	5.86	6.92	4.34
Plant or machine operator or assembler	1.31	1.90	6.27	2.78	3.55
Laborer or unskilled worker	7.07	12.88	18.84	20.62	16.54
Housewife	2.76	4.45	8.21	2.10	4.91
Special occupation	1.73	5.13	3.28	3.62	3.83
Weighted sample	18,764	72,883	77,921	65,124	234,692

4.8 In Batangas, which has the smallest proportion of farming households, 63.78% of household heads earn their living in other ways; 18.84% are laborers and unskilled workers, while 12.19% are services, shop, and market sales workers. Census data for the province show that 70.9% of households in Batangas are employed in tertiary industries, with only 23.7% in secondary industries and 28.9% in primary industries.

4.9 Spouses in all four provinces work as housewives. They comprise 80.30% of spousal occupations in Batangas, 79.75% in Nueva Ecija, and 78.58% in Camarines Sur. In the Mountain Province, 48% of household spouses are engaged in farming, forestry, and fisheries; while a smaller percentage (35.62%) work as housewives (Table 4.6).

Table 4.6: Percentage of Households, by Occupation of Spouse, 1998

Occupation of household spouse	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Govt. official, corporate exec., manager, or supervisor	0.71	0.85	1.85	5.61	2.50
Professional	6.77	3.34	3.12	3.67	3.59
Technician or assoc. professional	---	---	---	1.25	0.35
Clerk	0.75	---	---	0.58	0.21
Service, shop, or market sales worker	2.11	6.56	6.50	3.33	5.35
Farmer, forester, or fisher	48.02	0.99	0.53	1.27	4.08
Trader	2.15		2.84	3.18	2.00
Laborer or unskilled worker	2.54	3.99	2.25	2.14	2.78
Housewife	35.62	79.75	80.30	78.58	76.64
Special occupation	1.33	4.51	2.61	0.39	2.50
Weighted sample	14,277	66,201	72,869	58,503	211,851

Household income sources

4.10 Household incomes in the four provinces are derived mainly from labor market wages and agriculture. Agricultural income includes both the value of food produced for household consumption and commercial sale. Batangas households have the highest proportion of income from labor market wages and the lowest from agriculture. These findings support the regional profile described in Chapter 3 (Table 3.1), which found that most people in Batangas are engaged in non-agricultural sectors. As Table 4.7 shows, various other sources, though smaller in amounts and percentages, contribute to monthly household income. Average monthly household income is highest in Nueva Ecija (P10,768) and lowest in Camarines Sur (P4,611); while average monthly, per-capita income is highest in Nueva Ecija, more than double that of Camarines Sur.

Table 4.7: Average Monthly Household Income, by Source, 1998

Household income source	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Labor market wage	1,973	3,688	4,183	3,430	3,664
Agriculture	3,357	5,633	803	908	2,460
Livestock	146	240	145	50	147
Government Subsidy/pension	94	65	45	4	43
Remittances from relatives	143	269	251	55	194
Business income	362	317	389	88	283
Gambling	1	0	2	2	1
Rental	12	1	19	0	8
Other	1,117	2,975	708	147	1,260
Average monthly income					
Household	6,574	10,768	6,021	4,610	7,088
Per capita	1,570	2,496	1,394	1,109	1,657

Housing units

4.11 Most households in all four areas surveyed own their housing units. In Nueva Ecija, 99% of households own their units, 94% own in Batangas, 93% in Camarines Sur, and 91% in the Mountain Province. However, the types of building materials differ by area. Wood is heavily used in the Mountain Province (75%), while hollow bricks are preferred in Nueva Ecija (43%) and Batangas (43%). The most popular construction materials used in Camarines Sur are wood (28%), bamboo/sawali/cogun/nipa (28%), and half concrete/brick/stone and half wood (24%) (Table 4.8).

Table 4.8: Household Distribution (%), by Ownership and Construction Type, 1998

Household distribution (%)	*MountainP rovince*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Ownership of housing unit					
Yes	91	99	94	93	95
No	9	1	6	7	5
Construction material					
Wood	75	8	18	28	22
Hollow brick	2	43	43	15	32
Bamboo/sawali/cogun/nipa	0	27	12	28	20
Makeshift/salvaged/improvised	0	0	0	2	1
Half concrete/brick/stone and half wood	15	19	25	24	22
Other	4	0	0	1	0
Weighted sample	18,265	75,067	90,674	68,850	252,855

Note: The sum of percentages may not equal 100 because of rounding.

Sources of drinking water

4.12 Available sources of household drinking water vary widely among the four provinces. In Nueva Ecija and Batangas, tubed/piped wells are the primary source (98.9% and 68.5%, respectively); while in Mountain Province and Camarines Sur, the village/barangay/muncipal system is the main source (68.0% and 36.1%, respectively). Smaller sources of water include springs, rivers, and lakes; dug wells; and water vendors. In the Mountain Province, springs are the second major source of drinking water (37.1%); while, in Camarines Sur, the second and third major sources are other (27.3%) and tubed/piped wells (22.8%) (Table 4.9).

Table 4.9: Household Distribution (%), by Source of Drinking Water, 1998

Source of drinking water	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Spring/river/lake	37.1		1.5	12.3	7.4
Dug wells	3.1		4.6	10.8	5.0
Tubed/piped wells	2.2	98.9	68.5	22.8	60.5
Village/barangay/ municipal system	68.0	5.1	39.9	36.1	31.6
Water system					
Water vendor/peddler	1.6		1.2	8.6	3.1
Other	0.4		0.7	27.3	8.3

Note: Households may have more than one source of drinking water.

Energy use and expenditures

4.13 The study survey found that household energy use across the four provinces is surprisingly diverse, given that these are rural areas. In other developing countries, the primary form of rural energy use is biomass for cooking. By contrast, the Philippine households surveyed in this study use electricity as their main source of energy. Electricity plays the most important role in Batangas (84.4%), followed by Nueva Ecija (83.1%), the Mountain Province (68.3%), and Camarines Sur (only 55.2%). After electricity, the most important source of household fuel is kerosene, which is used by 68.3% of all the households sampled, followed by fuelwood, which is used by 65.3% (Table 4.10).

Table 4.10: Household Distribution (%), by Energy Use, 1998

Energy source	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Electricity	68.3	83.1	84.4	55.2	78.4
Fuelwood	76.1	61.9	67.6	63.1	65.3
Charcoal	8.7	3.8	4.8	30.9	12.0
Kerosene	55.9	78.9	56.0	76.2	68.3
LPG	68.7	62.7	73.1	29.0	57.6
Biomass residue	1.3	0.6	1.5	5.2	2.3
Dry-cell battery	66.9	15.1	49.4	58.1	42.9
Vehicular battery	0.5	8.9	0.4	2.6	3.6
Candles	40.7	20.2	51.7	34.8	36.9

Note: Households may use more than one type of energy.

4.14 While fuelwood is used by a significant number of households, as might be expected, LPG use is surprisingly extensive. Households in the Mountain Province use proportionately more fuelwood than those in the other three provinces. As a source of energy, fuelwood is used by 76.1% of households in the Mountain Province and by 61.9-67.6% of households in the other three areas surveyed, indicating that fuelwood continues as an important source of rural energy. After electricity, kerosene is the preferred fuel for cooking, lighting, and other household purposes in Nueva Ecija and Camarines Sur. Households also use LPG for cooking, lighting, and other purposes, though to a much smaller degree than electricity or fuelwood. In Batangas, which has high rates of electricity access, LPG use is higher (73.1%) than in the other three areas. Of all the rural households surveyed across the four provinces, 42.9% use dry-cell batteries, and 36.9% use candles. Biomass residue and vehicular batteries are the least used energy sources.

4.15 The highest household energy expenditures are for kerosene, LPG, and electricity. These modern fuels are purchased, while traditional fuels, including wood and biomass residue, are collected from the local environment. As Table 4.11 illustrates, the total monthly energy expenses for all households average P333.50. Expenditures on electricity and LPG comprise the largest amounts, averaging P181.71 and P82.04, respectively.

4.16 While electricity is the major energy expense in Batangas and Nueva Ecija, LPG consumes the largest portion of household energy budgets in the Mountain Province, an average of P113.99 per month, compared to P66.07 for electricity. In Camarines Sur, kerosene is the second largest expenditure, with an average of P48.21 per month, compared to P115.44 spent on electricity.

Table 4.11: Average Monthly Expenditure (Pesos), by Energy Type, 1998

Energy type	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Fuelwood	2.36	6.71	3.75	5.45	4.99
Charcoal	0.65	0.00	0.72	0.23	0.37
Kerosene	14.10	40.03	23.78	48.21	34.59
LPG	113.99	88.54	97.96	45.71	82.04
Dry-cell battery	33.78	5.23	12.73	22.67	14.80
Vehicular battery	0.34	29.35	0.91	8.47	11.41
Candles	6.31	3.18	3.39	3.61	3.61
Electricity	66.07	163.43	272.96	115.14	181.71
Total expenses	237.62	336.46	416.20	249.80	333.50

Appliance ownership[12]

4.17 Space illumination is the primary household use of electricity in all four provinces surveyed (Table 4.12). After lighting, the most commonly owned electric appliances are television sets and radios. Television sets are owned by 75.6% of all electrified households. Nueva Ecija and Batangas have the highest levels of ownership (83.5% and 81.4%, respectively). Radios are owned by 74.2% of all electrified households; in Camarines Sur, 82.2% of households with electricity have a radio, while the other three provinces have at least 70% ownership. Space-cooling appliances are the next most commonly owned appliances. Except for the Mountain Province, whose climate is relatively cool, more than half of all households in the other three provinces own electric fans. Electric appliances that

[12] Given the prevalence of electrified households' ownership of lighting and communication devices, the authors examine methods to evaluate the benefits of the services they provide in subsequent chapters.

minimize the burden of performing household chores—iron, refrigerator, and washing machine—are also prevalent among electrified households.

Table 4.12: Electrified Households' Ownership (%) of Appliances, 1998

Electric appliance	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Lights	100.0	100.0	100.0	100.0	100.0
Radio	73.7	79.1	73.0	82.2	74.2
Television sets	69.1	83.5	81.4	65.5	75.6
Black-and-white	43.0	44.0	36.0	30.8	35.4
Color	26.1	39.5	45.4	34.7	40.2
Iron	22.0	56.4	72.7	44.3	58.8
Fan	1.4	64.5	70.3	53.4	60.7
Water heater	1.4	1.4	1.4	--	1.1
Refrigerator	12.9	26.5	41.3	22.8	31.2
Stove, burner, oven, or range	1.2	0.6	3.6	6.9	3.1
Toaster or turbo broiler	2.1	2.2	2.6	5.6	3.0
Washing machine	2.9	22.2	21.3	10.9	18.4
Water pump	--	5.1	3.0	1.6	3.2
Power tools	4.7	0.3	0.5	1.4	0.9
Generator	--	0.7	--	--	0.2
Other	2.9	0.7	2.0	3.7	2.0

Note: Households may own more than one type of electric appliance.

4.18 By contrast, unelectrified households own significantly fewer appliances, the most prevalent being those used for cooking and lighting. Table 4.13 shows that 78.3% of non-electrified rural households own clay stoves (efficient or improvised), while 64.5% own kerosene lamps.

Table 4.13: Non-electrified Household Ownership (%) of Appliances, 1998

Non-electric appliance	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Stove					
Efficient clay (fuelwood)	0.9	72.5	--	12.7	24.1
Improvised clay (fuelwood)	74.6	1.9	72.9	68.6	54.2
Kerosene	38.8	21.7	16.8	6.1	14.3
Charcoal	9.3	--	--	22.7	13.9
Biomass residue	0.9	--	--	0.8	0.6
Lamp					
Kerosene	47.7	57.1	75.2	69.1	64.5
Candles	0.9	6.0	8.0	2.6	3.7
Charcoal flat iron	1.0	10.9	6.0	15.1	11.7

Note: Households may own more than one type of non-electric appliance.

Income, causality, and modeling the effects of electricity

4.19 Given that the method this study uses to estimate benefits compares electrified and non-electrified households, it us useful to examine some of their similarities and differences. Electrified and non-electrified households are about the same size, and they consume similar levels of non-electrical sources of energy (Table 4.14). However, households without electricity are more likely to earn their living from agriculture-related activities than from labor wages. Households with electricity are more likely to obtain their drinking water from tubed wells, and they are far more likely to own home-based businesses. Not surprisingly, households with electricity spend much more on lighting but, interestingly, about the same percentage of income as non-electrified households.

Table 4.14: Comparison of Non-electrified and Electrified Households

Household characteristic	*Unelectrified*	*Electrified*	*Total*
Family and income/expenses			
Size (no. family members)	4.7	4.9	4.8
Age of head (yrs.)	45	49	48
Education of head (yrs.)	5.8	7.4	6.9
Age of spouse (yrs.)	40	45	43
Education of spouse (yrs.)	6.6	7.7	7.3
Average monthly income (P)	3,935	7,653	6,487
Wages (P)	1,322	3,742	2,975
Agriculture-related (P)	2,232	2,630	2,504
Home business	7	21	16
Average monthly lighting expenses (P)	126	248	209
Energy use (%)*			
Radio or cassette			
Dry-cell battery	34	0	13
Cooking			
LPG	24	69	54
Wood	82	60	67
Kerosene	37	22	22
Lighting			
Kerosene	91	56	67
Source of drinking water (% who answered "yes")			
Springs/rivers/lakes	21	14	17
Dug wells	8	3	5
Tubed/piped wells	35	52	46
Village/barangay/municipal system	38	40	39
Water vendors/peddlers	5	3	4
Other systems	10	6	7

* These percentages differ somewhat from those found in Table 4.10 because they are not weighted by population.

4.20 The most significant difference between households with and without electricity is their income levels. Electrified households are about twice as wealthy, on average.[13] While electrification can be an important determinant of income, many other factors having little to do with electrification may play a role. Moreover, the directions of causality are never absolutely certain. Although electrification may "cause" income to

13 If the only reason for this income differential were the degree of electrification, then income gain might provide a rough index of electrification's benefits. Even in this hypothetical situation, however, one would need additional assumptions to use income as an index of utility or welfare. The most important would be to assume that household utility is a linear function of income, meaning that diminishing marginal utility with respect to income increases would be ruled out.

increase, the reverse may also be true; that is, households with higher incomes are more likely to adopt electricity when it becomes available.

4.21 Because the direction of causality is uncertain and electricity is one of many possible determinants of income, one must look beyond income differentials to find quantitative measures of electrification benefits. The method outlined in Chapter 2 and implemented in the following chapters uses a strategy to control for income in the context of a statistical model predicting the benefits of electricity. In other words, by examining the differences between households with and without electricity at the same or similar levels of income, one can assess the differences that can be attributed to having electricity in the household. These include level of lighting, education, and other factors that result from the services appliances provide.

Conclusion

4.22 The households surveyed in this benefits assessment study are not representative of the Philippines as a whole. However, they do profile four RECs fairly typical of the country and representative of the more than one million residents within their service territories. These populations are predominantly agricultural, have high literacy levels, and use diverse forms of energy. Because of this diversity, conditions are ideal, statistically speaking, for analyzing the benefits of rural electrification. The following chapter assesses the effects of rural electrification on energy services—the next step in developing estimates of rural electrification benefits.

5

Socioeconomic Effects of Rural Electrification

5.1 Investing in people or "human capital" is one of the World Bank's many programs to reduce poverty and improve the living standards of developing countries. Healthy, well-educated populations can ensure better lives for families and contribute to national wealth and progress. Education is a particularly important investment because it equips people with the knowledge and means to compete in the global market. It is thus vital to analyze electrification's role in providing better opportunities for education, particularly in rural areas.

5.2 This chapter assesses the effects of rural electrification on energy services in the Philippines. The energy services analyzed are those identified in Chapter 2: education, health, entertainment and communication, comfort and protection, convenience, and productivity. The goal of this analysis is to develop a better method for assessing the benefits of rural electrification.

Attitudes Toward Children's Education

5.3 The study's household survey found that electricity is good for children's education. Most adults (household heads and spouses) believe that electricity has positive effects on their children's study time and, consequently, good implications for their education. Survey respondents were asked to agree or disagree with the statement "Having electricity is important for children's education." As Table 5.1 shows, 97.7% of all households either agreed or strongly agreed with the statement. Those in strongest agreement were electrified households located in Camarines Sur (77.8%) and the Mountain Province (77.4%). Even unelectrified households (more than 50% in three of the four provinces) strongly agreed that electricity is important for their children's education.

Table 5.1: "Having electricity is important for children's education:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	51.4	77.4	59.2	60.6	18.5	44.2	63.2	77.8	56.9	58.0	57.8
Agree	41.6	19.4	37.6	36.9	75.5	55.4	32.6	19.5	38.7	40.3	39.9
Neutral	7.0	1.4	2.3	2.4	6.0	0.4	4.2	2.8	4.3	1.6	2.1
Disagree	0.0	1.8	0.9	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.2
Weighted sample	5,950	13,040	12,791	63,712	5,122	85,764	31,621	38,814	55,483	201,330	256,813

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.4 One reason given for electricity's being good for children's education is the high-quality lighting electricity makes possible. Therefore, respondents were next asked whether good lighting contributed to their children's studying. A high percentage (93.5%) of all households surveyed either agreed or strongly agreed that, because of good lighting, children study more during evening hours; only 1% of those surveyed disagreed or strongly disagreed. It is noteworthy that unelectrified households also agreed with this statement (Table 5.2).

Table 5.2: "Because of good lighting, children study more at night:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	20.7	51.3	56.2	48.9	18.5	27.1	29.9	30.5	33.9	36.2	35.7
Agree	67.3	45.5	30.3	44.4	62.0	68.4	59.2	66.0	53.7	58.9	57.8
Neutral	11.5	2.2	11.0	5.1	12.3	4.4	9.4	2.5	10.3	4.1	5.5
Disagree	0.4	0.6	2.6	1.3	3.6	0.0	1.5	0.6	1.8	0.6	0.8
Strongly disagree	0.0	0.4	0.0	0.3	3.6	0.0	0.0	0.4	0.3	0.2	0.2
Weighted sample	5,923	13,020	12,703	63,368	5,122	85,549	31,424	38,814	55,172	200,751	255,922

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors

5.5 To examine electricity's effects on studying indirectly, all surveyed households were presented the following statement: "My children study in the evening after dark." Once again, a high percentage (73.9%) of all households either agreed or strongly agreed that their children study in the evening after dark, revealing the high priority given to education in the Philippines (Table 5.3). Interestingly, a greater proportion of electrified households, compared to unelectrified ones, agreed with the statement, with the exception of Camarines Sur. This means that households with electric lighting believe their children study more during evening hours than do households without electricity.

Table 5.3: "My children study in the evening after dark:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	2.1	9.4	37.9	39.5	6.2	20.1	17.1	11.9	19.3	23.7	22.7
Agree	31.8	41.0	39.4	38.0	37.6	59.9	49.4	65.7	44.3	53.1	51.2
Neutral	31.0	17.1	11.1	18.2	43.9	15.9	16.8	13.6	19.4	16.2	16.9
Disagree	34.6	30.8	9.8	4.0	12.2	3.6	10.3	5.8	12.9	6.0	7.5
Strongly disagree	0.5	1.7	1.8	0.3	0.0	0.4	6.4	3.0	4.2	1.0	1.7
Weighted sample	5,645	12,873	11,940	59,191	4,570	82,825	31,118	38,712	53,273	193,601	246,874

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.6 As expected, households with electricity agreed with the statement "In my house, it is easy to read in the evening;" while fewer unelectrified households agreed (Table 5.4). Of the total surveyed households, 75.6% agreed or strongly agreed, while only 10.8% disagreed or strongly disagreed. This statement is further supported by Table 5.5, which shows that many households, both with and without electricity, agreed that reading is easier with electricity (rather than kerosene) lamps.

Table 5.4: "In my house, it is easy to read in the evening:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	0.8	25.2	10.1	31.8		17.7	17.1	32.1	12.1	25.5	22.6
Agree	14.2	54.4	28.1	49.3	11.1	62.0	48.8	61.7	36.8	57.4	53.0
Neutral	26.5	11.7	23.9	10.0	32.5	15.8	18.2	4.4	21.7	11.5	13.7
Disagree	54.0	8.1	37.8	8.7	49.2	3.9	14.3	0.9	27.3	5.1	9.9
Strongly disagree	4.5	0.6	0.1	0.2	7.2	0.6	1.6	0.9	2.1	0.5	0.9
Valid N	5,761	13,057	12,948	63,746	5,122	84,984	31,117	38,539	54,948	200,326	255,274

Note: NE = non-electrified, E = electrified, HHs = households.

Table 5.5: "Reading is easier with electricity compared to kerosene lamps:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	26.9	62.2	45.8	49.1	18.6	26.5	58.0	49.2	48.0	40.4	42.0
Agree	57.3	35.6	35.5	42.5	56.0	62.9	40.0	43.3	42.3	50.9	49.0
Neutral	14.0	1.5	11.5	5.2	21.8	8.3	2.0	2.1	7.4	5.7	6.1
Disagree	1.8	0.7	6.8	2.1	3.6	2.2		4.0	2.2	2.4	2.4
Strongly disagree			0.3	1.1				1.3	0.1	0.6	0.5
Valid N	5,944	12,990	12,948	63,805	5,122	84,453	30,528	37,846	54,542	199,093	253,635

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.7 Related to this statement, 73.1% of all household respondents agreed or strongly agreed that their families were happy with light from their current fuel, while only 12.9% disagreed or strongly disagreed (Table 5.6). A greater proportion of electrified, versus non-electrified, households agreed with the statement.

Table 5.6: "My family is happy with light from current fuel:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	2.0	44.5	12.6	27.3		20.3	28.0	35.8	19.1	27.1	25.4
Agree	36.5	47.4	27.1	37.6	35.4	59.7	43.4	51.1	38.2	50.2	47.7
Neutral	35.1	4.3	20.9	16.6	17.5	14.3	15.2	5.7	18.9	12.7	14.0
Disagree	25.8	3.5	39.0	18.4	39.4	3.6	9.5	6.0	20.8	8.7	11.3
Strongly disagree	0.6	0.4	0.4	0.1		2.1	3.8	1.3	3.0	1.2	1.6
Valid N	5,842	13,146	12,546	63,728	4,754	85,439	30,709	38,435	53,851	200,748	254,598

Note: NE = non-electrified, E = electrified, HHs = households. Total may not equal 100 due to rounding errors.

5.8 While electricity can give households access to television as a form of entertainment, most households consider television as having a negative effect on children's study time. Of all the households surveyed, 83.3% either agreed or strongly agreed that television takes study time away from their children, while few households, only 5.2%, disagreed (Table 5.7). Thus, people generally believe that, while electricity provides a better environment in which children can read and study, there is also a danger that television can take time away from studying.

Table 5.7: "Television takes study time away from children:" Responses (%)

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Survey response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Strongly agree	19.7	36.4	33.2	36.9	10.6	19.5	15.6	22.5	19.6	26.7	25.2
Agree	58.0	46.6	52.4	49.4	61.0	71.5	50.8	54.6	52.9	59.6	58.1
Neutral	17.7	11.9	12.3	7.5	26.8	6.7	24.5	14.5	21.2	8.8	11.5
Disagree	4.3	4.5	2.1	6.1	1.6	2.4	8.7	8.4	6.1	4.8	5.1
Strongly disagree	0.3	0.6		0.2			0.4		0.3	0.1	0.1
Valid N	5,871	13,040	12,791	63,805	5,122	84,934	31,621	38,814	55,404	200,593	255,997

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors

5.9 Findings that reveal reading and studying are higher in electrified households are fairly common in rural electrification literature. However, it is also well known that households with electricity generally have higher incomes that those without electricity. Thus, to determine the effects of better lighting through electricity on the time children spend reading and studying at home (considered investment time for human capital formation), the number of hours per day that children spend reading and studying was analyzed in a multivariate model. Only children of ages 5-14 years were included in the analysis because, as stated in Chapter 4, the ILO defines "children" as persons younger than 15 years. The lower age limit is based on the minimum age that a child reported an occupation and the youngest age for starting formal education. (In the public schools, children usually begin primary school at age 6. Some private schools, however, accept children as young as 5; those younger than 5 usually have not yet learned to read.)

Factors Affecting Reading

5.10 To determine electrification's effects on children's reading and studying, a model must be used to control for income, education of household head, child characteristics, farm and housing-unit ownership, type of dwelling unit, and uses and prices of energy sources for space illumination. This study used a two-step procedure to estimate how long children read or study (Table 5.8).[14]

5.11 In the Philippines, heads of households estimate that nearly 85% of school-age children read or study sometime during the day or evening hours. The main factors that affect the decision to read or study are labor wages, non-labor household income, gender, and employment status. The higher the educational level of the household head, the more likely his or her children will spend time reading or studying at home.

5.12 Of the infrastructure items surveyed, respondents reported that having electricity in the household decreased the probability that children would read or study. Also, responses to the attitude questions indicated that parents worry that other entertainment activities, such as television, can detract from children's study time. Although most children read or study, the availability of electricity in the household seems to negatively influence this decision. However, after having made the choice to read or study, a child in an electrified household reads or studies 48 minutes longer per day (0.798 multiplied by 60) than a child in an unelectrified household (Table 5.9), even after controlling for such factors as income, housing type, and price of energy. These findings are consistent with responses to the attitude questions, where households indicated that electricity is important for children's education and that reading is easier in electrified households. This result is strengthened by findings that show children in households using kerosene as a source of lighting spend less time reading or studying.

5.13 Employment status and housing characteristics were also found to affect children's reading and study time. Children who do not work study more than those who do; the reading/study time of those who work is lowered about 56 minutes per day. In addition, children living in houses constructed of poor-quality materials spend less time reading and studying, compared to those living in residences made of wood or concrete.

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14 The Heckman procedure was used to estimate the reduced form equation for the time children spent reading or studying at home. This two-step procedure reduces least-squares bias when the expected value of the regression error term is other than zero. The situation usually results when observed values of the dependent variable are "censored;" i.e., set to zero because of missing information. (See Appendices A and B.)

Table 5.8: Determinants of Children Reading or Studying at Home, 1998

	*Propensity to read**	*Study time*
Independent variable	*Probit*	*Heckman adjusted least squares*
Economic factor		
Monthly income (P)		
Wage	0.000296	
Non-wage, per-capita	0.000063	
Education of household head (no. yrs.)	0.032001	
Price of energy source		
Kerosene (P/l)	0.017431	
Dry-cell battery (P/unit)	0.046770	
Vehicular battery (P/unit)	-0.000227	
Electricity (P/kWh)	-0.072603	0.167332
Candles (P/unit)		-0.109812
LPG (P/kg)		0.054035
Social or infrastructure factor		
Gender of child (1 = male, 0 = female)	-0.939777	
Employment status of child (1 = employed, 0 = other status)	-0.428198	-0.939777
Property ownership (1 = year, 0 = no)		
Farm		
Housing-unit	-0.513705	
Dwelling-unit construction materials (1 = yes, 0 = no)		
Makeshift or salvaged		
Half concrete/brick/stone and half wood	-0.261554	-0.513705
Bamboo/sawali/cogun/nipa		-0.428198
Energy source and use (1 = yes, 0 = no)		
Kerosene for light		-0.261554
Candle for light	0.178284	-0.424884
Dry-cell battery for light	-0.392343	1.048808
Household electrification (1 = electrified, 0 = non-electrified)	-0.292995	0.798041
Inverse Mills Ratio		-3.143608
Constant	0.339	1.721
McFadden or OLS R Square	0.074	0.13
Number of children	2,149	1,714

* The term *propensity* is understood to mean the contribution to the probability that the dependent variable will have a non-zero value in response to the independent variable. The coefficients should not be interpreted as marginal contributions to the probability.

Note: The two-stage analysis used is known as the Heckman procedure; the first stage analyzes the choice to read and the second analyzes the reading level of a selected sample of readers. Only significant coefficients have been listed here.

5.14 The importance attributed to education can be understood from survey responses regarding educational expectations for children. More than 70%, both with and without electricity, expect their children to attain a college education. Table 5.9 shows that electrified households have slightly higher expectations than do non-electrified households. Most households surveyed expect their children to attain a college-level education and professional careers, such as doctors, lawyers, or accountants.

5.15 The factors affecting adults' decision to read were analyzed, using an approach similar to that used for children. It was found that electrification increases adults' chances of reading (Table 5.10). As might be expected, higher labor wages and older age tend to decrease the likelihood that adults will read, while education tends to increase it. Adults employed in government-, corporate-, or service-sector positions are more likely to spend time reading at home.

Table 5.9: Household Aspirations (%) for Children's Educational Attainment, 1998

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Educational aspiration	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Expected level of attainment											
Male											
None	10.0	9.0	5.0	11.1	10.0	8.7	5.4	10.0	6.1	9.7	8.9
Primary	0.4	0.4	1.4		23.8	4.8	0.8		2.2	2.1	2.1
High school	12.4	8.6	13.5	6.6		3.2	13.9	6.0	12.9	5.2	6.9
Vocational	8.1	2.9	2.7	1.6	35.3	3.7	8.4	12.8	8.8	4.9	5.8
College	69.3	75.3	77.4	80.7	30.9	69.9	63.8	68.6	65.2	73.1	71.3
Post-graduate		3.8				9.6	7.7	2.6	4.9	5.1	5.0
Valid N	3,299	9,772	6,445	31,367	1,835	50,025	20,531	23,504	32,110	114,668	146,778
Female											
None	30.0	14.2	3.0	9.0		11.9	7.9	10.6	9.2	11.0	10.6
Primary				0.2		4.0				1.7	1.4
High school	5.5	3.5	12.9	5.8	5.1	5.6	9.0	8.1	9.2	6.0	6.7
Vocational	4.8	2.9	2.5	2.4	7.5	2.6	7.7	5.1	6.3	3.1	3.8
College	59.3	73.8	81.6	82.6	87.4	67.6	70.0	71.7	71.9	73.3	73.0
Post-graduate	0.4	5.7				8.3	5.3	4.4	3.3	4.9	4.5
Valid N	4,051	9,314	6,861	33,721	1,624	49,026	20,419	24,991	32,955	117,052	150,007

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.16 To a certain degree, the factors that affect the time adults spend studying and reading parallel the findings for children. Adults who own their farms or work in professional occupations tend to read more than other adults. Predictably, older adults read less than younger ones. Interestingly, electric lighting leads to increased reading by adults by close to 15 minutes per day, while use of kerosene lamps decreases reading time by about 20 minutes per day. These findings reconfirm results from the attitude survey, which show electric lighting is better for reading than kerosene lamps (kerosene lamps provide 10-50 times less light than an incandescent lamp, depending on the type of bulb).

Table 5.10: Determinants of Adults Reading or Studying at Home, 1998

Independent variable	*Propensity to read**	*Reading time*
	Probit	*Ordinary least squares*
Economic factor		
Monthly income (P)		
Wages	-0.000025	
Non-wage per capita		-0.000037
Education of household head (no. yrs.)	0.095741	
Price of energy source		
Kerosene (P/l)	-0.013207	
Dry-cell battery (P/unit)	0.036591	0.047682
Vehicular battery (Punit)	0.000093	0.000361
Electricity (P/kWh)	-0.015823	
Candles (P/unit)	-0.031217	
Social or infrastructure factor (1 = yes; 0 = no, unless otherwise noted)		
Age of household member	-0.008061	-0.020124
Education (no. of yrs.)		0.176769
Occupation		
Government official	0.365644	
Professional, manager, corporate executive, or supervisor	0.358207	0.944655
Service, shop, or market sales worker	0.150979	
Farmer, forester, or fisher	-0.184290	-0.724293
Machine operator		-0.717807
Trade-related worker	-0.220810	
Unskilled worker	-0.120417	-0.594726
Property ownership		
Farm	-0.076185	
Housing unit		0.163274
Dwelling-unit construction materials		
Half concrete/brick/stone and half wood	0.134630	
Bamboo/sawali/cogun/nipa		-0.135408
Energy source used for lighting (1 = yes, 0 = no)		
Kerosene	-0.140271	-0.318457
Candles		
Dry-cell batteries		0.313418
Vehicular battery		-0.285473
Household electrification (1 = electrified, 0 = non-electrified)	0.134200	0.215819
Inverse Mills Ratio		2.188674
Constant	-0.417189	1.509354
McFadden or OLS R Square	0.09	0.153185.
Number of adults	5,625	3,185

* The term *propensity* is understood to mean the contribution to the probability that the dependent variable will have a non-zero value in response to the independent variable. The coefficients should not be interpreted as marginal contributions to the probability.

Note: The two-stage analysis used is known as the Heckman procedure; the first stage analyzes the choice to read and the second analyzes the reading level of a selected sample of readers. Only significant coefficients have been listed here.

5.17 In addition, because electric lighting is less expensive than kerosene lamps, adults who have cheaper sources of improved lighting are able to spend more time reading during evening hours.

Returns to Education

5.18 Mincer's dynamic model for returns to education was used to analyze the educational benefits of electrification for adults (Mincer 1974). In this framework, it is assumed that individuals maximize the present value of their life-cycle income. Adults in electrified households generally have a higher level of education than those in non-electrified households. The study found that adults living in non-electrified households achieve only an elementary level of education, while those in electrified households manage to achieve a secondary level of schooling. Among non-electrified households, adults who reside in the Mountain Province have the lowest level of educational attainment (Table 5.11).

Table 5.11: Adults' Average No. Years of Education, by Electrification Status, 1998

Household electrification status	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*Average no. of years*
Non-electrified	5.0	7.0	6.3	6.9	6.7
Electrified	8.5	8.7	8.2	8.8	8.5

5.19 The regression estimates of the returns to education show that the probability of participating in the labor market increases with education and age and that men are more likely than women to participate (Table 5.12). It was found that electricity service is a major determinant in the decision to work. For example, individuals living in the Mountain Province and Nueva Ecija are less likely to participate in the labor market than are residents of Camarines Sur.

5.20 Table 5.12 also shows the major factors that affect adults' annual wage incomes (only adults who reported a labor wage income were included in this regression). For individuals already participating in the labor market (whether full-time, part-time, or self-employed), annual wage income significantly increases (by P125,538) for a person with about nine years of education, while the annual wage income of a 36-year-old person increases by P39,600. The annual wage income for males is higher than for females (by about P103,501). Residents of the Mountain Province and Nueva Ecija earn less than do residents of Camarines Sur. Adults employed as corporate executives, technicians, and other professionals earn more than adults with special occupations, including those who are still studying. On the other hand, farmers and unskilled laborers earn less than adults with special occupations.

Table 5.12: Determinants of Annual Wage Income for Adults, 1998

	Propensity of adult to work for wages[1]	*Annual returns from wages*
Independent variable	*Probit*	*Heckman adjusted least squares*
Social or infrastructure factor		
Household member		
Age (yrs.)	0.0037	1,103
Education (yrs.)	0.0707	13,902
Gender (1 = male, 0 = female)	0.4979	103,050
Occupation (1 = yes, 0 = no)		
Professional, manager, corporate executive, or supervisor		36,398
Technician or associate professional		20,761
Farmer, forester, or fisher		-12,806
Unskilled worker		-10,898
Electrification factor		
Household is electrified (1 = yes, 0 = no)	0.0938	
Electricity and education interaction term[2]		2,722
Mountain Province (1 = yes, 0 = no)	-0.5368	-99,446
Nueva Ecija (1 = yes, 0 = no)	-0.1048	-18,975
Inverse Mills Ratio		248,771
Constant	-1.5678	-475,060
McFadden or OLS R Square	0.06	0.34
Number of adults	5,661	1,534

[1] The term *propensity* is understood to mean the contribution to the probability that the dependent variable will have a non-zero value in response to the independent variable. The coefficients should not be interpreted as marginal contributions to the probability.
[2] Denotes relation between years of education and household electrification.
Note: The two-stage analysis used is known as the Heckman procedure; the first stage analyzes the choice to read and the second analyzes the reading level of a selected sample of readers. Only significant coefficients have been listed here.

5.21 The returns to education for adults living in electrified households is greater by P2,722 (the coefficient of the interaction term for electrification and education) for each year of education, compared to adults living in non-electrified households. The higher education returns for adults in households with electricity may be attributed to less time spent in home production because of the conveniences electricity service provides, which allow individuals to spend more time in the labor market to earn higher incomes for their families.

Electricity and Health

5.22 The types of energy households use, whether for lighting or cooking, can affect household members' health. This section examines both attitudes toward health issues related to access to electricity and causes of illnesses in adults and children, resulting in days missed from work and school.

Attitudes toward energy and health

5.23 A general perception among rural households in the Philippines is that using kerosene or diesel for lighting can cause health problems. Table 5.13 shows that more than

70% of all households surveyed agreed, with electrified households more inclined to agree strongly.

Table 5.13: "Lighting with kerosene can cause health problems:" Responses (%),1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Strongly agree	19.7	33.4	14.2	28.5	8.7	14.9	13.4	14.4	13.8	20.3	18.9
Agree	33.9	40.0	57.5	50.2	55.6	69.4	32.8	42.7	40.8	56.3	52.9
Neutral	29.2	11.6	12.8	9.1	23.4	10.3	29.5	37.8	25.0	15.3	17.4
Disagree	16.0	13.5	15.5	12.0	8.7	5.4	20.1	5.0	17.5	7.9	10.0
Strongly disagree	1.2	1.5		0.2	3.6		4.2		2.9	0.1	0.7
Valid N	5,868	13,052	12,948	63,805	5,122	85,617	31,196	38,759	55,134	201,233	256,367

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not add up to 100 due to rounding errors.

5.24 The source of household drinking water can also affect health. For example, water from springs/lakes/rivers or wells may be contaminated with disease-causing bacteria. This is less likely for water distributed from a municipal water system. Table 5.14 shows that most households surveyed agreed that electricity is important for local water supply. In Batangas, close to 90% of electrified households agreed or strongly agreed. Most households who disagreed were located in the Mountain Province, where infrastructure is more limited, compared to the other three provinces.

Table 5.14: "Electricity is important for our local water supply:" Responses, 1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Strongly agree		3.5	39.7	26.6	18.9	24.9	24.1	15.4	24.7	22.3	22.8
Agree	20.8	15.8	28.9	28.0	54.9	63.7	52.6	48.7	43.8	46.5	45.9
Neutral	43.6	40.1	28.2	32.0	22.6	9.2	18.7	28.1	23.9	22.0	22.4
Disagree	32.2	35.3	3.3	13.2	0.0	2.2	3.0	4.0	5.9	8.1	7.7
Strongly disagree	3.5	5.2	0.0	0.2	3.6	0.0	1.6	3.7	1.6	1.1	1.2
Valid N	5,880	12,620	12,948	63,805	5,122	86,025	30,968	38,814	54,918	201,265	256,183

Note: NE = non-electrified, E = electrified, HHs = households.

Estimating infrastructure's effects on health

5.25 One way to analyze the health benefits of electricity or other infrastructure is to determine the number of days missed from work or school each year because of illness. Other factors involve practices of cooking and boiling water using various types of energy. Type of dwelling unit can serve as a proxy for protection against adverse weather conditions or outdoor pollution, with the strong assumption that houses constructed entirely of concrete or wood can protect residents from these conditions, compared to those made of lighter materials, such as bamboo, or makeshift/salvaged materials. Finally, the presence of community-level facilities may also affect the health of rural people.

5.26 This study mainly analyzed the annual number of days children miss from school and adults miss from work because of illness (Table 5.15). In general, the factors explaining school or work days missed are weak. Age and poorly constructed dwelling units are related to increased number of school days missed. Children in households whose main source of drinking water is the municipal/village water system report an average of four fewer sick days per year than other children. There is no significant difference in sick days reported by children in households that use LPG for cooking and boiling water and those that use other cooking fuels (e.g., fuelwood, charcoal, and kerosene). The presence of a barangay health center decreases the number of sick days from school by about four days; electricity itself, however, has no direct effect on children's health.

Table 5.15: Determinants of Days Missed from School or Work Due to Illness, 1998

	No. of days per year	
	Children	*Adults*
Independent variable	*Tobit*	*OLS*
Social or infrastructure factor		
Household member characteristic	0.732054	0.0387
Age (yrs.)		
Education (yrs.)		
Gender (1 = male, 0 = female)		1.2974
Presence of municipal/village water supply	-4.480923	
Presence of barangay health center	-4.429807	-1.4507
Dwelling-unit construction material (1 = yes, 0 = no)	15.50280	
Makeshift or salvaged	8.621173	
Half concrete/brick/stone and half wood	3.912664	
Bamboo/sawali/congun/nipa		
Constant	-33.48	0.350978
OLS R Square	0.02	0.01
Number of members (children, adults)	2,604	5,990

Note: The appropriate method to estimate the regression model for health production is the Tobit method because of zero-censoring in the number of sick days reported. Because of the low explanatory power of the models, convergence problems were encountered in estimating the equation for number of work days missed by adults due to illness. Thus, the Tobit method was used for the regression for number of school days missed by children due to illness, and the ordinary least squares method was used for the health production model for adults.

5.27 The survey found that men miss work more frequently than do women and that older adults also have a higher incidence of missing work because of illness. The presence of a barangay health center decreases the number of days missed by an average of 1.4 days per year. Using cleaner-burning fuels, such as LPG, to cook food and boil water has no effect on the health of adults, and no significant relationship was found between the presence of electricity service and the number of sick days reported by adults (Table 5.15).

5.28 Respondents also were asked whether they experienced symptoms of illness, such as coughing, wheezing, shortness of breath, diarrhea, or intermittent fever. Table 5.16 shows that, in all four provinces, non-electrified households have a higher incidence of coughing, compared to other symptoms. In all provinces except the Mountain Province, non-electrified households experience a higher incidence of shortness of breath, compared to electrified households. Incidence of wheezing and intermittent fever are slightly higher in non-electrified rural areas (17%), compared to electrified areas (16.8%). Incidence of diarrhea, however, is higher in areas with electricity (16%), compared to those without electricity (10.1%).

Table 5.16: Comparison of Illness Symptoms in Non-electrified and Electrified Households, by Province, 1998

	Mountain Province		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		
Symptom	*NE*	*E*	*NE*	*E*	*N*	*E*	*NE*	*E*	*NE*	*E*	*All HHs*
Coughing	46.3	44.3	49.7	40.7	69.2	53.9	42.8	39.4	47.2	46.3	46.5
Wheezing	4.0	3.3	2.5	5.2		5.5	12.4	9.2	8.2	6.0	6.5
Shortness of breath	3.6	9.4	24.6	17.3	24.4	18.4	12.2	8.8	15.2	15.5	15.5
Intermittent fever	15.9	19.8	11.8	9.2	18.6	22.4	19.0	15.0	17.0	16.8	16.9
Diarrhea	8.3	13.4	17.9	8.7	3.6	25.9	8.4	6.2	10.1	16.0	14.7

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.29 The authors took simple measures, including days missed from work and school and self-reported illnesses, to gain an adequate, easily measured indicator of health and its relationship to electricity access. However, because of the complex relations between health, lifestyle, environment, and infrastructure, they were unsuccessful in properly measuring the health variables in this survey. The number of days missed from school and work due to illness may not adequately measure the health status of individuals. Future surveys might also include reasons for and frequency of visits to village health or medical professionals. Availability of such information may yield more conclusive findings about the relationship between health and access to electricity service.

Attitudes Toward Entertainment and Leisure

5.30 This study also sought to discover how access to the grid affects the time rural households spend on entertainment and leisure. To achieve this goal, the authors first examined rural household members' perceptions of radio and television. About 80% of all households surveyed agree that television is a significant source of entertainment (Table 5.17). This perception is strongest in areas with higher levels of electricity and weakest in the Mountain Province, where fewer households have access.

Table 5.17: "Watching TV provides my family great entertainment:" Responses (%),1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Strongly agree	1.1	11.9	22.3	38.6	7.0	14.0	18.4	22.6	16.5	23.2	21.8
Agree	20.4	36.9	39.6	44.4	34.8	75.6	63.4	63.0	50.9	61.0	58.8
Neutral	47.8	40.9	20.5	13.7	46.3	6.3	14.0	11.0	21.9	11.7	13.9
Disagree	30.0	9.4	17.3	3.1	8.0	4.0	3.8	3.0	10.0	3.9	5.2
Strongly disagree	0.7	0.9	0.3	0.2	4.0		0.4	0.4	0.7	0.2	0.3
Valid N	5,871	13,040	12,791	63,805	5,122	84,934	31,621	38,814	55,404	200,593	255,997

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.31 Not surprisingly, more than 90% of all rural households in the four provinces agreed that "watching television is a great source of news and information," while only 1.3% disagreed with this statement (Table 5.18). However, when asked about the difficulty in obtaining news and information, many more non-electrified households (57%) than electrified ones (40%) agreed that it is difficult (Table 5.19).

Table 5.18: "Watching TV is a great source of news and information:" Responses (%), 1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Strongly agree	4.1	12.6	36.8	50.5	9.8	22.0	29.1	40.6	26.5	34.0	32.3
Agree	29.0	50.4	58.4	43.6	69.2	74.0	62.0	55.0	58.3	59.2	59.0
Neutral	52.7	34.5	2.3	5.4	21.0	3.3	6.8	3.5	12.0	6.0	7.3
Disagree	14.2	2.4	2.5	0.6		0.7	2.1	0.7	3.3	0.8	1.3
Strongly disagree								0.3		0.1	0.0
Valid N	5,891	13,022	12,948	63,195	5,122	85,315	31,086	38,814	55,047	200,346	255,393

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

Table 5.19: "It is difficult to get news and information:" Responses (%), 1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Strongly agree	6.7	5.3	21.8	24.9	13.4	6.2	17.0	11.8	16.7	13.1	13.9
Agree	38.3	19.3	29.4	33.5	42.6	25.8	46.1	26.8	41.0	28.0	30.8
Neutral	29.6	31.9	21.2	12.4	23.1	27.1	21.3	14.4	22.3	20.3	20.8
Disagree	25.2	42.4	26.1	27.4	17.3	40.8	14.9	41.7	18.8	36.8	33.0
Strongly disagree	0.2	1.2	1.5	1.8	3.6	0.2	0.7	5.2	1.1	1.7	1.6
Valid N	5,937	13,068	12,948	63,166	5,122	85,497	30,983	38,539	54,990	200,269	255,260

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.32 The authors also sought to determine the relationship between availability of electric lighting during evening hours and social gatherings. Thus, the household survey included a question on whether guests were received in the evening after dark. Responses to this question varied according to regional geography and social conditions. In Batangas, for example, 56% of electrified households, compared to only 8.6% of non-electrified households, agreed or strongly agreed that they can receive guests after dark (Table 5.20). Obviously, having electricity strongly influenced their decision. However, in the Mountain Province, only 8.4% of electrified households said they entertain guests during evening hours, compared to 1.6% without electricity, and, in Nueva Ecija, the results were similar (25.6% of electrified households versus 27.2% non-electrified households). Clearly, the tradition of entertaining guests during evening hours is related to having electricity, but many other factors are involved.

Table 5.20: "We receive guests in the evening after dark:" Responses (%), 1998

Survey response	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*HHs*
Strongly agree	0.6	1.2	6.2	7.5		7.1	3.2	8.9	3.4	7.2	6.3
Agree	1.0	7.2	21.0	18.1	8.6	48.9	36.8	33.8	26.6	33.6	32.1
Neutral	25.6	43.5	19.7	35.0	57.0	29.7	30.9	21.5	30.1	30.7	30.6
Disagree	68.4	45.3	49.3	38.8	34.4	14.2	22.8	32.4	35.1	27.5	29.1
Strongly disagree	4.3	2.8	3.8	0.5		0.2	6.3	3.4	4.9	1.1	1.9
Valid N	5,976	13,112	12,908	62,757	5,122	85,497	31,101	38,264	55,107	199,630	254,737

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

Analysis of radio and television use

5.33 Past studies on time allocation used data collected from the activities of individuals, following Becker's time allocation framework. By contrast, this study determined the time allocated for entertainment and leisure by measuring radio and television use. Survey respondents were asked to aggregate the time they spend listening to the radio and watching television. This data was then analyzed according to such factors as number of children in the family, availability of electricity, and prices (Table 5.21).

5.34 Analysis of the survey findings showed that the factors that significantly affect radio-listening time are educational attainment of household members and number of children younger than five years of age. The higher the average educational level of households, the more time they spend listening to the radio. Having more infants and toddlers in the household also increases radio listening time. Those living in houses of half-wood or half-concrete construction also spend more time listening to the radio, compared to those living in houses made entirely of wood or concrete.

5.35 Not surprisingly, the main factors that affect radio listening involve electricity, through access to the grid or use of dry-cell batteries. Electrified households, compared to non-electrified ones, spend an average of 1.91 more hours per day listening to the radio. Changes in electricity price do not affect the time allocated to this activity. Use of dry-cell batteries increases radio-listening time 2.16 hours per day, while an increase in battery price decreases listening time. Interestingly, the presence of barangay recreational facilities, such as local parks, increases household listening 12.6 minutes per day, while video cassette recorder (VCR) rental facilities increases listening 25 minutes per day.

5.36 The amount of television that households with electricity watch per day is significantly affected by income changes (Table 5.21). An increase in market labor wages causes a shift from leisure to income-earning activities in the market, while an increase in non-labor income increases the amount of time spent watching television. An increase in the number of household members in all age groups leads to increased family viewing time per day. For a family with two adults, daily viewing time increases 0.03 hours (1.8 minutes); for a family with one child 5-14 years of age, it increases 0.37 hours (22.1 minutes); and for a family with one child younger than 5 years old, 0.06 hours (3.48 minutes). These data support findings presented earlier in this chapter that families perceive the importance of electrification in terms of having better access to information and news, but also believe that television can distract school-age children from studying.

5.37 For households that use grid-powered electricity to operate a television set, viewing time increases 2.25 hours per day, compared to non-electrified households or those that use other types of energy to operate a television. However, if vehicular batteries are used to operate a television, daily viewing time increases by 1.08 hours on average. These results indicate a significant demand for radio and television among rural households.

Table 5.21: Determinants of Listening to the Radio and Watching Television, 1998

Independent variable	*Hours per day*	
	Listening to the radio(Tobit)	*Watching television(Tobit)*
Social or infrastructure factor		
Age of household member (yrs.)		
Monthly income (P)		
Average wage (P)		-0.0001
Non-wage per capita		0.00004
Number of household members		
15 years and older		0.1518
5-14 years		0.0771
Younger than 5 years		0.1121
Younger than 5 years	0.1130	
Local parks in village (1 = yes, 0 = no)		0.4317
Private VCR facilities in village (1 = yes, 0 = no)		0.2059
Property ownership		
Farm (1 = yes, 0 = no)		-0.4943
House (1 = yes, 0 = no)		0.2643
Dwelling unit construction		
Makeshift or salvaged materials (1 = yes, 0 = no)		
Half concrete/brick/stone and half wood (1 = yes, 0 = no)	0.5050	
Bamboo/sawali/cogun/nipa (1 = yes, 0 = no)		
Price of energy source		
Dry-cell battery (P/unit)	-0.0288	-0.1060
Vehicular battery (100 P/unit)	-0.000563	-0.0005
Electricity (P/kWh)		-0.0878
Battery type and use		
Dry-cell battery for radio/cassette player (1 = yes, 0 = no)		2.1621
Vehicular battery for television (1 = yes, 0 = no)		1.0806
Household electrification status (1 = yes, 0 = no)	1.9078	2.2543
Constant	1.2098	-0.5446
R Square	0.06	0.13
Number of households	1,902	1,903

Note: Since a significant number of households reported zero radio-listening and television-watching time, the Tobit model was estimated because ordinary least squares estimates would likely have been biased.

Comfort and Protection; Convenience

5.38 The study survey found that electrification can increase rural households' sense of security in their homes after dark, a feeling they might not have using kerosene lamps. In addition, electrification makes it convenient for household members to do housework during evening hours. When asked whether they felt safe in their homes in the evening, 90% of all respondents agreed that they did (Table 5.22). Although a greater proportion of electrified households strongly agreed, many non-electrified households agreed as well. These responses confirm that most people feel safe in their homes, but those with electricity have a stronger feeling of security than those without access.

Table 5.22: "We feel safe in our house in the evening:" Responses (%), 1998

	Mountain						*Camarines*		*Total*		l
Survey	*Province*		*Nueva Ecija*		*Batangas*		*Sur*		*sample*		*All*
Response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*HHs*
Strongly agree	13.3	25.5	23.5	42.3	11.4	22.7	24.8	26.4	22.0	29.8	28.1
Agree	74.3	62.7	56.7	47.1	65.2	70.5	61.4	67.4	62.0	62.0	62.0
Neutral	5.9	9.3	13.1	7.5	11.1	4.8	12.7	5.1	11.9	6.0	7.3
Disagree	6.6	2.2	6.7	3.0	3.6	1.8	0.8	1.1	3.1	2.1	2.3
Strongly disagree		0.3		0.2	8.7	0.1	0.3		1.0	0.1	0.3
Valid N	6,013	13,171	12,948	63,368	5,122	85,497	31,101	38,539	55,185	200,575	255,759

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.39 Electricity also makes it possible to do household chores—washing, cooking, and cleaning—during evening hours. About 75% of all surveyed households (79% of electrified households and 59.8% of non-electrified households) agreed or strongly agreed that they can complete housework after dark (Table 5.23).

Table 5.23: "I complete work in my house during the evening after dark:" Responses(%), 1998

	Mountain						*Camarines*		*Total*		
Survey	*Province*		*Nueva Ecija*		*Batangas*		*Sur*		*sample*		*All*
response	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*HHs*
Strongly agree	1.6	5.5	30.8	35.9	3.5	18.0	16.9	9.0	17.3	21.0	20.2
Agree	23.9	29.4	35.7	46.9	27.3	68.1	51.4	63.3	42.5	58.0	54.7
Neutral	14.0	19.3	16.0	12.5	39.5	8.5	20.3	11.8	20.4	11.1	13.1
Disagree	55.6	42.7	17.4	4.7	29.7	5.4	6.2	12.5	16.4	9.0	10.6
Strongly disagree	4.8	3.1					5.2	3.4	3.5	0.9	1.4
Valid N	5,964	13,092	12,948	62,762	5,122	85,497	31,101	38,539	55,135	199,890	255,026

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

Does convenience increase household chores?

5.40 The convenience resulting from availability of electricity service can also be expressed by the decreased time households spend on home-production and household chores. These include washing clothes, cooking, child care, helping with farm chores, and collecting fuelwood, and fetching drinking water. The hours spent each day on such activities are added, and their sum functions as the dependent variable in the equation representing demand for non-market home production time. As might be expected, higher education among household members generally means less time spent on household chores. Similarly, ownership of a dwelling unit, a proxy variable for household wealth, significantly decreases the time spent on home production activities (0.66 hours, or about 40 minutes, per day) (Table 5.24).

5.41 One interesting finding is that participation in household chores decreases with the use of commercial energy. For example, availability of electricity lessens the amount of time household members spend on non-market home production activities by 1.09 hours per day. Use of kerosene decreases this time by 1.02 hours per day. An increase in the price of fuelwood tends to decrease the amount of time spent on household chores. However, households that report using fuelwood spend more time on household chores than those who do not use fuelwood.

Table 5.24: Determinants of Time Spent on Household Chores, 1998

Variable	*Effect of variable on time spent on household chores (hrs. per day)*
Independent variable	*obit*
Number of household members (age)	
15 years or older	0.2150
5-14 years old	0.2150
Average education of household members (no. of yrs.)	-0.1098
Price of fuelwood (P/kg)	-0.3076
Price of charcoal (P/kg)	0.1713
Proxy independent variable	
Municipal water system as source of drinking water	1.0959
Use of fuelwood	1.1072
Use of kerosene	-1.0239
Household electrification status (yes = 1, no = 0)	-1.0936
Dwelling unit is made of bamboo/sawali/cogun/nipa	-0.8134
House ownership status	-0.6622
Farm ownership status	1.0340
Day-care center in the village	0.4674
Constant	4.53
R Square	0.16
Number of households	1,928

Note: Because many zero values were reported for time spent on household chores, the Tobit model (with maximum likelihood estimation) was chosen, which is more efficient than ordinary least squares.

5.42 Unexpectedly, increased charcoal prices decrease the time spent on household chores, while the presence of a municipal water system increases the time spent on such chores by 0.712 hours (42.7 minues) per day.[15]

Electricity's Role in Home Businesses

5.43 To better understand electricity's role in improving home-business productivity, the study gathered data on the number of hours households spend working in home businesses and the monthly income they generate. Most of the home businesses (nearly 71%) consist of small variety (*sari-sari)* stores. Another 10.6% includes tailor and dressmaker shops (5.3%), food stands and restaurants (2.6%), and hairdressers and barbershops (1.2%); while the remaining 18.4% is devoted to other types of businesses. Of

[15] This survey result may have been caused by the El Niño-related drought, which prevailed during the survey period. For example, the survey team in Nueva Ecija reported that an entire sampled village had to be replaced because nearly all of the residents had to move temporarily to areas where water was available. In other villages, field enumerators had difficulty obtaining respondents' consent because of the long distance they had to travel to get drinking water for their families.

the four provinces, Nueva Ecija has the largest proportion of sari-sari stores. Electrified households have a larger variety of home businesses, indicating that electricity makes a wider range of profitable alternatives possible. For example, in electrified areas of the Mountain Province, households have carpentry, food stands, and goldsmith and silversmith businesses. In Batangas, they have video rental stores; goldsmith and silversmith shops; food stands; laundry, tailor, and dressmaking shops; and hairdressers and barbershops (Table 5.25).

Table 5.25: Distribution of Households (%), by Type of Home Business, 1998

Home-business type	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
Hairdresser/barbershop				3.1		0.3		1.8		1.4	1.2
Tailor/dressmaker					13.6	11.2	3.6	3.2	4.5	5.4	5.3
Laundry						1.0				0.4	0.3
Carpentry business		1.9								0.1	0.1
Food stand/restaurant	58.9	2.7				4.6	7.9		8.4	2.0	2.6
Goldsmith/silversmith		2.6				2.1				1.0	0.9
Video rental						0.5				0.2	0.2
Sari-sari store	28.3	64.3	100.0	90.8		67.0	51.4	72.3	46.5	73.7	70.9
Other type	12.8	28.6		6.1	86.4	13.3	37.2	22.7	40.6	15.9	18.4
Valid N	123	2,056	148	6,568	418	11,625	2,799	9,981	3,488	30,230	33,719

Note: NE = non-electrified, E = electrified, HHs = households. Totals may not equal 100 due to rounding errors.

5.44 As Table 5.26 shows, 22.5% of all households across the four provinces are involved in some form of home business, which typically is small. Close to 25% of electrified and 14.8% of non-electrified households run a home business. Thus, it appears that households with electricity are more likely to have some form of home-based business. Of the four provinces, Camarines Sur has the largest proportion of households with home businesses—more than 33% of the province's electrified households and 18% of its non-electrified households.

Table 5.26: Distribution of All Households (%), by Presence of Home Business, 1998

Home-business status	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*Total sample*		*All HHs*
	NE	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	*NE*	*E*	
No	96.0	80.6	89.4	74.4	84.2	79.2	81.9	66.7	85.2	75.3	77.5
Yes	4.0	19.4	10.6	25.6	15.8	20.8	18.1	33.3	14.8	24.7	22.5
Valid N	5,893	12,353	10,027	51,102	4,308	79,079	30,751	37,721	50,978	180,256	231,234

Note: NE = non-electrified, E = electrified, HHs = households.

5.45 Whether to start a home-based business to augment family income—a decision usually made by the household head—is largely driven by the availability of electricity service; however, other significant factors are involved. For example, household heads with low labor wages and many school-age children are more likely to initiate a home business (Table 5.27). Household heads with relatively higher levels of education are also more likely to start a home business. Moreover, high prices for fuelwood, charcoal, kerosene, and LPG lower the probability that household heads will decide to initiate a home-based business.

5.46 As Table 5.27 shows, there is a direct relationship between the hours spent working in a home business and the amount of household income from other sources. Female household heads tend to spend more hours engaged in home-business activities than do males, and older adults spend less time than do younger adults. Compared to household heads who are unemployed or working part-time, fully employed household heads spend about two hours more per day running their home businesses. It can be inferred from Table 5.25 that households spend more time running sari-sari stores than other home-based businesses.

5.47 To better understand electricity's relationship to the amount of time spent running a home business, this study divided household businesses into those that 1) use electricity directly in their businesses, 2) do not use electricity directly in their businesses but have it in their houses, and 3) do not have access to electricity. Compared to households without access, households that use electricity directly in their businesses spend about four hours more per day running their businesses; interestingly, electrified households that do not use electricity directly in their home businesses spend about two hours more per day (this type of household probably has electric lights used for multiple purposes during evening hours). Assuming that households with home-based businesses operate 24 days per month (6 days per week, 4 weeks per month), the increased time spent per month equals 96 hours for households who use electricity directly in their businesses and 48 hours for those who use electricity indirectly.

5.48 The study found that the total time spent running a home-based business is unrelated to the total amount of income the business produces. This means that the quality or type of service the business provides is more important for income generation than the total hours spent running the business. For this reason, the authors examined the relationship between businesses with and without electricity. Results indicated that, in the four provinces, businesses in non-electrified households have the lowest average monthly incomes, while electrified households that use electricity directly in their businesses yield the highest income returns (Table 5.28).

Table 5.27: Determinants of Business Types and Hours, 1998

Independent variable	*Propensity to run a home business** Probit	*No. of hours spent in home business* OLS
Social or infrastructure factor		
Household-head characteristics		
Age (yrs.)		-0.069
Full-time employment		1.728
Gender		-2.284
Average monthly income (P)		
Labor wages	-0.000041	
Non-wages per capita		0.000879
Education (yrs.)	0.037264	
Number of household members ages 5-14 years	0.055302	
Price of energy source		
Fuelwood (P/kg)	-0.071348	-0.734
Charcoal (P/kg)	-0.066081	
Kerosene (P/l)	-0.021128	
LPG (P/kg)	-0.030707	-0.190
Dwelling unit is constructed mainly of bamboo/sawali/cogun/nipa (1 = yes, 0 = no)	-0.213238	
Home ownership status (1= yes, 0 = no)		3.024
Type of business is sari-sari store		2.045
Electricity used in home business		4.283
Electricity not used in home business		2.454
Household electrification status [1 = yes, 0 = no]	0.574713	
Constant	0.467591	7.310
R Square	0.08	0.38
Number of households	1,776	180

* The term *propensity* is understood to mean the contribution to the probability that the dependent variable will have a non-zero value in response to the independent variable. The coefficients should not be interpreted as marginal contributions to the probability.

Table 5.28: Home-business Income, by Use of Electricity, 1998

Home-business use of electricity	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*Average business income (P/mo.)*
Direct	--	1,424	5,919	968	3,868
Indirect	3,871	2,797	2,195	605	2,090
No	1,131	1,000	2,753	722	1,052

Note: -- means no business in this category.

5.49 Thus, results of the analysis are fairly conclusive—electricity plays a significant role in the development and profitability of home businesses in rural Philippines. Areas with electricity have more home businesses; they are operated for longer hours and are more profitable. From these results, one should not conclude that electricity is the answer to local business development, as the average monthly business income is only about P2,000. However, the results do indicate the importance of electricity for micro-enterprise development.

Electricity and Agricultural Production

5.50 Although the study hypothesized that the per-hectare agricultural output of farm households would increase as a result of electricity-powered irrigation, electricity was found to have no effect on agricultural output or income. Of the 702 farm households surveyed, the only factor that appears to affect agricultural production is use of animal manure as a fertilizer. Nonetheless, one must exercise care in interpreting these results as evidence against the benefits of rural electrification on agricultural productivity.

5.51 During the time of the survey, the study area was experiencing a severe drought caused by El Niño. As a result, the country's agriculture sector had an overall dismal performance. The National Economic Development Authority reported that, during the second and third quarters of 1998, the sector's growth rate was –15.6% and –2.16%, respectively (Table 5.29). (One village in the survey was evacuated because of lack of drinking water.) The rains returned in mid-July, and agricultural production improved during the fourth quarter. With the exception of Nueva Ecija, the provinces surveyed lacked any irrigation infrastructure for farm households. Had appropriate irrigation facilities been available, the drought's adverse effects could have been mitigated.

Table 5.29: Output and Growth Rate of Philippines Agriculture Sector, by Quarter, 1997-1999

Quarter (Q)	*Output (P)**	*Real growth rate (%)*
1997, Q4	54,332	--
1998, Q1	45,828	-15.6
1998, Q2	38,668	-15.6
1998, Q3	37,831	-2.16
1998, Q4	50,118	32.5
1999, Q1	46,953	-6.3

* Constant 1985 prices

5.52 In other developing countries, electricity has been found to affect agricultural production through irrigation and changes in cropping patterns (Ranganathan and Ramanayya 1998; Barnes and Binswanger 1986). However, during the period of time covered by this study, use of electricity for improving agricultural production did not occur.

Conclusion

5.53 This chapter has focused on the social and economic effects of rural electrification in order to quantify some of the benefits of electrification programs. From this survey, much evidence supports the notion that rural electrification is an important component of the social infrastructure that leads to development. Perhaps one of the most important findings is the link between electricity and education. Not only do rural households perceive electricity as important for their children's education by improving study conditions during the evening; the number of hours both children and adults spend reading is higher when a household has access to electricity. Electricity improves the flow of information and entertainment to rural households; decreases the amount of time rural households spend collecting fuelwood or fetching water; and facilitates the start-up and improves the productivity of more small businesses in electrified regions.

5.54 At this stage, the benefits of electricity for rural households in four diverse provinces of the Philippines are known. Even so, many of the benefits discussed in this chapter have not been quantified in monetary terms. In fact, the authors purposely reported both quantitative and qualitative benefits to present a truer picture of how electricity affects rural households and areas. The next step is to take the results presented in this chapter and assess the level of economic benefits for rural areas in the Philippines. This is the focus of the next chapter.

6

Assessing Electrification's Economic Benefits

6.1 The most fundamental way to assess rural electrification's economic benefits is to observe the changes that formerly non-electrified rural populations make as they gain access. However, to understand how a region develops in response to electrification (project intervention), all other changes that affect the region's economic well-being must be evaluated. For this reason, policy analysts emphasize that appropriate project evaluations compare a region's situation *with and without*, rather than *before and after*, a project. However, it is impossible to observe the behavior of non-electrified and electrified households isolated from other factors that affect changes in rural well-being. In fact, even the less desirable before-and-after project comparison is impossible when data are drawn from cross-sectional surveys, as is indeed the case in the Philippines.

6.2 In this chapter, the authors use the techniques outlined in Chapter 2, the survey results found in Chapter 4, and the data analysis presented in Chapter 5 to estimate, in monetary terms, the quantitative benefits of providing electricity to approximately four million, non-electrified households in rural Philippines. Before turning to the substantive findings, however, the authors clarify economic background assumptions used in estimating the benefits. These assumptions are presented in the section below.

Background Assumptions

6.3 Since it is impossible to observe households with and without electricity independent of other factors that affect their well-being, this study relies on the ability to model behavioral changes of non-electrified and electrified households in rural Philippines. In theory, the model should specify the relationship between electricity benefits and key parameters for each non-electrified Philippine household (e.g., income, family size, occupation, health status, location, educational attainment, and energy consumption). In practice, however, the authors' sample of rural households was far too small to develop an all-inclusive functional relationship that would be reliable, not only for the four diverse provinces from which the data were drawn, but for the entire Philippine population.

6.4 Another issue involves the time frame for discounting benefits. Since this study does not aim to evaluate an actual project, the authors have adopted an approach that considers the benefits of electrification as accumulating in a "steady state." This means that households who adopt electricity enjoy a steady stream of monthly benefits they otherwise would forego had they remained without electricity.

Modeling the "with" and "without" case

6.5 Modeling the changes households undergo when moving from a non-electrified to an electrified status is difficult to accomplish empirically. Instead, the authors have adopted a simpler, more pragmatic approach. For each benefit category, they estimate the gains resulting from electrification for a hypothetical household. This household is assigned energy-consumption and other socioeconomic characteristics equal to the average of some or all of the non-electrified households in the survey sample. Thus, for example, to estimate the benefits of electric lighting, the authors assign a pre-electrification lumen consumption equal to the average for all households without electricity. In the strictest sense, they can only impute the results of this study to the four RECs in the provinces that comprise the study sample. However, the sample RECs are diverse in geography, level of development, and populations. Thus, the authors have assumed that this "average" household is representative of Philippine households—that is, the features of a randomly selected sample household will approximate those of a randomly selected household drawn from the entire Philippine population.

6.6 At times, the authors could not average over all sample households due to lack of data. For example, the costs of watching television for a household without grid electricity (using batteries) was estimated only for the subset of those sample households that, in fact, did use batteries for this purpose. Clearly, the reliability of these averages—the ability to declare they are typical for the Philippine population—will differ by benefit category. For example, it is likely that the lighting benefit number is far more reliable that the television benefit number.

Considerations for discounting

6.7 The benefit estimates of this report are "steady-state," meaning that the numbers envision a constant stream of monthly benefits that non-electrified households would enjoy if they suddenly attained full electrification. This presentation is especially useful for comparing benefits and monthly tariffs. However, to assess any specific electrification program, the numbers may be misleading since implementing electrification is costly and can take many years. Moreover, it takes time to fully realize the benefits resulting from electrification. Thus, for policy purposes—comparing a potential electrification project with another social investment or comparing several potential electrification projects—the stream of future benefits and costs should be discounted in order to express them in present-value terms.

6.8 Since this report focuses on methodology rather than assessment of any specific electrification project with a known time frame, there is no meaningful way to apply discount rates to any of the results. On the other hand, with a known project time frame (schedule of connecting a specified number of households over time), determining the flow of most electrification benefits over time is easy. The only major uncertainly is the time between initial service connection and the point at which benefits accrue. With one exception, the benefits of electrification (e.g., better lighting, convenience, and entertainment) can be enjoyed as soon as a household attains suitable appliances. The authors assume that some appliance purchases, such as lamps and communication devices (radios and televisions), occur fairly quickly or even before electric current is turned on. Thus, for discounting purposes, they assume that the stream of some benefits begins at the point that power becomes available to the rural household, while other benefits take longer to accrue.

6.9 Some educational benefits may begin shortly after electrification; however, their major effect on household income may take several years to realize. The basic model relating electrification to improved education and greater household income considers education as an investment. The time frame of this investment and the returns on it are largely determined by the age distribution of household members. The time and money invested in a six-year-old child's education may not be realized for 10-12 years. Similarly, any increases in educational returns resulting from electrification may not be realized for 10-12 years.

6.10 Determining the levels of educational benefits that accrue from electrification is difficult. If all households at the point of electrification only had six-year-old children, it would be relatively easy to adjust the benefit stream to reflect the gap between the timing of electrification and educational benefits. Of course, households have a mix of members of all ages and degrees of educational attainment. Thus, educational benefits will be realized far sooner for older children, although the level of benefits may be far less than for younger children. While this study's statistical analysis revealed that the number of years of education increased for electrified households by about two years (which account for about $10 more per month per wage earner), these numbers are averages that do not apply to any specific household. For detailed analysis of the time-distribution of educational benefits, these averages would have to be replaced by estimates more specific to the age composition of individual households.

6.11 Such a detailed analysis, while beyond the scope of this study, would be possible with a rich database capable of estimating educational return as a function of age, gender, and number of household members—perhaps with certain parameters expressed in a way that would facilitate statistical analysis (e.g., using average age instead of the specific age of each household member). Given such an estimate, expressed analytically as an equation, it would then be possible to apply the equation to each non-electrified household in the sample to estimate the likely level of return and average number of years before it is realized.

6.12 This line of analysis would be worthwhile for future analyses of electrification benefits. That it was not undertaken in this study should not be overstated as a potential weakness. While important, education is not the largest benefit resulting from electrification. Lighting and time savings are greater and entertainment benefits are about the same. Moreover, a large portion of educational benefits is probably counted in the lighting estimates. Therefore, the failure to allow for the gap between the time a household obtains electricity service and the time educational benefits accrue may not be as serious as it first appears.

Electric Lighting

6.13 The authors assumed that a hypothetical non-electrified household would move from total reliance on kerosene lanterns for lighting to total reliance on a mix of incandescent and florescent lamps. Both electricity and kerosene consumption figures are based on the lumens produced by the lamps. As Table 6.1 shows, besides kerosene, non-electrified households have a variety of energy sources, including LPG, batteries, and candles, but their use is minor. The assumed shift from kerosene lanterns to electric lamps and the associated assumption that the demand curve has only two observable consumption levels, one for each lighting source, seem fair.

Table 6.1: Lighting Source of Non-electrified Rural Households (%), by Province, 1998*

Lighting source	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
Kerosene	89.1	92.4	96.6	95.7	93.0
LPG	1.2	--	--	0.4	2.3
Dry-cell battery	1.8	2.9	--	2.6	2.3
Other battery	--	4.8	--	--	0.9
Candles	3.0	6.6	27.6	5.2	6.4
Population	6,112	12,948	5,122	31,621	55,803

* Households may use more than one type of energy. All numbers represent the percentage of households without grid-based electrification.

6.14 The assumption of a linear demand curve allows for the direct computation of benefits according to the model presented in Chapter 2 (Figure 2.2). In the simple linear case, benefits or consumer surplus is estimated by adding the rectangle ***cdef*** and the triangle ***feb*** of the diagram: the difference between the gain in total willingness to pay for lumens minus the cost of the higher consumption level with electrification. Thus, the gain in lighting benefits of this hypothetical household is equal to the initial consumption level ***Q(0)*** times the difference in the lumen price with and without electricity (***P(1)*** - ***P(0)***) plus one-half the difference in price times the gain in lumen consumption (***Q(1)*** - ***Q(0)***). Based on survey data and assumed lumen costs with and without electricity, the following values are assigned for the computation (Table 6.2).

Table 6.2: Price and Quantity of Light Used in Rural Households, 1998

Parameter	*Value**	*Unit*	*Assumption (average)*
P(0)	$0.36	Per klm hr.	Kerosene cost/klm hr.
P(1)	$0.0075	Per klm hr.	Grid electricity cost/klm hr.
Q(0)	4.1	Klm/mo.	Consumption of non-electrified households
Q(1)	204.4	Klm/mo.	Consumption of electrified households

* Peso values were converted into U.S. dollars, using the exchange rate P40 = US$1.

6.15 These parameters yield an estimated gain in lumen benefit for our hypothetical non-electrified household of $36.75 per month. If this household is representative of the four million non-electrified households throughout the Philippines, then the total national lumen benefit from electrifying them would be about $147.5 million per month.

6.16 Of course, these estimates may be too high or low if the underlying assumptions fail to hold. Two reasons, in particular, could result in error. First, the demand curve could deviate from the assumed linear form. For example, if lumen consumption were insensitive to price changes for low levels of consumption but highly sensitive to price changes for high levels of consumption, the demand curve shown in Figure 2.2 could move toward the axes, carving out a much smaller area for consumer surplus. If this were the case, then the above estimates would be far too high. Of course, other non-linear demand forms (e.g., ones that curved away from the axes) could, instead, lead to much higher estimates. Unfortunately, accurate demand curve estimation is fairly data intensive. While this study's data set was reasonably large, it was not big enough to allow for observation of a wide range of pre-electrification lumen prices and consumption levels. The actual lumen consumption by energy source is given in Table 6.3, which indicates similar patterns to those described above.

Table 6.3: Rural Lumen Consumption, by Energy Type, 1998

Household electrification status	*Lumens consumed, by energy source (users only)*				
	Candle	*Kerosene*	*Battery*	*Grid*	*All sources*
Non-electrified					
Mean	0.156	5.14	6.915	--	5.08
Household use	98	588	2	0	601
Electrified					
Mean	0.125	4.26	--	203.41	205.68
Household use	449	556	--	1,068	1,068
All households					
Mean	0.130	4.71	6.915	203.41	133.44
Household use	547	1,144	2	1,068	1,669

Note: Figures represent only those households who use an energy source for lighting; numbers vary slightly from those in previous tables because of missing values.

6.17 Second, the assumption of a single demand curve ignores possible shifts in demand as household income rises. As indicated in Chapter 2 (Figure 2.3), if recently electrified households continue to adhere to their original, low-income demand curve for lumens, then the study's estimates of their lumen consumption with electrification will be too high. As a result, the benefit estimates will likewise be too high. On the other hand, if these households behave more like wealthier ones with high lumen-demand curves, estimates may be too low.

6.18 Although the assumption of a single demand curve may be a good compromise between these two situations, a more sophisticated way of controlling for income effects on demand is desirable.[16] This would require a larger, more detailed survey that allows for observation of lumen consumption levels for a wide range of incomes and prices.[17]

[16] The obvious approach would be to use multiple regression analysis with income as an explanatory variable.

[17] This survey did not allow for direct observation of lumen consumption. Instead, lumen consumption was inferred from non-electrified households' consumption of kerosene and electrified households' use of light bulbs. Possible mixed use of appliances for lighting (kerosene lamps, candles, light bulbs) was unaccounted for. In addition, the sample frame did not allow for much observed price variation in energy. Future surveys could cover a larger geographical area with a wider variety of electricity and energy supply conditions. Moreover, they could contain more detailed information on appliance use (e.g., relative use of kerosene lamps, pressure lamps, and candles for lighting).

Radio and Television

6.19 Rural people's desire for information and entertainment from radios and television is quite high, but measuring the value of these benefits in monetary terms has always challenged analysts. Some national income economists have suggested using expenditures for radio and television advertising as a measure of this value (Cremeans 1980).[18] However, such expenditures are more a measure of the benefits to advertisers than to the listening and viewing public. As Chapter 4 makes clear, after lighting, the most popular appliance for a newly electrified household is a television set. Furthermore, the shift from battery-operated to plug-in radios results in nearly two hours more listening time per day.

6.20 As a consequence, the method for assessing the electrification benefits of radio and television is similar to that of lighting. The consumer obtains more listening and viewing time at a lower cost per hour. The widespread use of batteries for radio listening and television viewing in households without grid electricity makes it possible to estimate the benefits. Rather than observing the effect of less costly lumens on lighting consumption between households with and without grid electricity, one can observe the effects of less expensive listening and viewing hours. This study assumed that a hypothetical non-electrified household, because of its reliance on batteries, would pay a high price for radio listening and television viewing hours. With electrification, the price of listening and viewing for particular time periods would decrease considerably, resulting in substantial increases in listening and viewing hours (Table 6.4).

Table 6.4: Rural Entertainment and Communication Consumption, by Energy Source, 1998

	Listening hours consumed, by energy source (users only)			
Electrification status	*Battery radio (3W)*	*Radio (15W)*	*Battery TV*	*Grid TV*
Non-electrified				
Mean	13.8	--	1.85	--
Household use	--	--	21	--
Electrified				
Mean	--	104	--	129
Household use	--	--	--	--

Note: Numbers represent only those households using an energy source for lighting; they vary slightly from those in previous tables because of missing values.

6.21 As with lumen demand, the study assumed a simple, linear demand function for radio and television. The relevant parameters are presented in Tables 6.5 and 6.6. These parameters and the assumed linear demand function yield an estimated per-household benefit of $19.60 per month from gaining access to less expensive radio and television viewing hours. Assuming that the country's four million non-electrified households are similar to this

[18] In the national accounts, this advertising is treated as an intermediate business cost; thus, it is largely missed in the total GDP.

hypothetical household, the entertainment value of electrifying them would equal about $77.5 million per month.

6.22 As with the lumen demand analysis, one should be aware of the possible effects of the linear demand and single-demand curve assumption on these results. In addition, it should be noted that only about 21 non-electrified households used vehicular batteries to operate televisions, while about 70 non-electrified households used batteries to operate radios. Thus, the high estimated price for a radio/television listening hour for a non-electrified household is based on a small number of observations. The estimates, therefore, are subject to large variances.

Table 6.5: Price and Quantity of Radio Listening in Rural Households, 1998

Parameter	*Value*[1]	*Unit*	*Assumption (average)*[2]
P(0)	$0.11	Per listening hr.	Cost per listening hr. using typical dry-cell radio (3W)
P(1)	$0.0028	Per listening hr.	Cost per listening hr. using typical plug-in radio (18W)
Q(0)	13.8	Listening hrs./mo.	Surveyed consumption for non-electrified households
Q(1)	104.6	Listening hrs./mo.	Surveyed consumption for electrified households

[1] Peso values were converted into U.S. dollars, using the exchange rate P40 = US$1.

[2] No quality difference in listening hours was assumed between the two types of radios; however, plug-in radios using grid electricity usually have better sound quality.

Table 6.6: Price and Quantity of Television Viewing in Rural Households, 1998

Parameter	*Value**	*Unit*	*Assumption (average)*
P(0)	$0.22	Per viewing hr.	Cost of viewing hrs. using a vehicular battery (48W for black-and-white or 90W for color)
P(1)	$0.0125	Per viewing hr.	Cost of viewing hrs. using plug-in (48W for black-and-white or 90W for color)
Q(0)	1.85	Viewing hrs./mo.	Surveyed consumption for households without grid electricity using battery
Q(1)	129	Viewing hrs./mo.	Surveyed consumption for households with grid electricity using plug-in

* Peso values were converted into U.S. dollars, using the exchange rate P40 = US$1.

6.23 Finally, the analysis depended on assumptions about the types of radios and televisions in use. However, it would have been more accurate to estimate per-hour listening and viewing costs based on the average of what households spent. Correcting this deficiency would require obtaining more information on the wattage of the radios, which future surveys may wish to undertake.

Education

6.24 Electricity's estimated benefits for education have been well documented for developed countries and, to a lesser extent, developing countries. Intuitively, one knows that education can lead to higher streams of future income over an individual's lifetime. Because education is more an investment than a consumer good, it is impossible to estimate benefits by computing areas under the demand curve. For these reasons, this study uses an approach to estimate education benefits separate from that used to evaluate the more easily measured benefits of lighting, communications, and entertainment—one that focuses on the direct benefits of electricity combined with education.

6.25 The study's findings indicate that members of electrified households attain about two years more formal education than their non-electrified counterparts. In addition, a household's use of electricity influences the quality of education. For example, members of electrified households spend more time reading and studying. The effect of education alone has high rates of return for individuals. But combined with electricity, education leads to even higher income, even for households with the same educational levels. In short, the presence of electricity in a household enhances the returns to education beyond the effects of having electricity or having attained a certain level of education.

6.26 As a result of a household's investment in education, wage earners in households with electricity can expect to earn between $37 and $47 more per month than their counterparts without electricity. The lower figure reflects current educational levels of households without electricity (6.7 years, as shown in Table 5.11), while the higher figure could result if these households adopted the educational levels of typical households with electricity (8.5 years).[19] To be conservative, the lower figure is adopted in the summary estimates of benefits. Assuming about two wage earners per household, which is typical for the Philippines, these earnings suggest that providing electricity to the country's four million non-electrified households would amount to about $297 million per month in educational benefits.

6.27 As with the study's other estimates, these must be interpreted with care. Formal education, in particular, depends on far more than access to electricity. While this analysis attempted to account for the influence of other factors on education, it was not able to quantify the cost of education. In the Philippines, elementary and high-school education are free to the public, but there may be considerable time and travel costs when schools are located far from residences in rural areas. Homes with grid electricity may be more highly clustered and located nearer schools, explaining, in part, why these households have higher levels of education. Furthermore, the estimates reflect only the income returns to formal education. Other forms of education—particularly on-the-job training—were not considered. However, the combined effect of electricity and education on income is compelling evidence of the complementary nature of the social infrastructure of electricity, schools, and educational programs.

Time Savings

6.28 Electricity makes it possible to perform household chores more easily and in less time. Electric appliances and, to some extent, better household lighting can lessen the

[19] The calculations result from the product of the electricity-education interaction parameter (Pesos 2,722) shown in Table 5.12 and the years of education shown in Table 5.11. They reflect a conversion of pesos to dollars, divided by 12 to show figures on a monthly basis.

drudgery of family chores, including washing clothes, cooking, cleaning, child care, collecting fuelwood, and fetching drinking water.

6.29 For savings in time, the benefits are estimated directly as the reduction in time needed to perform such activities. Use of electricity saves households about one hour per day, or about 33 hours per month (Table 5.24). Using an average wage estimated from the survey, this time can be valued at about $0.74 per hour. Thus, the 33 hours of time saved from household drudgery is worth about $24.50 per month per household. For the Philippines as a whole, the value in time savings from electrification is about $97.5 million per month.

6.30 The wage is an opportunity cost measure of time saved. The assumption implicit in this measure is that a household uses the time saved to earn income. Of course, in practice, savings in time might be used for less productive purposes, such as watching television. Therefore, researchers have suggested other ways to value time saved (e.g., the cost of hiring others to do household chores). Applying such a measure, however, would require detailed data on which chores and costs change when a household adopts electricity service (e.g., collecting fuelwood and the cost of purchasing it or hiring someone to collect it). Given that these measures, in principle, are not significantly better than the wage measure and require extremely detailed information, future surveys are unlikely to apply them.

Productivity

6.31 Having electricity increases the likelihood that a household will run a home business and affects the amount of time spent running it. Most of these businesses are small, involving small increases in income. The most common type is the sari-sari store, which sells food items and other goods. Even though these stores are small, the extra income can significantly affect a family's economic welfare. In addition, when aggregated over the many households engaged in home businesses, the benefits can be surprisingly large.

6.32 The benefits of electricity for a home business can be estimated by placing a value on the number of additional hours spent conducting the business. As the study survey indicates, about 22.5% of all households engage in some form of home business (Table 5.26). Among non-electrified households, about 14.8% do. Electrification apparently increases the chances that a household will engage in a home business by about 10.7%.[20] Thus, with electrification, one can expect that about 25.5% of non-electrified households (14.8% + 10.7%) will engage in a home-based business.

6.33 With electricity, a business can operate more efficiently and for longer periods of time—about two hours more per day (Table 5.27). Assuming that 24 days are worked per month, the additional time equals 48 business hours per month. Depending on the type of business, these hours could be worth far less or far more than the average hourly income of the business. For example, for a home sewing business, one might expect that the income generated from the additional hours of work may be somewhat less per hour than average since fatigue may set in. On the other hand, additional evening hours for a home barbershop could yield much higher income per hour than the daily average because it is easier to service

[20] This percentage represents the sum of the constant term in the regression (-0.467591) and the coefficient on the electrification proxy variable (0.574713).

working customers. Rather than speculate about the nature of each business that would exist in non-electrified households of the Philippines, the authors chose to estimate these marginal hours arbitrarily at the average wage rate of $0.74 per hour. This suggests that, for each business in a non-electrified household, acquiring access would increase monthly income by $34.

6.34 If the percentage of the country's four million non-electrified households that engage in business is proportionate to the survey sample, then about 592,000 have a home business. Switching to electricity could significantly improve this group's monthly business income—about $20 million overall (592,000 multiplied by $34). In addition, for non-electrified households who do not run a business, the number of households starting new businesses is estimated at about 63,000 households, or about 10.7%.

6.35 The average monthly income for a household's home business is about $75, which is estimated from an average of the households using electricity both directly and indirectly in their businesses (about P3,000 per month). Using an average business income of $75 per month, one would expect an additional $4.7 million per month resulting from the 63,000 new businesses. Therefore, the total productivity benefit resulting from electrification would equal about $24.7 million per month, which includes $20 million for productivity improvements of existing businesses and an additional $4.7 million for households that previously did not have a business. Clearly, home-business income is a significant benefit for rural households. Electricity allows for expanded productivity of a home business, even when used indirectly. Used directly, the benefits are even greater.

Other Benefit Categories

6.36 This study investigated other expected benefits of rural electrification related to improved health, safety and security, and agricultural productivity; but none were discovered. However, it should be noted that the survey was not designed to measure public benefits, such as street lighting, to individual households.

6.37 Although electricity was found to increase feelings of security, no data were generated to permit any monetary quantification. Future surveys may wish to take the contingent valuation approach—that is, adding direct questions on willingness to pay. To address benefits to the public good, they might compare property values in well- and poorly-lit rural areas.

6.38 That the survey failed to capture reliable data on health differences is somewhat surprising. A brief health section was modeled after existing surveys that measured living standards in developing countries. The method assessed self-reported illnesses and symptoms of illness, such as coughing. However, the authors have since learned that these types of questions are usually unsatisfactory; more extensive sections in the questionnaire developed by qualified health survey specialists are necessary for reliability of responses. The survey section did establish a relationship between rural electrification and fewer days missed from school over a three-month period. However, there were no similar health benefits for adults in terms of fewer days missed from work. These results may suggest the need for more detailed, reliable health questions in future surveys.

6.39 Also surprising was the apparent lack of improved agricultural performance resulting from electrification. In many developing countries, electrification permits more extensive irrigation and crop rotations. Apparently—at least in the four surveyed provinces—natural rainfall permits the same number of rotations for all farms, whether electrified or not. Lack of agricultural performance can be explained, at least in part, by the El Niño weather phenomenon, which occurred during the time of the survey, drying up many farmers' water sources. Significant evidence from other countries confirms that availability of electricity for agricultural pumping improves crop production, increases farm income, and reduces agricultural risk caused by unpredictable weather.

Summary of Monetary Benefits

6.40 The benefits summarized in Table 6.7 are derived from various, sometimes overlapping sources. It would not be especially meaningful to sum these estimates over *all* benefit categories since double counting would likely result. For example, educational benefits may result from better lighting, allowing for improved reading and longer homework hours.

Table 6.7: Summary of Electrification Benefits for Rural Households, 1998

Benefit category	*Benefit value*	*Unit*	*Total per month (millions)*
Less expensive and higher levels of lighting	$36.75	Per household per mo.	$147.5
Less expensive and higher levels of radio and television use	$19.60	Per household per mo.	$77.5
Adult education and electricity wage- income returns	$37.07	Per wage earner per mo.	$296.6
Time savings for household chores	$24.50	Per household per mo.	$97.5
Improved productivity for home business	$34.00 (existing home business), $75 (new home business)	Per business per mo.	$24.7
Improved health	None	NA	NA
Improved agricultural productivity resulting in increased irrigation	None	NA	NA
Feelings of security	Not quantified in monetary terms	NA	NA
Public-good benefits	Not quantified	NA	NA

6.41 Education is also related to access to inexpensive communication devices, such as radios and televisions that plug in to grid electricity. However, it can be assumed that benefit categories other than lighting are reasonably independent of each other. If this is true, the total benefit of electrifying the country's remaining four million, non-electrified households will exceed $324 million per month ($81 per month for each household without electricity).[21]

6.42 The amount for the country as a whole is the benefit that could be expected if all remaining non-electrified households gained access to electricity from a central grid system. This is a goal of the Government of the Philippines; however, given the pace of grid expansion, the target will not be reached for many years to come. In addition, the cost of providing service from the grid increases significantly as the number of non-electrified households dwindles. This is because more densely populated areas are typically given priority for grid expansion. However, methods similar to these could be applied to the benefits of renewable energy systems, including household photovoltaic (PV) systems, which provide lower service levels but are superior to kerosene lighting.

Conclusion

6.43 This chapter has attempted to measure a range of rural electrification benefits using well-accepted benefit-evaluation techniques. Previously, application of these techniques has been limited to measuring rural electrification's effects on the price of electricity or some other benefit proxy. Relating its effects to development outcomes (such as better education, increased business productivity, and improved communication) is more intuitive. Nonetheless, policy decisions that encourage the spread of electricity are based on expected development outcomes, not the electricity industry's projected load growth. The implications of applying these common techniques, the so-called "new approaches," to evaluating harder-to-measure benefits are discussed in Chapter 7.

[21] The estimate also assumes at leas one wage earner per household. With no wage earner, the estimate drops to $44 per household per month for those without electricity.

7

Conclusions and Implications for the Future

Principal Findings

7.1 This study has explored methods for quantifying, in monetary terms, the benefits of bringing electricity to rural populations in the Philippines. That electrification brings large benefits is the view of most potential recipients of World Bank programs and is consistent with qualitative investigations. However, to assess whether these benefits are commensurate with program costs, they must be quantified in monetary terms.

7.2 The challenge of doing this is that many benefits, such as greater convenience or improved education, are seemingly intangible or otherwise difficult to quantify. Even so, this study has demonstrated that such benefits can be expressed in monetary terms using techniques that estimate what rational individuals would be willing to pay for them. Moreover, simple (albeit crude) estimates can be made at a cost of less than $100,000. While a much larger outlay of funds would be required for more refined estimates (primarily because of greater data-collection costs), the costs of estimating benefits are probably a small fraction of total project costs. Furthermore, for many developing countries, local nationals can undertake the effort with only a minimal amount of outside analytical support.

7.3 The quantitative results of this study indicate that monetary benefits, measured by the amount a Philippine household would be willing to pay for electrification, appear large. Of course, the estimates rely on simple linearity assumptions and, as a result, may be too high. In addition, since the estimated per-household benefits are averages, the numbers do not pertain to every non-electrified household in the Philippines. For some, benefits are far lower; for others, they are far higher. On the other hand, a number of benefit categories were not quantified because of lack of data. In any event, even if the estimates were too large by a factor of two, they would still exceed the likely annualized cost of providing electricity service.

7.4 It is apparent from the household survey that even very poor households appear willing to pay large amounts for the energy sources they use in the absence of electrification—a major reason for the high benefit estimates. As noted in Chapter 2, benefit estimates are largely a function of the difference between pre- and post-electrification costs of satisfying consumer demands for lighting and other benefits of electrification. In terms of the per-unit (per lumen) cost of lighting, for example, the outlay for non-electrified households is more than 50 times what it would be with electricity service.

7.5 Those involved in providing electricity to rural populations of developing countries will not be surprised by the high willingness to pay for the benefits of electrification. Although little empirical work has been done recently, this study's message of a high willingness to pay is consistent with other studies that have assessed the benefits of electrification in more qualitative, non-monetary terms (Shamannay 1996; Barnes 1988; Brodman 1982; Fluitman 1983; Herrin 1979; Saunders, Davis, Moses, and Ross 1975; Wasserman and Davenport 1983).

7.6 Quantitative findings must be interpreted with care. The numbers attest only to the likely economic efficiency of projects designed to bring electrification to rural Philippine households. As noted in Chapter 1, project evaluation involves more than considerations of economic efficiency. Issues of equity and effectiveness are equally important. That benefits exceed costs is no assurance of project success. Indeed, past analyses suggest that many previous World Bank electrification programs were not deemed successful by the Bank's own criteria (Mason 1990; World Bank 1994). The problem, however, did not necessarily involve the economic efficiencies of these projects, but rather their implementation; that is, their project effectiveness.

7.7 For example, simply because a household is willing to pay more for electricity than the amount of its monthly bill does not mean it will pay any price, particularly if service is unreliable. This study's estimates refer to the benefits of electrification, not electrification marked by frequent brownouts or blackouts. A project is headed for failure if poor service leads to non-payment of bills, which, in turn, depletes funds for maintenance, causing further deterioration of service. In short, economic efficiency is a necessary, but insufficient, condition for project success.

Data and Research Needs

7.8 The purpose of this study involved more than a demonstration of methods for quantifying electrification benefits. As a pilot project, it aimed to identify data and research needs to improve future assessment efforts. The following sections highlight some major areas where improvement is needed.

Better control of income effects

7.9 It is well known that, in theory, higher-income, non-electrified households are willing to pay more for electricity than lower-income, non-electrified households. While this income effect was accounted for fairly easily in some estimates (e.g., the benefits of additional television viewing), more often than not, it was ignored. One overriding problem is that income is both an *independent* variable that helps explain the benefits of electrification and a *dependent* variable that reflects the outcome of electrification. When a variable functions both ways, it is often difficult to identify its precise contribution using simple statistical procedures, such as single-equation regressions.

7.10 One frequently used approach that attempts to resolve this identification problem is to specify a multi-equation model that disaggregates the variable's multiple roles. Even if one successfully specifies such a model, however, it is not always possible to assign unique values to the model's parameters. A second approach relies on a single-equation regression to estimate the parameters for groups of households separately identified by income class (Fitzgerald, Barnes, and McGranahan 1990; Peskin and Barnes 1994). While often viable, this approach, like the first, requires large amounts of data. It is unlikely that the amount of data in this sample of 2,000 Philippine households is large enough to ensure that income sub-groups are adequately represented. Nevertheless, tackling income effects and the associated identification problem should be a principal focus of future benefit-estimation efforts.

Accounting for more socioeconomic factors

7.11 This study's benefit estimates attempt to account for socioeconomic determinants of electrification benefits. For example, in estimating the effects of electrification on income, the analysis also attempted to control for many socioeconomic factors that affect income, such as age, education, gender, and occupation. Undoubtedly, other factors unaccounted for also help explain income, such as health status, migration history, and employment opportunities. All or most of the statistical analyses in Chapter 5, which served the benefit estimates of Chapter 6, would have benefited from additional socioeconomic factors. The major impediments to a more complete coverage of such factors in this study were the size of the survey instrument and the sample.

7.12 A longer questionnaire could have extracted more socioeconomic information from respondents and a larger survey could have increased the chances that the effects of various socioeconomic factors on benefits could have been identified. However, the cost of longer surveys and larger samples could be prohibitive.

Measuring benefits for the public good

7.13 While the project did include a small amount of community data, the major focus was on the household. As a result, the quantitative estimates were confined to so-called private benefits of electrification. Certain public benefits (e.g., better street lighting or medical equipment) were not measured.

7.14 Addressing this issue requires not only more community-specific information; it also requires richer, and perhaps larger, amounts of household data. For example, an often-used method for estimating public benefits, such as street lighting, is to measure the differences in property values between well- and poorly-lit neighborhoods. Doing this, however, requires detailed data on property values and location, both of which were missing from this survey. Another approach uses a separate, contingent valuation survey that asks respondents how much they would be willing to pay for various bundles of public-good amenities associated with electrification. Regardless of one's view of the validity of contingent valuation approaches—they are highly controversial—it is generally agreed that they are expensive to implement.

Detailed information on appliances

7.15 One weakness in using consumption of more lumens at lower cost as a way to estimate household benefits is the need to observe energy use to determine lumen consumption. A more exact approach would observe the mix of lighting appliances used by electrified and non-electrified households to determine consumption. Unfortunately, while the survey instrument covered light-bulb ownership in some detail, there was less coverage of non-electric sources of lighting, and no data on mixed use of light bulbs, kerosene lamps, and candles.

7.16 Similarly, estimating the benefits of inexpensive radio listening and television viewing were hampered by poor data on the energy consumed by these communication devices and their associated costs. Instead, the researchers were forced to assume "typical" wattages and no mixed use. Thus, they did not allow for the possibility that an electrified household listened to both a battery-powered and a plug-in radio during a given month.

7.17 Moreover, while the survey instrument covered ownership of various non-electric appliances (e.g., charcoal stoves, charcoal irons, or candles), no questions covered the use of these appliances. It was therefore impossible to ascertain whether electrification could yield substantial savings in cost or time.

More detail on time use

7.18 While the study did estimate the overall savings in time required to do household chores as a result of having electrification, more detailed time-use information could have provided alternative ways of valuing the savings in time. This study's researchers used an average household hourly wage, but other investigators have suggested that the value of time should relate to the specific activities being undertaken. For example, an hour of food preparation is not necessarily equal to an hour of fuelwood collection.

7.19 One suggested approach to accounting for differences in activity is to estimate the value of time by the market cost of the service associated with the time use. For example, rather than estimating the value of an hour of fuelwood collection by the hourly wage, it could be determined by the market cost of the wood collected or the cost of hiring someone to collect it. However, this approach requires substantial detail on the amount of time used for the activity. One way to obtain such data is to construct a survey of the total allocation of time throughout the day. While such a time-use survey could be useful for benefit estimation, it would greatly increase the cost of data collection.

Infrastructure data

7.20 This analysis could have benefited from more information on the social infrastructure available to household survey respondents, including distance to public transportation, schools, shops, and neighbors; proximity to medical services; and access to telephones. In the case of education, such data would have provided better estimates of its true costs and, therefore, a more refined estimate of the monetary return to the additional education resulting from electrification. Schools located close by or easily accessible by public transportation are, in terms of time cost, less expensive than those more difficult to reach. Data on proximity to neighbors could help estimate the costs of alternatives to television and perhaps other appliances. For example, if neighbors already provide ready access to an electric appliance, the benefit of ownership might be reduced. On the other hand, the perceived benefit may be increased if there is envy of the neighbor's ownership.

Informal education data

7.21 To determine the relationship between electrification and the monetary returns to education, this study measured educational attainment in terms of years of formal schooling. However, other sources of education should be considered as well, particularly home schooling and on-the-job training. Future surveys might develop questions on home schooling and job history, especially for younger members of the work force, which can be used as a proxy for on-the-job training.

Improved health data

7.22 One surprising result of this study's analysis was the lack of measurable health benefits resulting from electrification. However, the survey asked only about possible days missed from work because of illness. But health damages cover more than simply lost work days. For example, a non-electrified household might suffer greater mortality, more discomfort from or a more severe form of illness, and increased medical expenses. Thus, electrified and non-electrified households could differ in benefits and health status even if the number of lost work days were the same.

7.23 To investigate these issues, surveys would need to be developed to obtain detailed health data on both households and the community. The household survey would ask specific questions about illnesses, doctor visits, and cost of medicine and medical services, while the community survey would gather general data on visits to hospitals and health clinics, as well as mortality.

Wider geographical frame

7.24 For reasons of cost, data gathering for this study was limited to the Luzon region of the Philippines. Despite this relatively narrow geographic focus, it was possible to observe substantial differences in income and electrification status among the four selected provinces. However, the selected geography did not cover the large agricultural areas in the central and southern regions of the country, some of which are significantly drier than Luzon and have irrigation systems in place. Their omission from the study made it impossible to observe electricity's benefits to agriculture through improved, inexpensive irrigation. Limited geographic coverage also resulted in a failure to capture benefits of electrification that may be affected by differences in level of economic development, culture, and religion. Future surveys that cast a wider geographic net could improve on capturing such data.

Final Thoughts

7.25 Much of the above discussion points to the need for better and more detailed data. While this would be desirable, it is unclear whether the resulting benefits would justify the required costs, which would well exceed those available for this study. The difference between this study's rough measurements of benefit estimates and the likely costs of electrification are so large that refining these estimates might not have any effect on the decision to electrify. Rather than making major refinements in estimation methods, an alternative approach, at least initially, might focus on some, but not all, areas that need data improvement. Choosing these areas, however, would be difficult, as it would involve deciding how to allocate research funds. A simpler, less controversial approach might simply replicate the current study in another geographic region. Then, any major changes in findings could be used to make more useful refinements.

7.26 Moreover, much of the additional data needed serves purposes other than estimating rural electrification benefits. For example, information on social infrastructure—location of schools, hospitals, and transportation systems—are also needed by those responsible for providing these services. Data on use of household time has proven useful in understanding changes in labor-force participation (especially that of women) and welfare issues. Health information is essential for understanding changes in labor productivity and in planning allocation of health services.

7.27 It would appear reasonable that those not directly involved in the energy policy sector should be willing to help support the suggested areas for data development. Through cost sharing, the incremental expenses of data refinements and associated improvement in benefit estimates could amount to far less than they at first appear. In addition, the relationship between electricity and other development programs could be more easily explored.

7.28 Estimating the benefits of rural electrification is not an easy task. This study—a first step in a longer process of evaluating rural infrastructure—has demonstrated that benefits can be much higher than expected in some areas, while much lower or negligible in others. It has shown that qualitative data can be used to support more quantitative analysis, yielding promising results in relating social processes to the benefits that rural households value. The overall conclusion is this: Gaining a better understanding of rural electrification's benefits will help clarify the framing of policies and options for developing countries.

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Appendices

Tables

APPENDIX A: CONCEPTUAL AND THEORTICAL FRAMEWORKS

Conceptual Framework

The key approach in this study method is to treat electricity as an input in the production of services demanded by households. Thus, electricity in isolation does not generate benefits; rather, it produces services through electricity-using appliances and other household devices. The services produced include improved space lighting, cooling, and filtration; food preservation; water pumping; and radio listening and television viewing. In turn, these services generate consumer benefits, categorized as education; health; entertainment and communication; comfort, protection, and convenience; and productivity.

Education benefits include longer study hours or reading time and access to televised learning programs. ***Health*** benefits include reduced concentration of mosquitoes through improved air circulation, better water quality through access to groundwater, preservation of food through refrigeration, and access to health programs on radio and television. ***Entertainment and communication*** benefits include increased evening socializing with friends and family and access to a variety of radio and television shows. ***Comfort, protection, and convenience*** benefits include ease of living in hot climates; protection against household and business theft; and reduction in the amount of time spent cleaning, cooking, washing clothes, collecting fuelwood, and fetching drinking water. ***Productivity*** benefits include longer or more flexible working hours, better working conditions through space cooling and filtration, and access to learning agricultural methods introduced on radio or television.

Household Production Theory

This study uses household production as its general theoretical framework (Deaton and Muellbauer 1980). In this approach, it is assumed that the goods and services households purchase in the market are not the agents that bring satisfaction. Rather, they are inputs in a process, defined by a household production function that generates more essential, utility-yielding, non-market goods, such as convenience in doing household chores, feelings of safety and security, and enjoyment from watching television or listening to the radio.

The overall optimization problem can be described in two stages. At the first (lower) stage, the household acts like a firm that produces an output vector of Z-commodities, the objects of final consumption, from a vector of inputs (e.g., market goods, labor, and capital). At this stage, the household's objective is to minimize its short-term cost subject to the constraint imposed by the production. At the second (higher) stage, the household chooses the best combination of Z-commodities to maximize their utility function, subject to the minimum cost of producing them.

The household production theory has been expanded and modified to analyze various household behaviors. For example, the theory considers the term *household* synonymous with *individual*. Becker (1965) and Lancaster (1966a, 1966b) modified the theory to emphasize the role of household members in producing the joint utility or welfare function for the household (i.e., the household allocates its total resources, including members' time, to maximize household satisfaction). For example, in preparing a household meal (a non-traded Z-commodity), needed time inputs would include time to collect fuelwood (if used for cooking), purchase ingredients, and cook the meal. Deciding which household members perform these chores depends on their respective productivities in carrying them out.

The theory has also been modified in its treatment of leisure. In the classical theory, leisure was defined as a residual between total time endowment and labor time supplied in the market, and was implicitly treated as part of the production function for the Z-commodity. Thus, time spent working at home to produce Z would also be counted as leisure. Gronau (1973) qualified this, stating that, although working at home and the market are close substitutes, a clear distinction must be made between working at home (home production time) and leisure (home consumption time).

Time Allocation Theory

From the modification described above, a new household economics, known as the time allocation theory, emerged. Time activities were now divided into the following categories: 1) market production, 2) home production, 3) leisure, and 4) investment for human-capital formation. Category 1 includes time spent in paid labor. Category 2 includes tasks performed at home, such as child care, cooking, washing, and even unpaid work on the family farm. Category 3 covers recreational activities, such as radio listening, television viewing, playing sports, and sleeping. Category 4 includes time spent in school and studying at home. Based on this theory, the household objective is to maximize its utility function, expressed as the following:

(A.1) $U = U(Z_i, Q_k, T_{Lh}, T_{Ih}, T_{Mh})$ $i = 1, ..., m$ $k = 1, ..., o$ $h = 1, 2$

where Z_i = vector of non-traded goods produced by household
Q_k = vector of market goods and services purchased by household
T_{Hh} = home production time spent by h^{th} household member
T_{Lh} = leisure time spent by h^{th} household member
T_{Ih} = human capital formation time spent by h^{th} household member
T_{Mh} = market labor time supplied by h^{th} household member
m = number of non-traded Z-commodities
o = number of market goods and services purchased by household
h = 1 for children, 2 for adults
$\delta \tilde{U} \delta Z > 0$, $\delta \tilde{U} \delta Q > 0$, $\delta \tilde{U} \delta T_{Lh} > 0$ for all h, $\delta \tilde{U} \delta T_{Ih} > 0$ for all h,
$\delta \tilde{U} \delta T_{Mh} > 0$ for all h

subject to the following constraints: production function of the Z-commodities

(A.2) $Z_i = Z(X_{j,} T_{Hh})$ $j = 1,2, \ldots, n$

where X_j = vector of market inputs used to produce Z-commodity
T_{Hh} = vector of home production time spent by h^{th} household member
n = number of market inputs used to produce Z-commodity
$\delta\tilde{Z}\delta X_j > 0$ for all j, $\delta\tilde{Z}\delta T_{Hh} > 0$ for all h

and the full-income constraint is

(A.3) $P_{Qk}.Q_k + \sum P_{Xj}.X_j + \sum \pi_i.Z_i + \sum W_h.(T_{Lh} + T_{Hh} + T_{Ih}) = Y$

where $Y = \sum W_h.T_{Mh} + V$
P_Q = Price of market goods and services purchased by household
P_x = Price of market inputs used to produce Z-commodity
W_h = wage rate of h^{th} household member
T_h = total time endowment of h^{th} household member
$= T_{Mh} + T_{Hh} + T_{Lh} + T_{Ih}$
V = nonwage income

Gronau (1973) derived a shadow price for Z-commodities (weighted value of price of market inputs and market wages to produce the non-marketed commodity). The full-income constraint shows that the value of market labor and nonwage income of the household must equal the summation of the value of goods, services, and inputs purchased in the market, value of non-traded Z-commodities produced by the household, and foregone earnings or value of home production and leisure time spent by household members.

Assuming an interior solution, the first-order conditions for utility maximization, given the production and income constraints, are

(A.4a) $U_Q = \lambda P_Q$
(A.4b) $U_Z = \lambda\pi$
(A.4c) $U_Z Z_x = \lambda P_x$
(A.4d) $U_{TMh} = \lambda W_h$
(A.4e) $U_Z Z_{THh} = \lambda W_h$
(A.4f) $U_{TLh} = \lambda W_h$
(A.4g) $U_{TIh} = \lambda W_h$
(A.4h) $\sum P_{Qk}.Q_k + \sum P_{Xj}.X_j + \sum \pi_i.Z_i + \sum W_h.(T_{Lh} + T_{Hh} + T_{Ih}) = Y$

where λ represents the marginal utility of income. Equations A.4a-A.4h give the optimal solution for the uncompensated demand for market goods and inputs, Z-commodities, uncompensated demand for market, home production, leisure, and investment time on capital formation of household members, respectively. The indirect utility function can then be derived, given as

(A.5) $\upsilon (Y, \pi_i, P_{Qk}, P_{Xj,} W_h) = \upsilon [Q^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$X^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$Z^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$T_{Mh}^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$T_{Hh}^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$T_{Lh}^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h),$
$T_{Ih}^* (Y, \pi_i, P_{Qk}, P_{Xj,} W_h)]$
$= \max U[Z_i((X_{j,} T_{Hh}), Q_k, T_{Lh}, T_{Ih}, T_{Mh})]$

For purposes of this study, the relevant equations to be estimated are expressed as

(A.6) $T_{Hh}^* = f (Y, \pi_i, P_{Qk}, P_{Xj,} W_h, S_h, D_h, EL_h, E_h)$
$T_{Lh}^* = f (Y, \pi_i, P_{Qk}, P_{Xj,} W_h, S_h, D_h, EL_h, E_h)$
$T_{Ih}^* = f (Y, \pi_i, P_{Qk}, P_{Xj,} W_h, S_h, D_h, EL_h, E_h)$
$X^* = f (Y, \pi_i, P_{Qk}, P_{Xj,} W_h, S_h, D_h, EL_h, E_h)$

where S_h = vector of socioeconomic characteristics of the h^{th} household member
D_h = vector of demographic variables faced by the h^{th} household
EL_h = service provided by electrification for the h^{th} household
E_h = vector of other energy sources used by the h^{th} household

where $\delta T_{Lk}/\delta EL > 0$, $\delta T_{Ik}/\delta EL > 0$, while $\delta T_{Hk}/\delta EL < 0$.

APPENDIX B: RESEARCH METHODOLOGY

Survey Design and instruments

Data from a sample of 2,000 households serviced by four RECs in four respective provinces of Luzon, Philippines were collected for this study during June and July of 1998. Using a two-stage sampling design, the four RECs were chosen through purposive sampling, mainly because of cost constraints. The criteria for their selection were: a) operational performance rating and b) proportion of connected households in the service area. The NEA determined the performance rating criteria of the RECs, and regularly monitored them (NEA 1994).

The NEA rating criteria were as follows:

- *Amortization payment*—ability to fulfill loan obligations to the NEA in terms of payment of amortizations due
- *Systems loss*—technical systems loss beyond the tolerable level of 12%, which may be attributed to pilferages and inadequate line maintenance
- *Collection efficiency*—capability of RECs to collect consumer accounts receivable on time
- *Payment to power supplier*—ability to promptly pay for power purchased from the NPC
- *Non-power cost*—ability to confine non-power expenditures within the limits set by the NEA-approved budget in relation to collections
- *Cash advances to officers and employees*—demerit points to discourage RECs from granting excessive cash advances to officers and employees and to encourage them to strictly effect immediate liquidation of the same

REC performance is rated annually, based on the above criteria (Table B1):

Table B1. Performance Ratings of RECs

Score	*Category*	*Rating description*
90 or above	A+	Outstanding
75-89	A	Very satisfactory
65-74	B	Satisfactory
55-64	C	Fair
30-54	D	Poor
29 or below	E	*

Table B2 provides performance ratings for and other pertinent information on the four RECs selected for the study.

Table B2: Performance Ratings of the Sample RECs

REC	*Region*	*Province*	*Performance rating (1995)*	*HHs connected (%) (1996)*	*Load factor* (%) (1995)*
BATELEC I	Southern Tagalog (IV)	Batangas	A	92	53
MOPRECO	Cordillera Autonomous Region (CAR)	Mountain Province	B	47	30
CASURECO I	Bicol (V)	Camarines Sur	C	58	42
NEECO II North	Central Luzon (III)	Nueva Ecija	D	68	55

Note: REC = rural electric cooperative, HHs = households.
*Load factor refers to the proportion of total generating capacity used by the REC.

Selection of the barangays for the sampling frame was based on the NEA's complete list of municipalities and barangays within each REC service area. Some barangays were excluded because a) local authorities considered that the presence of rebel groups made them unsafe, b) transportation to reach them was poor, or c) their long distance from the survey base made it impossible to complete the field survey within the targeted time. For each of the four RECs, 20 barangays were chosen; the number with and without electricity was based on the proportion of electrified and non-electrified barangays serviced by the REC. For example, if 90% of a barangay had electricity service, then 18 of the 20 sampled (90%) were electrified and 2 (10%) were non-electrified.

The next step was to select 25 households per sample barangay, using systematic sampling with a random start. The sampling frame used was the complete household listing in each barangay, based on the 1990 census of population and households conducted by the National Statistical Office (NSO 1995). Table B3 shows the distribution of sample households by province and electrification status.

Household and barangay survey questionnaires were developed and used for data collection (Appendix D). The household questionnaire was pre-tested in Rizal (20 households in Binangonan and 10 households in Baras) to identify areas needing modification prior to the field survey. A manual of instructions was prepared with guidelines on how to approach a sample household, choose an alternate household in case of refusal, and other survey-related matters, including data coding and field editing. All survey instruments originated in English and were translated into the vernacular used in each survey area. The barangay survey was undertaken to obtain information on local socioeconomics and infrastructure (e.g., condition of roads, availability of education and health facilities, status of garbage disposal systems).

In addition to the household and barangay surveys, focus-group interviews were conducted to elicit detailed, qualitative information on benefits gained from electrification. Composition of the focus groups was determined by pre-selected criteria, including income, age, and electrification status.

Table B3: Distribution of Sample Households, by Province and Electrification Status, 1998

	Household electrification status (%)			
	NE		*E*	
Province	*No.*	*%*	*No.*	*%*
Mountain Province	166	33.2	334	66.8
Nueva Ecija	105	21.0	395	79.0
Batangas	29	5.8	471	94.2
Camarines Sur	232	46.4	268	53.6
Total	532	26.6	1,468	73.4

NE = non-electrified, E = electrified.

Empirical Methodology

Time-use Equation. When the ordinary least squares method is used to estimate the reduced form equation given in Equation A.5 (Appendix A), the coefficient estimates may be biased if they only include observations of individuals who report positive values of the dependent variable (time spent on leisure, home production, or human capital investment) or if all observations are included in the estimation process (Heckman 1979). On the other hand, estimates of the regression parameters may be biased if all observations are included, since the dependent variable is censored at zero. To account for zero censoring in the dependent variable, the Tobit method was used to obtain the regression estimates (Maddala 1993).

However, this method requires that the parameters that determine the decision to participate in a particular time activity be similar to those that determine the hours allocated to that activity by those who participate. If this condition is not satisfied, the Tobit estimators may be biased (Cragg 1971; Lin and Schmidt 1984). For example, if the Tobit method is used to estimate the equation for time spent reading or studying as the dependent variable, then individuals' decision about whether to read is based on the same factors that determine the number of hours spent reading if the individual decides to do so. However, this may not always be true for all persons. The presence of electricity may not be a major factor in deciding whether to read or study; however, once a person decides to read or study, electricity allows the person to spend more time doing so.

Since zero censoring in the dependent variable for the time-use equation is common, the Tobit restriction is tested, based on the method suggested by Cragg. If rejected, then Heckman's two-step estimation procedure is used to control for sample-selection bias. The first step is to estimate an equation by maximum likelihood probit method using all observations, where the dependent variable is a binary variable that equals 1 if the individual reports positive hours in the activity and 0 if otherwise. The value of the Inverse Mills Ratio is then constructed from the estimated results of the participation equation for each observation. In the second step, the Inverse Mills Ratio is included as an independent variable in the relevant time-use equation, estimated using the ordinary least squares method; however, only observations in which the reported value of the dependent variable is positive are included. Including the Inverse Mills Ratio in the second step eliminates any bias caused by sample selection. Moreover, the coefficient of this variable provides a consistent estimate of the covariance between unmeasured variables in the participation and time-use equations. The Newey-West method is used to correct for the presence of heteroskedasticity and serial correlation of error terms of equations estimated by the least squares method (Newey and West 1987).

Imputation of Missing Wages and Prices. Labor wage is an independent variable used for all reduced-form equations. Unfortunately, individuals who were unemployed during the survey period did not report any wage. Since labor wages are used to measure the opportunity cost of their time, the two-step Heckman procedure is used to impute labor wages of unemployed individuals. The first stage involves estimating a labor participation equation with a binary dependent variable (equal to 1 if employed and 0 if not employed). The Inverse Mills Ratio computed in the first stage is then used as an independent variable in the second stage, along with other variables, with non-zero labor wage as the dependent variable.

Prices of goods and services, as well as market inputs to produce the Z-commodities, are also included as independent variables in all time-use, reduced form equations. If the household reported zero consumption during the time of the survey, then the prevailing price of the good, service, or market input during the time of the survey (like labor wages) would not be reported. Since this study focuses on the reduced form equations for time use, the prices included in the model are assumed to be equilibrium market prices—the prices consumers are willing to pay for goods, services, or inputs and the prices at which producers are willing to sell their products. Missing values for prices are thus replaced with barangay- or municipality-level averages.

APPENDIX C: SURVEY TABLES FOR THE FOUR PROVINCES

Table C1: Average Household Size and Monthly Income

Household characteristic	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Household size (no. members)	4	5	5	5	5
Valid N	500	500	500	500	2,000
Access to electricity					
No	2,354.95	8,144.86	2,912.07	2,499.20	3,934.92
(Valid N)	N=185	N=161	N=33	N=245	N=624
Yes	6,623.29	11,079.20	6,927.95	5,674.39	7,652.87
(Valid N)	N=306	N=338	N=467	N=255	N=1366
Total household income/mo.	5,015.05	10,132.45	6,662.90	4,118.55	6,487.04
Valid N	491	499	500	500	1990

Table C2: Total Households (No. and %), by Income Quintile

Income quintile (P/mo.)	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*All provinces*	
	No.	%	No.	%	No.	%	No.	%	No.	%
< 833.33	213	43	23	5	59	12	96	19	391	20
833.33-2,625.00	70	14	75	15	96	19	163	33	404	20
2,625.01-4,979.67	64	13	103	21	110	22	115	23	392	20
4,979.68-9,878.33	64	13	131	26	133	27	76	15	404	20
> 9,878.33	80	16	167	34	102	20	50	10	399	20
All households	491	100	499	100	500	100	500	100	1,990	100

Table C3. Main Type of Dwelling Unit, by % of Households

Construction materials	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Wood	75	10	16	29	32
Hollow brick	2	43	45	13	26
Bamboo/sawali/cogun/nipa	2	29	13	35	20
Makeshift/salvaged/improvised	0	1	0	2	1
Half concrete/brick/stone and wood	14	17	26	20	19
Other	8	0	0	0	2
All households (500 per province)	100	100	100	100	100

Table C4: Sources of Drinking Water, by % of Households

Drinking-water source	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Springs/rivers/lakes					
No	64	100	99	77	84
Yes	36	0	1	23	17
Total (Valid N)	499	397	380	451	1,727
Dug wells					
No	97	100	95	90	95
Yes	3	0	5	10	5
Total (Valid N)	498	397	390	452	1,737
Tubed/piped wells					
No	98	1	36	80	54
Yes	2	99	64	20	46
Total (Valid N)	497	497	434	455	1,883
Village/barangay/municipal system					
No	32	96	52	70	61
Yes	69	5	48	30	39
Total (Valid N)	499	401	436	453	1,789
Vendors/peddlers					
No	98	100	98	90	96
Yes	2	0	2	10	4
Total (Valid N)	498	397	380	474	1,749
Other systems					
No	100	100	99	73	93
Yes	0	0	1	27	7
Total (Valid N)	496	396	355	414	1,661
Time spent collecting (minutes)	9.7	7.3	9.7	10.2	9.2
Total (Valid N)	500	477	451	471	1,899

Table C5: Total Households with Home Business Activities, % and Number

Household business characteristic	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Have business in home (%)					
No	89	88	79	79	84
Yes	11.2	12.2	20.6	20.6	16.3
Total (Valid N)	475	370	447	475	1,767
Type of home business (%)					
Hairdresser/barber	--	3	1	2	2
Tailor/dressmaker	--	--	16	3	6
Laundry	--	--	3	--	0.8
Carpentry	2	--	--	--	0.4
Food stand/restaurant	6	--	4	1	3
Goldsmith/silversmith	4	--	3	--	2
Video/movie rental	--	--	1	--	0.4
Sari-sari store	61	92	55	62	64
Other, specify:	28	5	17	31	23
Total households with business (Valid N)	51	38	76	93	258

Table C6: Number and % of Households Engaged in Business Activities, by Electricity Access

Home-business status	*Access to electricity*				*Total*	
	No		*Yes*			
	No.	%	No.	%	No.	%
No	520	93	959	79	1,479	84
Yes	39	7	249	21	288	16
Total	559	100	1,208	100	1,767	100

Table C7: Type of Energy Used for Lighting and Access to Electricity

Energy source status for all households	*Mountain Province*		*Nueva Ecija*		*Batangas*		*Camarines Sur*		*All provinces*	
	No.	%	No.	%	No.	%	No.	%	No.	%
Candles										
No	294	59	408	82	264	53	328	66	1,294	65
Yes	206	41	92	18	236	47	172	34	706	35
Kerosene										
No	203	41	110	22	234	47	112	22	659	33
Yes	297	59	390	78	266	53	388	78	1,341	67
Dry-cell battery										
No	145	29	412	82	284	57	200	40	1,041	52
Yes	355	71	88	18	216	43	300	60	959	48
Car battery										
No	498	100	437	87	496	99	494	99	1925	96
Yes	2	0.4	63	13	4	1	6	1	75	4
Access to electricity										
No	194	38.8	162	32.4	33	6.6	245	49	634	31.7
Yes	306	61.2	338	67.6	467	93.4	255	51	1,366	68.3

Table C8: Type of Energy Used for Lighting and Access to Electricity, % and Number of Households, by Income Class

Energy source	*Income quintile (P per mo.)*										*All income classes*	
	< 833.33		*833.33-2,625.00*		*2,625.01-4,979.67*		*4,979.68-9,878.33*		*> 9,878.33*			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Candles												
No	288	74	279	69	253	65	235	58	229	57	1,284	65
Yes	103	26	125	31	139	36	169	42	170	43	706	36
Kerosene												
No	92	24	104	26	108	28	159	39	187	47	650	33
Yes	299	77	300	74	284	72	245	61	212	53	1,340	67
Dry-cell battery												
No	191	49	198	49	204	52	230	57	208	52	1,031	52
Yes	200	51	206	51	188	48	174	43	191	48	959	48
Car battery												
No	386	99	395	98	373	95	385	95	376	94	1,915	96
Yes	5	1	9	2	19	5	19	5	23	6	75	4
Electricity access												
No	210	54	166	41	116	30	74	18	58	15	624	31
Yes	181	46	238	59	276	70	330	82	341	86	1,366	69

Table C9: Percent of Households Using Candles, by Province and Income Class

Income class (quintile) use of candles (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 P/mo.					
No	78	100	59	68	74
Yes	23	0	41	32	26
All households (Valid N)	213	23	59	96	391
833.33-2,625.00 P/mo.					
No	57	89	56	72	69
Yes	43	11	44	28	31
All households (Valid N)	70	75	96	163	404
2,625.01-4,979.67 P/mo.					
No	53	85	47	69	65
Yes	47	15	53	31	36
All households (Valid N)	64	103	110	115	392
4,979.68-9,878.33 P/mo.					
No	36	77	47	63	58
Yes	64	23	53	37	42
All households (Valid N)	64	131	133	76	404
> 9,878.33 P/mo.					
No	29	77	59	36	57
Yes	71	23	41	64	43
All households (Valid N)	80	167	102	50	399
Use status (all income classes)					
No	58	82	53	66	65
Yes	42	18	47	34	35

Table C10: Percent of Households Using Kerosene, by Province and Income Class

Income class (quintile) use of kerosene (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 P/mo.					
No	24	13	41	15	24
Yes	76	87	59	85	77
All households (Valid N)	213	23	59	96	391
833.33-2,625.00 P/mo.					
No	37	16	41	17	26
Yes	63	84	59	83	74
All households (Valid N)	70	75	96	163	404
2,625.01-4,979.67 P/mo.					
No	41	14	46	15	28
Yes	59	86	54	85	72
All households (Valid N)	64	103	110	115	392
4,979.68-9,878.33 P/mo.					
No	59	23	50	33	39
Yes	41	77	50	67	61
All households (Valid N)	64	131	133	76	404
> 9,878.33 P/mo.					
No	66	31	53	58	47
Yes	34	70	47	42	53
All households (Valid N)	80	167	102	50	399
Use status (all income classes)					
No	40	22	47	22	33
Yes	60	78	53	78	67

Table C11: Percent of Households Using Dry-cell Battery, by Province and Income

Income class (quintile) use of Dry-cell batteries (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All Provinces*
< 833.33 P/mo.					
No	46	83	58	42	49
Yes	54	17	42	58	51
All households (Valid N)	213	23	59	96	391
833.33-2,625.00 P/mo.					
No	20	85	59	39	49
Yes	80	15	41	61	51
All households (Valid N)	70	75	96	163	404
2,625.01-4,979.67 P/mo.					
No	16	85	53	43	52
Yes	84	16	47	57	48
All households (Valid N)	64	103	110	115	392
4,979.68-9,878.33 P/mo.					
No	9	86	62	38	57
Yes	91	15	38	62	43
All households (Valid N)	64	131	133	76	404
> 9,878.33 P/mo.					
No	10	77	51	38	52
Yes	90	23	49	62	48
All households (Valid N)	80	167	102	50	399
Use status (all income classes)					
No	72	18	43	60	48
Yes	28	82	57	40	52

Table C12: Percent of Households Using Car Battery, by Province and Income Class

Income class (quintile) use of car battery (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 P/mo.					
No	100	91	97	99	99
Yes	0.00	9	3	1	1.3
All households (Valid N)	213	23	59	96	391
833.33-2,625.00 P/mo.					
No	100	91	100	99	98
Yes	0.00	9.30	0.00	1.20	2.20
All households (Valid N)	70	75	96	163	404
2,625.01-4,979.67 P/mo.					
No	100	85	99	98	95
Yes	0	16	1	2	5
All households (Valid N)	64	103	110	115	392
4,979.68-9,878.33 P/mo.					
No	98	87	100	99	95
Yes	2	13	0	1	5
All households (Valid N)	64	131	133	76	404
> 9,878.33 P/mo.					
No	99	87	99	100	94
Yes	1	13	1	0	6
All households (Valid N)	80	167	102	50	399
Use status (all income classes)					
No	100	87	99	99	96
Yes	0	13	1	1	4

Table C13: Percent of Households with Electricity Access, by Income Class

Income class (quintile) with electricity access (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 P/mo.					
No	58	57	12	71	54
Yes	42	44	88	29	46
All households (Valid N)	213	23	59	96	391
833.33-2,625.00 P/mo.					
No	37	48	13	58	42
Yes	63	52	88	42	58
All households (Valid N)	70	75	96	163	404
2,625.01-4,979.67 P/mo.					
No	19	39	11	50	31
Yes	81	61	89	50	69
All households (Valid N)	64	103	110	115	392
4,979.68-9,878.33 P/mo.					
No	23	27	2	33	19
Yes	77	73	99	67	81
All households (Valid N)	64	131	133	76	404
> 9,878.33 P/mo.					
No	15	23	4	12	15
Yes	85	77	96	88	85
All households (Valid N)	80	167	102	50	399
Use status (all income classes)					
No	38	32	7	50	32
Yes	62	68	93	50	68

Table C14: Household Average Monthly Spending on Lighting Energy and Electricity (users only)

Energy source (P/mo.)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All Provinces*
Candles					
No access to electricity	28.33	19.24	7.8	6.1	11.43
(Valid N)	N=13	N=14	N=10	N=55	N=92
Access to electricity	15.59	15.73	7.3	9.23	11.25
(Valid N)	N=165	N=71	N=204	N=112	N=552
All households	16.52	16.31	7.32	8.2	11.28
(Valid N)	N=178	N=85	N=214	N=167	N=644
Kerosene					
No access to electricity	29.69	69.41	66.19	71.17	58.17
(Valid N)	N=174	N=148	N=28	N=236	N=586
Access to electricity	20.51	42.85	36.68	55.31	39.9
(Valid N)	N=117	N=234	N=228	N=150	N=729
All households	26	53.14	39.9	65.01	48.04
(Valid N)	N=291	N=382	N=256	N=386	N=1,315
Dry-cell battery					
No access to electricity	73.04	43.19	58.27	50.8	57.76
(Valid N)	N=111	N=40	N=11	N=161	N=323
Access to electricity	42.54	35.85	26.95	30.03	34.53
(Valid N)	N=234	N=47	N=180	N=127	N=588
All households	52.36	39.22	28.76	41.64	42.77
(Valid N)	N=345	N=87	N=191	N=288	N=911
Car battery					
No access to electricity	0	397.02	249.75	310.13	383.13
(Valid N)	N=0	N=56	N=2	N=7	N=65
Access to electricity	169.17	144.7	280	0	167.52
(Valid N)	N=1	N=5	N=1	N=0	N=7
All households	169.17	376.34	259.83	310.13	362.17
(Valid N)	N=1	N=61	N=3	N=7	N=72
Electricity	107.21	207.93	320.13	237.77	228.21
(Valid N)	N=287	N=318	N=427	N=201	N=1,233
Total spending for all energy and electricity					
No access to electricity	75.79	225.51	99.09	113.09	129.65
(Valid N)	N=180	N=153	N=31	N=243	N=607
Access to electricity	150.87	239.99	330.46	241.81	251.04
(Valid N)	N=304	N=332	N=459	N=252	N=1,347
All Households	122.95	235.42	315.82	178.62	213.33
(Valid N)	N=484	N=485	N=490	N=495	N=1,954

Table C15: Household Average Monthly Spending on Lighting Energy and Electricity

Energy source (P/mo.)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Candles					
No access to electricity	1.9	1.66	2.36	1.37	1.66
(Valid N)	N=194	N=162	N=33	N=245	N=634
Access to electricity	8.41	3.3	3.19	4.05	4.55
(Valid N)	N=306	N=338	N=467	N=255	N=1366
All households	5.88	2.77	3.13	2.74	3.63
(Valid N)	N=500	N=500	N=500	N=500	N=2,000
Kerosene					
No access to electricity	26.63	63.41	56.16	68.55	53.76
(Valid N)	N=194	N=162	N=33	N=245	N=634
Access to electricity	7.84	29.67	17.91	32.54	21.29
(Valid N)	N=306	N=338	N=467	N=255	N=1366
All households	15.13	40.6	20.43	50.18	31.59
(Valid N)	N=500	N=500	N=500	N=500	N=2,000
Dry-cell battery					
No access to electricity	41.79	10.66	19.42	33.38	29.42
(Valid N)	N=194	N=162	N=33	N=245	N=634
Access to electricity	32.53	4.99	10.39	14.95	14.86
(Valid N)	N=306	N=338	N=467	N=255	N=1366
All households	36.13	6.82	10.98	23.98	19.48
(Valid N)	N=500	N=500	N=500	N=500	N=2,000
Car battery					
No access to electricity	0	137.24	15.14	8.86	39.28
(Valid N)	N=194	N=162	N=33	N=245	N=634
Access to electricity	0.55	2.14	0.6	0	0.86
(Valid N)	N=306	N=338	N=467	N=255	N=1366
All households	0.34	45.91	1.56	4.34	13.04
(Valid N)	N=500	N=500	N=500	N=500	N=2,000
Monthly expenditures on electricity	61.54	132.25	273.4	95.58	140.69
(Valid N)	N=500	N=500	N=500	N=500	N=2,000
Total spending on energy and electricity					
No access to electricity	70.32	212.98	93.08	112.17	124.13
(Valid N)	N=194	N=162	N=33	N=245	N=634
Access to electricity	149.88	235.73	324.8	238.96	247.55
(Valid N)	N=306	N=338	N=467	N=255	N=1,366
All households	119.01	228.36	309.5	176.83	208.43
(Valid N)	N=500	N=500	N=500	N=500	N=2,000

Table C16: Household Average Monthly Spending on Lighting Energy and Electricity (users only)

Energy source	*Income class (quintile), P/mo.*					*All income classes*
	< 833.33	833.33-2,625.00	2,625.01-4,979.67	4,979.68-9,878.33	> 9,878.33	
Candle (Valid N)	9.09 N=82	9.58 N=119	9.35 N=125	10.95 N=159	15.51 N=159	11.28 N=644
Kerosene (Valid N)	42.21 N=292	56.36 N=296	49.1 N=280	52.49 N=239	37.84 N=208	48.04 N=1,315
Dry-cell battery (Valid N)	43.32 N=190	39.46 N=196	37.76 N=177	46.7 N=166	47.03 N=182	42.77 N=911
Car battery (Valid N)	323.07 N=5	362.93 N=9	396.27 N=18	367.16 N=17	340.01 N=23	362.17 N=72
Electricity (Valid N)	116.33 N=158	222.86 N=206	184.56 N=247	229.23 N=305	320.47 N=317	228.21 N=1,233
Total spending on energy and electricity (Valid N)	108.11 N=382	185.90 N=402	193.54 N=384	247.34 N=397	329.84 N=389	213.33 N=1,954

Table C17: Household Average Monthly Spending on Lighting Energy and Electricity (all households)

Energy source	*Income class (quintile), P/mo.*					*All income classes*
	< 833.33	833.33-2,625.00	2,625.01-4,979.67	4,979.68-9,878.33	> 9,878.33	
Candle (Valid N)	1.91 N=391	2.82 N=404	2.98 N=392	4.31 N=404	6.18 N=399	3.65 N=1,990
Kerosene (Valid N)	31.52 N=391	41.29 N=404	35.07 N=392	31.05 N=404	19.73 N=399	31.75 N=1,990
Dry-cell battery) (Valid N)	21.05 N=391	19.15 N=404	17.05 N=392	19.19 N=404	21.45 N=399	19.58 N=1,990
Car battery (Valid N)	4.13 N=391	8.08 N=404	18.2 N=392	15.45 N=404	19.6 N=399	13.1 N=1,990
Electricity (Valid N)	47.01 N=391	113.64 N=404	116.29 N=392	173.06 N=404	254.61 N=399	141.40 N=1,990
Total spending on energy and electricity (Valid N)	105.62 N=391	184.98 N=404	189.59 N=392	243.06 N=404	321.57 N=399	209.47 N=1,990

Table C18: Household Monthly Spending on Candles (users only)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All households*
< 833.33	15.32	---	4.87	5.99	9.09
(Valid N)	N=30	N=0	N=23	N=29	N=82
833.33-2,625.00	16.63	11.25	7.66	6.91	9.58
(Valid N)	N=26	N=8	N=40	N=45	N=119
2,625.01-4,979.67	11.48	18.09	6.97	7.25	9.35
(Valid N)	N=27	N=15	N=49	N=34	N=125
4,979.68-9,878.33	15.71	12.96	7.44	10.04	10.95
(Valid N)	N=40	N=28	N=63	N=28	N=159
> 9,878.33	20.18	19.47	8.67	11.5	15.51
(Valid N)	N=55	N=34	N=39	N=31	N=159
Group total	16.52	16.31	7.32	8.2	11.28
Valid N	N=178	N=85	N=214	N=167	N=644

Table C19: Household Monthly Spending on Candles (all households)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33	2.16	0	1.9	1.81	1.91
(Valid N)	N=213	N=23	N=59	N=96	N=391
833.33-2,625.00	6.18	1.2	3.19	1.91	2.82
(Valid N)	N=70	N=75	N=96	N=163	N=404
2,625.01-4,979.67	4.84	2.63	3.1	2.14	2.98
(Valid N)	N=64	N=103	N=110	N=115	N=392
4,979.68-9,878.33	9.82	2.77	3.53	3.7	4.31
(Valid N)	N=64	N=131	N=133	N=76	N=404
> 9,878.33	13.87	3.96	3.31	7.13	6.18
(Valid N)	N=80	N=167	N=102	N=50	N=399
Group total	5.99	2.78	3.13	2.74	3.65
Valid N	N=491	N=499	N=500	N=500	N=1,990

Table C20: Household Monthly Spending on Dry-cell Batteries (users only)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33	44.2	66.67	29.57	45.53	43.32
(Valid N)	N=112	N=3	N=21	N=54	N=190
833.33-2,625.00	45.36	36.83	26.65	41.16	39.46
(Valid N)	N=53	N=11	N=35	N=97	N=196
2,625.01-4,979.67	47.15	27.91	30.58	37.38	37.76
(Valid N)	N=53	N=16	N=44	N=64	N=177
4,979.68-9,878.33	64.99	40.81	25.57	49.41	46.7
(Valid N)	N=56	N=18	N=49	N=43	N=166
> 9,878.33	64.37	41.7	31.9	34.13	47.03
(Valid N)	N=71	N=39	N=42	N=30	N=182
Group total	52.36	39.22	28.76	41.64	42.77
Valid N	N=345	N=87	N=191	N=288	N=911

Table C21: Household Monthly Spending on Dry-cell Batteries (all households)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33	23.24	8.70	10.53	25.61	21.05
(Valid N)	N=213	N=23	N=59	N=96	N=391
833.33-2,625.00	34.34	5.40	9.72	24.50	19.15
(Valid N)	N=70	N=75	N=96	N=163	N=404
2,625.01-4,979.67	39.05	4.33	12.23	20.80	17.05
(Valid N)	N=64	N=103	N=110	N=115	N=392
4,979.68-9,878.33	56.87	5.61	9.42	27.95	19.19
(Valid N)	N=64	N=131	N=133	N=76	N=404
> 9,878.33	57.13	9.74	13.14	20.48	21.45
(Valid N)	N=80	N=167	N=102	N=50	N=399
Group total	36.79	6.84	10.98	23.98	19.58
Valid N	N=491	N=499	N=500	N=500	N=1,990

Table C22: Household Monthly Spending on Car Batteries (users only)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33	--	465.63	249.75	184.58	323.07
(Valid N)	N=0	N=2	N=2	N=1	N=5
833.33-2,625.00	--.	363.07	--.	362.42	362.93
(Valid N)	N=0	N=7	N=0	N=2	N=9
2,625.01-4,979.67	--.	400.62	280	421.75	396.27
(Valid N)	N=0	N=15	N=1	N=2	N=18
4,979.68-9,878.33	--.	380.63	--.	151.67	367.16
(Valid N)	N=0	N=16	N=0	N=1	N=17
> 9,878.33	169.17	351.65	--.	266.33	340.01
(Valid N)	N=1	N=21	N=0	N=1	N=23
Group total	169.17	376.34	259.83	310.13	362.17
Valid N	N=1	N=61	N=3	N=7	N=72

Table C23: Household Monthly Spending on Car Batteries (all households)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 (Valid N)	0 N=213	40.49 N=23	8.47 N=59	1.92 N=96	4.13 N=391
833.33-2,625.00 (Valid N)	0 N=70	33.89 N=75	0 N=96	4.45 N=163	8.08 N=404
2,625.01-4,979.67 (Valid N)	0 N=64	58.34 N=103	2.55 N=110	7.33 N=115	18.2 N=392
4,979.68-9,878.33 (Valid N)	0 N=64	46.49 N=131	0 N=133	2 N=76	15.45 N=404
> 9,878.33 (Valid N)	2.11 N=80	44.22 N=167	0 N=102	5.33 N=50	19.6 N=399
Group total Valid N	0.34 N=491	46.01 N=499	1.56 N=500	4.34 N=500	13.1 N=1,990

Table C24: Household Monthly Spending on Electricity (users only)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 (Valid N)	71.11 N=83	107.74 N=10	186.56 N=47	146.24 N=18	116.33 N=158
833.33-2,625.00 (Valid N)	79.03 N=41	133.63 N=39	337.51 N=74	240.03 N=52	222.86 N=206
2,625.01-4,979.67 (Valid N)	96.51 N=48	155.41 N=60	251.68 N=89	184.58 N=50	184.56 N=247
4,979.68-9,878.33 (Valid N)	111.49 N=51	193 N=90	311.26 N=121	213.91 N=43	229.23 N=305
> 9,878.33 (Valid N)	176.67 N=64	278.48 N=119	446.79 N=96	375.03 N=38	320.47 N=317
Group total Valid N	107.21 N=287	207.93 N=318	320.13 N=427	237.77 N=201	228.21 N=1,233

Table C25: Household Monthly Spending on Electricity (all households)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 (Valid N)	27.71 N=213	46.84 N=23	148.62 N=59	27.42 N=96	47.01 N=391
833.33-2,625.00 (Valid N)	46.29 N=70	69.49 N=75	260.16 N=96	76.57 N=163	113.64 N=404
2,625.01-4,979.67 (Valid N)	72.38 N=64	90.53 N=103	203.64 N=110	80.25 N=115	116.29 N=392
4,979.68-9,878.33 (Valid N)	88.85 N=64	132.59 N=131	283.17 N=133	121.03 N=76	173.06 N=404
> 9,878.33 (Valid N)	141.34 N=80	198.44 N=167	420.51 N=102	285.03 N=50	254.61 N=399
Group total Valid N	62.66 N=491	132.51 N=499	273.4 N=500	95.58 N=500	141.4 N=1,990

Table C26: Total Household Spending per Month on Lighting Energy and Electricity (by province)

Income class (quintile), P/mo.	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33 (Valid N)	73.3 N=213	144.16 N=23	201.17 N=59	109.38 N=96	105.62 N=391
833.33-2,625.00 (Valid N)	107.25 N=70	159.69 N=75	299.43 N=96	162.59 N=163	184.98 N=404
2,625.01-4,979.67 (Valid N)	128.16 N=64	204.89 N=103	242.05 N=110	159.9 N=115	189.59 N=392
4,979.68-9,878.33 (Valid N)	160.68 N=64	229.68 N=131	312.52 N=133	213.93 N=76	243.06 N=404
> 9,878.33 (Valid N)	223.74 N=80	285.59 N=167	450.46 N=102	335.34 N=50	321.57 N=399
Group total Valid N	121.19 N=491	228.81 N=499	309.5 N=500	176.83 N=500	209.47 N=1,990

Table C27: Total Household Spending per Month on Lighting Energy and Electricity (by income class)

Household expenditures (P/mo)	*Income class (quintile)*					*All income classes*
	< 833.33	833.33-2,625.00	2,625.04 4,979.67	4,979.68-9,878.33	> 9,878.33	
Electricity access status No (Valid N)	 79.99 N=210	 111.63 N=166	 139.44 N=116	 187.29 N=74	 229.88 N=58	 126.12 N=624
Yes (Valid N)	135.35 N=181	236.14 N=238	210.67 N=276	255.56 N=330	337.17 N=341	247.55 N=1,366
All households (Valid N)	105.62 N=391	184.98 N=404	189.59 N=392	243.06 N=404	321.57 N=399	209.47 N=1,990

Table C28: Comparison of Monthly Spending on Lighting Energy and Electricity

Household income class (quintile)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
< 833.33					
No (Valid N)	55.77 N=122	159.76 N=13	143.98 N=7	101.61 N=68	79.99 N=210
Yes (Valid N)	96.79 N=91	123.88 N=10	208.87 N=52	128.23 N=28	135.35 N=181
All households (Valid N)	73.3 N=213	144.16 N=23	201.17 N=59	109.38 N=96	105.62 N=391
833.33-2,625.00					
No (Valid N)	73.07 N=26	136.84 N=36	105.37 N=10	113.31 N=94	111.63 N=166
Yes (Valid N)	127.46 N=44	180.78 N=39	321.99 N=86	229.73 N=69	236.14 N=238
All households (Valid N)	107.25 N=70	159.69 N=75	299.43 N=96	162.59 N=163	184.98 N=404
2,625.01-4,979.67					
No (Valid N)	95.75 N=12	219.18 N=39	63.62 N=12	107.82 N=53	139.44 N=116
Yes (Valid N)	135.65 N=52	196.19 N=64	263.9 N=98	204.41 N=62	210.67 N=276
All households (Valid N)	128.16 N=64	204.89 N=103	242.05 N=110	159.9 N=115	189.59 N=392
4,979.68-9,878.33					
No (Valid N)	136.79 N=13	252.58 N=35	45.11 N=2	131.29 N=24	187.29 N=74
Yes (Valid N)	166.77 N=51	221.33 N=96	316.6 N=131	252.07 N=52	255.56 N=330
All households (Valid N)	160.68 N=64	229.68 N=131	312.52 N=133	213.93 N=76	243.06 N=404
No (Valid N)	167.57 N=12	266.09 N=38	78.25 N=2	175.7 N=6	229.88 N=58
Yes (Valid N)	233.66 N=68	291.34 N=129	457.91 N=100	357.11 N=44	337.17 N=341
All households (Valid N)	223.74 N=80	285.59 N=167	450.46 N=102	335.34 N=50	321.57 N=399
All income-classes households No (Valid N)	 70.32 N=194	 212.98 N=162	 93.08 N=33	 112.17 N=245	 124.13 N=634
Yes (Valid N)	149.88 N=306	235.73 N=338	324.80 N=467	238.96 N=255	247.55 N=1,366
All income-classes households (Valid N)	119.01 N=500	228.36 N=500	309.50 N=500	176.83 N=500	208.43 N=2,000

Table C29: Lighting Ownership and Use

Lighting factor	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
No. of incandescent bulbs	2.1	1.4	2.2	0.9	1.7
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total watts of incandescent lamps	77	63	87	39	66
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total hrs. used per day	2.6	2.5	3.9	1.9	2.7
(Valid N)	N=467	N=421	N=404	N=424	N=1716
No. of fluorescent tubes	0.2	0.8	1.2	0.7	0.7
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total watts of fluorescent tubes	4	17	30	16	17
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total hrs. used per day	0.4	2.2	3.8	2.2	2.1
(Valid N)	N=467	N=421	N=404	N=424	N=1716
No. of compact bulbs	0.5	0.1	0.3	0.2	0.3
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total watts of compact bulbs	9	1	6	3	5
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total hrs. used per day	0.8	0.1	0.9	0.3	0.5
(Valid N)	N=467	N=421	N=404	N=424	N=1716
Total no. of light bulbs/tubes	2.8	2.3	3.8	1.7	2.6
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total watts of lamps, tubes, and compact bulbs	90	80	123	57	87
(Valid N)	N=500	N=500	N=500	N=500	N=2000
Total hrs. used per day for all lamps	3.8	4.9	8.6	4.4	5.3
(Valid N)	N=467	N=421	N=404	N=424	N=1716

Note: Only bulbs and tubes used more than 30 minutes per day are included.

Table C30: Household Attitude

Questionnaire statement response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Having electricity in a household is important for children's education.					
Strongly agree	69	66	49	69	63
Agree	26	31	51	28	34
Neutral/no opinion	4	2	1	3	2
Disagree	1	0	0	0	0
Strongly disagree	0	0	0	0	0
Total (Valid N)	486	498	499	499	1,982
Television takes study time away from children.					
Strongly agree	27	41	22	21	28
Agree	52	48	66	47	53
Neutral/no opinion	15	6	9	22	13
Disagree	5	6	3	9	6
Strongly disagree	0.6	0.2		0.4	0.3
Total (Valid N)	483	499	495	499	1,976
With good lighting, children would study more at night.					
Strongly agree	40	55	32	36	41
Agree	54	38	62	55	52
Neutral/no opinion	5	4	5	7	6
Disagree	1	2	0.2	1	1
Strongly disagree	0.4	1	0.2	0.4	0.5
Total (Valid N)	484	496	498	497	1,975
My children study during the evening after it is dark outside.					
Strongly agree	6	43	21	14	21
Agree	43	39	54	54	48
Neutral/no opinion	21	10	18	19	17
Disagree	28	7	5	7	11
Strongly disagree	2	1	1	6	3
Total (Valid N)	470	458	479	493	1,900
My family feels very secure at night.					
Strongly agree	24	48	29	34	34
Agree	60	43	66	53	56
Neutral/no opinion	6	6	4	11	7
Disagree	9	3	1	2	3
Strongly disagree	1	0.0	0.4	0.2	0.5
Total (Valid N)	489	500	497	494	1,980

Table C30: ***(Continued)***

Questionnaire statement response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
My family is extremely happy with the light we get from our current fuel.					
Strongly agree	32	24	22	33	28
Agree	41	35	56	44	44
Neutral/no opinion	13	14	15	15	14
Disagree	13	26	6	7	13
Strongly disagree	0.4	0.4	2	1	1
Total (Valid N)	486	496	493	489	1,964
In my house, it is easy to read in the evening.					
Strongly agree	19	29	18	30	24
Agree	41	41	57	46	46
Neutral/no opinion	15	12	17	13	14
Disagree	23.0	17.6	7.5	8.1	14.0
Strongly disagree	3	0.4	1	2	2
Total (Valid N)	487	499	495	494	1,975
Lighting with kerosene can cause health problems.					
Strongly agree	21	29	16	18	21
Agree	40	49	68	34	48
Neutral/no opinion	20	10	10	35	19
Disagree	17	12	6	12	12
Strongly disagree	1	0.2	0.2	1	1
Total (Valid N)	483	500	497	497	1,977
Lighting with diesel fuel can cause health problems.					
Strongly agree	27	32	17	21	24
Agree	41	46	67	39	48
Neutral/no opinion	16	10	10	32	17
Disagree	12	11	5	7	9
Strongly disagree	5	0	0	2	2
Total (Valid N)	476	500	496	496	1,968
Reading is easier with electric lamps compared to kerosene lamps.					
Strongly agree	49	49	32	61	48
Agree	45	39	59	36	45
Neutral/no opinion	5	6	8	3	5
Disagree	1	4	2	1	2
Strongly disagree	0	1	0	0.2	0.4
Total (Valid N)	489	500	489	486	1,964

Table C30: ***(Continued)***

Questionnaire statement response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
It is difficult for my family to get news and information.					
Strongly agree	4	223	7	14	12
Agree	26	31	25	38	30
Neutral/no opinion	29	11	25	16	20
Disagree	39	33	42	26	35
Strongly disagree	2	2	1	6	3
Total (Valid N)	491	498	496	493	1,978
Watching TV provides my family with great entertainment.					
Strongly agree	9	37	16	30	23
Agree	37	44	69	53	51
Neutral/no opinion	40	11	11	13	19
Disagree	13	7	4	3	7
Strongly disagree	0.8	0.6	0.2	0.6	0.6
Total (Valid N)	476	485	491	493	1,945
I complete work in my house during the evening after it is dark outside.					
Strongly agree	5	39	18	14	19
Agree	36	44	64	49	48
Neutral/no opinion	18	9	11	21	15
Disagree	38	9	7	11	16
Strongly disagree	3	0	0	7	2
Total (Valid N)	492	497	496	494	1,979
We often receive guests in the evening after it is dark outside.					
Strongly agree	1	7	7	8	6
Agree	6	18	43	31	25
Neutral/no opinion	33	25	29	35	30
Disagree	58	48	21	21	37
Strongly disagree	3	3	0	6	3
Total (Valid N)	494	496	496	493	1,979
We feel safe in our house in the evening.					
Strongly agree	21	35	28	30	29
Agree	68	49	65	59	60
Neutral/no opinion	7	9	5	10	8
Disagree	4	6	1	1	3
Strongly disagree	0.2	0.4	0.6	0.2	0.4
Total (Valid N)	495	499	496	494	1,984

Table C30: ***(Continued)***

Questionnaire statement response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Car batteries are good source of electric lighting.					
Strongly agree	4	10	3	8	6
Agree	24	13	17	22	19
Neutral/no opinion	61	22	42	55	45
Disagree	10	53	37	11	28
Strongly disagree	1	2	1	5	2
Total (Valid N)	461	496	492	490	1,939
Compared to 15 years ago, life is better today.					
Strongly agree	24	21	14	8	17
Agree	41	25	50	27	36
Neutral/no opinion	20	20	18	28	21
Disagree	15	32	17	25	22
Strongly disagree	1	2	1	12	4
Total (Valid N)	495	499	495	500	1,989
Today life is better than it was 5 years ago.					
Strongly agree	17	18	13	8	14
Agree	39	33	52	28	38
Neutral/no opinion	27	22	17	28	24
Disagree	17	25	17	27	21
Strongly disagree	0	2	1	10	3
Total (Valid N)	494	500	500	499	1,993
I am optimistic that life will get better in the future.					
Strongly agree	10	52	41	21	31
Agree	32	28	51	41	38
Neutral/no opinion	46	17	6	33	25
Disagree	11	3	2	3	5
Strongly disagree	1	0	0	2	1
Total (Valid N)	463	499	499	499	1,960
Electricity is important for our local water supply.					
Strongly agree	3	38	31	21	23
Agree	16	28	58	52	39
Neutral/no opinion	40	26	9	18	23
Disagree	36	8	2	4	12
Strongly disagree	6	0	0	5	3
Total (Valid N)	461	500	500	494	1,955
I prefer to pay cash for my major purchases.					
Strongly agree	13	54	26	31	31
Agree	43	35	60	52	48
Neutral/no opinion	23	7	12	14	14
Disagree	21	3	1	2	7
Strongly disagree	0	0	0	1	1
Total (Valid N)	480	498	499	493	1,970

Table C30: ***(Continued)***

Questionnaire response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Solar PV system is a good source of energy for lighting.					
Strongly agree	37	7	4	12	15
Agree	31	10	17	40	25
Neutral/no opinion	27	46	55	38	42
Disagree	4	32	23	8	16
Strongly disagree	0	6	1	2	2
Total (Valid N)	496	431	498	490	1,915
Watching TV is a great source of news and information.					
Strongly agree	12	50	27	42	33
Agree	50	45	68	52	54
Neutral/no opinion	33	4	4	4	11
Disagree	5	1	1	2	2
Strongly disagree	0	0	0	0.20	0.10
Total (Valid N)	488	498	496	495	1,977

Table C31: Household Aspirations for Children's Education and Career

Questionnaire response (%)	*Mountain Province*	*Nueva Ecija*	*Batangas*	*Camarines Sur*	*All provinces*
Do you still have children in school?					
No	38	42	44	34	39
Yes	62	58	57	66	61
Total (Valid N)	496	472	496	491	1,955
What level of education do you expect your sons to have?					
None	8	10	10	7	9
1-6 years (elementary)	0.6	0.4	5	0.6	1.5
7-10 years (high school)	8	9	3	11	8
Vocational	4	2	4	10	5
College	75	79	73	67	73
Post-graduate	4		6	4	4
Total	334	246	287	325	1,192
What level of education do you expect your daughters to have?					
None	12	9	11	8	10
1-6 years (elementary)		0.4	3		0.8
7-10 years (high school)	5	9	6	11	8
Vocational	3	3	2	9	4
College	74	79	73	70	74
Post-graduate	6		5	3	4
Total	333	258	285	325	1,201

APPENDIX D: HOUSEHOLD AND BARANGAY QUESTIONNAIRES

HOUSEHOLD SCHEDULE

Philippines–1998

Date: ______________________________

Time began: ______________________________
Time ended: ______________________________

Name of Interviewer: ______________________________

Name of Supervisor: ______________________________

Name of Respondent: ______________________________

Address of Respondent: ______________________________

Household ID Number:	**Q1**	
Region:	**Q2**	
Province:	**Q3**	
Municipality:	**Q4**	
Barangay:	**Q5**	
Respondent's Relation to Head [1] Head of the Family [2] Spouse	**Q6**	

(HM) HOUSEHOLD MEMBERSHIP

Line No.	Name	Relation To head	Sex	Age	Education	Occupation	Employment status	Wage/income per month	No. of hours spent reading/ studying at home per day	No. of paid work or school days lost due to illness during the past 3 months
		[1] Head [2] Spouse [3] Son [4] Daughter [5] Son-in- law [6]Daughter-in-law [7] Mother [8] Father [9] Other relatives [10]Other non-relatives [-1]No response	[1] Male [2] Female	(Years)	(No. of years)	[1] Government Official [2] Professional, Manager, Corporate Executive [3] Technician, Associate Professional [4] Clerk [5] Service Worker, Shop or Market Sales Worker [6] Farmer, Forester, or Fisher [7] Trader or Related Worker [8] Plant or Machine Operator or Assembler [9] Laborer or Unskilled Worker [10] Child Worker [11] Housewife [12] Special Occupation, specify: [-1] No response [-8] Not applicable	[0]Unemployed [1] Full time [2] Part time [-1] No response [-8] Not applicable			
hm1		**hm2**	**hm3**	**hm4**	**hm5**	**hm6**	**hm7**	**Hm8**	**hm9**	**hm10**
01										
02										
03										

Line No.	Name	Relation to head	Sex	Age	Education (no. of years)	Occupation	Employment status	Wage/income per month	No. of hours spent reading/ studying at home per day	No. of paid work or school days lost due to illness during the past 3 months
hm1		**hm2**	**hm3**	**hm4**	**hm5**	**hm6**	**hm7**	**Hm8**	**hm9**	**hm10**
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										

(HU) HOUSING UNIT

Hu1	Do you own this house? [0] No [1] Yes	**hu1**	
Hu2	What are your sources of drinking water? [0] No [1] Yes	**hu2**	
Hu2.1	Spring/river/lake	**hu2.1**	
Hu2.2	Dug well	**hu2.2**	
Hu2.3	Tubed/piped well	**hu2.3**	
Hu2.4	Village/barangay/municipal water system	**hu2.4**	
Hu2.5	Water vendor/peddler	**hu2.5**	
Hu2.6	Other, specify:	**hu2.6**	
Hu3	How long did it take to collect your drinking water yesterday? (in minutes, use fractions if necessary)	**hu3**	
Hu4	Main type of dwelling [1] Wood construction [2] Hollow brick construction [3] Bamboo/sawali/cogun/nipa [4] Makeshift/salvaged/improvised [5] Half concrete/brick/stone and half wood [6] Other, specify:	**hu4**	

(AG) AGRICULTURE

Ag1	Do you and your family farm? [0] No. If No, go to **ag20**. [1] Yes	**ag1**	
Ag2	For the land that you farm, what is your relationship with the owner? [1] Owner [2] Renting [3] Tenancy/shared tenancy [4] Using land for free [5] Other, specify: [-1] No response [-8] Not applicable	**ag2**	
Ag3	What is the total area you farm? (in hectares)	**ag3**	
Ag4	What percent of land that you farm do you own?	**ag4**	
Ag5	Percent of total area under current cultivation	**ag5**	

Ag6	What crops do you produce? [0] No [1] Yes	**ag6**	
Ag6.1	Rice. If Yes, go to **ag7**.	**ag6.1**	
Ag6.2	Corn. If Yes, go to **ag8**.	**ag6.2**	
Ag6.3	Coconut. If Yes, go to **ag9**	**ag6.3**	
Ag6.4	Vegetables. If Yes, go to **ag10**.	**ag6.4**	
Ag6.5	Tuber, root & bulb crops. If Yes, go to **ag11**.	**ag6.5**	
Ag6.6	Other, specify: If Yes, go to **ag12**.	**ag6.6**	
Ag7	Rice	**ag7**	
Ag7.1	Number of times harvested per year	**ag7.1**	
Ag7.2	Proportion of total harvest consumed by household	**ag7.2**	
Ag7.3	Proportion of total harvest sold	**ag7.3**	
Ag8	Corn	**ag8**	
Ag8.1	Number of times harvested per year	**ag8.1**	
Ag8.2	Proportion of total harvest consumed by household	**ag8.2**	
Ag8.3	Proportion of total harvest sold	**ag8.3**	
Ag9	Coconut	**ag9**	
Ag9.1	Number of times harvested per year	**ag9.1**	
Ag9.2	Proportion of total harvest consumed by household	**ag9.2**	
Ag9.3	Proportion of total harvest sold	**ag9.3**	
Ag10	Vegetables	**ag10**	
Ag10.1	Number of times harvested per year	**ag10.1**	
Ag10.2	Proportion of total harvest consumed by household	**ag10.2**	
Ag10.3	Proportion of total harvest sold	**ag10.3**	
Ag11	Tubers, root & bulb crops	**ag11**	
Ag11.1	Number of times harvested per year	**ag11.1**	
Ag11.2	Proportion of total harvest consumed by household	**ag11.2**	
Ag11.3	Proportion of total harvest sold	**ag11.3**	
Ag12	Other, specify:	**ag12**	
Ag12.1	Number of times harvested per year	**ag12.1**	
Ag12.2	Proportion of total harvest consumed by household	**ag12.2**	
Ag12.3	Proportion of total harvest sold	**ag12.3**	

For each cropping period, please describe the planted area (in hectares), total production (in kilograms), and total value of sales (in Pesos) for each crop.

Cropping 1 (ag13)

		Planted Area (ha)		Total Production (kg)		Total Sales Value (P)
Rice	**ag13.11a**		**ag13.11b**		**ag13.11c**	
Corn	**ag13.21a**		**ag13.21b**		**ag13.21c**	
Coconut	**ag13.31a**		**ag13.31b**		**ag13.31c**	
Vegetables	**ag13.41a**		**ag13.41b**		**ag13.41c**	
Tubers, root & bulb	**ag13.51a**		**ag13.51b**		**ag13.51c**	
Other, specify:	**ag13.61a**		**ag13.61b**		**ag13.61c**	

Cropping 2

		Planted Area (ha)		Total Production (kg)		Total Sales Value (P)
Rice	**ag13.12a**		**ag13.12b**		**ag13.12c**	
Corn	**ag13.22a**		**ag13.22b**		**ag13.22c**	
Coconut	**ag13.32a**		**ag13.32b**		**ag13.32c**	
Vegetables	**ag13.42a**		**ag13.42b**		**ag13.42c**	
Tubers, root & bulb	**ag13.52a**		**ag13.52b**		**ag13.52c**	
Other, specify:	**ag13.62a**		**ag13.62b**		**ag13.62c**	

Cropping 3

		Planted Area (ha)		Total Production (kg)		Total Sales Value (P)
Rice	**ag13.13a**		**ag13.13b**		**ag13.13c**	
Corn	**ag13.23a**		**ag13.23b**		**ag13.23c**	
Coconut	**ag13.33a**		**ag13.33b**		**ag13.33c**	
Vegetables	**ag13.43a**		**ag13.43b**		**ag13.43c**	
Tubers, root & bulb	**ag13.53a**		**ag13.53b**		**ag13.53c**	
Other, specify:	**ag13.63a**		**ag13.63b**		**ag13.63c**	

Ag14	Percent of total land area irrigated by	**ag14**	
Ag14.1	Dug well	**ag14.1**	
Ag14.2	Stream, river, or lake	**ag14.2**	
Ag14.3	Tubed/piped well	**ag14.3**	
Ag14.4	Gravity water	**ag14.4**	

Ag15	How many pumps do you use? (list number)	**ag15**	
Ag15.1	Manual power	**ag15.1**	
Ag15.2	Animal driven	**ag15.2**	
Ag15.3	Electric pump	**ag15.3**	
Ag15.4	Diesel/gasoline pump	**ag15.4**	

Ag16	How many hours do you use the pumps per week?	**ag16**	
Ag16.1	Manual power	**ag16.1**	
Ag16.2	Animal driven	**ag16.2**	
Ag16.3	Electric pump	**ag16.3**	
Ag16.4	Diesel/gasoline pump	**ag16.4**	
Ag17	Do you have fruit-bearing trees for commercial sale? [0] No [1] Yes	**ag17**	
Ag18	Last year, how many kilograms of animal manure did you use for fertilizers?	**ag18**	
Ag19	Last year, how much did you spend (in Pesos) on	**ag19**	
Ag19.1	Animal manure for fertilizers	**ag19.1**	
Ag19.2	Chemical fertilizers	**ag19.2**	
Ag19.3	Pesticides	**ag19.3**	
Ag19.4	Hired labor	**ag19.4**	
Ag19.5	Irrigation	**ag19.5**	
Ag19.6	Other farm expenses, specify:	**ag19.6**	
Ag20	Do you and your family raise livestock? [0] No [1] Yes	**ag20**	
Ag21	What types of livestock and how many of these do you raise? (number of heads)	**ag21**	
Ag21.1	Duck	**ag21.1**	
Ag21.2	Poultry	**ag21.2**	
Ag21.3	Pig	**ag21.3**	
Ag21.4	Fighting cock	**ag21.4**	
ag21.5	Other, specify:	**ag21.5**	
Ag22	Do you practice inland fishing? [0] No. If No, go to **se1**. [1] Yes [-1] No response	**ag22**	
Ag23	How many times do you fish? [1] Every day [2] Every other day [3] Once a week [4] Once a month [5] Other, specify:	**ag23**	

Ag24	What type of fishing vessel do you use? [1] Motorized boat (powered). Go to **ag25.** [2] Banca (not powered). Go to **ag27**. [3] Both, go to **ag25.**	**ag24**	
Ag25	How much is your fuel consumption per fishing (in liters)?	**ag25**	
Ag26	Last year, how much did you spend (in Pesos) for	**ag26**	
Ag26.1	Fuels	**ag26.1**	
Ag26.2	Maintenance and repair	**ag26.2**	
Ag26.3	Lubricants	**ag26.3**	
Ag26.4	Other, specify:	**ag26.4**	
Ag27	What is your total annual fish production?	**ag27**	
Ag27.1	Proportion of total produce consumed by household	**ag27.1**	
Ag27.2	Proportion of total produce sold	**ag27.2**	
Ag28	What is your total annual sales (in Pesos)?	**ag28**	
Ag29	What type of lighting do you use in your vessel? [1] Petromax [2] Wick lamp [3] Solar lantern [4] Other, specify:	**ag29**	
Ag30	Last year, how much was your fuel consumption (in liters)?	**ag30**	
Ag31	For solar lantern:	**ag31**	
Ag31.1	Capacity (watts)	**ag31.1**	
Ag31.2	No. of hours used per fishing	**ag31.2**	
Ag32	Where do you store your produce? [1] Individual refrigerator [2] Communal cold storage [3] Solar refrigerator [4] None [5] Other, specify:	**ag32**	

(SE) SOCIOECONOMIC

Se1	Do you have a business at home? [0] No. If no, go to **EGY**. [1] Yes	**se1**	
Se2	If yes, what is the type of business? [1] Hairdresser/barber [2] Tailor/dressmaker [3] Laundry [4] Carpentry [5] Food stand/restaurant	**se2**	

[6] Goldsmith/silversmith
[7] Repair shop
[8] Video/movie rental
[9] Sari-sari store
[10] Other, specify:
[-1] No response
[-8] Not applicable

Se3	Number of hours worked per week in your home business	**se3**	
Se4	How much is the total annual non-wage income of the household from the following sources?	**se4**	
Se4.1	Income from agriculture	**se4.1**	
Se4.2	Income from livestock	**se4.2**	
Se4.3	Government subsidy/pension	**se4.3**	
Se4.4	Remittance from relatives	**se4.4**	
Se4.5	Business income	**se4.5**	
Se4.6	Income from gambling	**se4.6**	
Se4.7	Rental income	**se4.7**	
Se4.8	Other income, specify:	**se4.8**	

(EGY) ENERGY: FUEL CONSUMPTION

Please indicate which of the following fuels your household has used for any activity during the past 12 months. [0] = No, [1] = Yes

egy1	Fuelwood. If Yes, go to **FW**	**egy1**	
egy2	Lumber waste. If Yes, go to **LW**	**egy2**	
egy3	Charcoal. If Yes, go to **CHA**	**egy3**	
egy4	Kerosene. If Yes, go to **KER**	**egy4**	
egy5	LPG. If Yes, go to **LPG**	**egy5**	
egy6	Biomass residue. If Yes, go to **BMR**	**egy6**	
egy7	Solar energy (for Tingloy Island, Batangas only)	**egy7**	
egy8	Dry-cell batteries. If Yes, go to **DRY**	**egy8**	
egy9	Other batteries. If Yes, go to **BAT**	**egy9**	
egy10	Candles. If Yes, go to **CAN**	**egy10**	
egy11	Other: Wind energy Dendrothermal/Geothermal energy If Yes, go to **OTH**	**egy11**	
egy12	Electricity. If Yes, go to **ELE**	**egy12**	

(FW) FUELWOOD

If household did not use fuelwood, write [-8] in boxes fw1-fw14.

Fw1 Last month, was fuelwood used for the following purposes? **fw1**
- [0] No
- [1] Yes
- [-1] No response
- [-8] Not applicable

Fw1.1 Cooking and boiling water for drinking **fw1.1**
Fw1.2 Heating water (for bathing, washing clothes) **fw1.2**
Fw1.3 For home business **fw1.3**
Fw1.4 Other, specify: **fw1.4**

Fw2 How do you obtain your fuelwood? **fw2**
- [1] Collect/given only
- [2] Purchase only
- [3] Purchase and collect
- [4] Other, specify:
- [-1] No response
- [-8] Not applicable

The following are questions for purchased fuelwood. If household did not purchase fuelwood, write [-8] in boxes fw3-fw8.

Fw3 What unit(s) of measure do you use in purchasing fuelwood? **fw3**
- [1] Bundle
- [2] Stack or pile
- [3] Sack or bag
- [4] Other, specify:

Fw4 Enumerator: Ask respondent to show you typical stack/bundle/sack. Weigh it and note the weight (in kilograms). Enter value as the weight of the typical stack/bundle/sack. **fw4**

Fw5 During your last purchase, how many units (given in fw4) of fuelwood did you buy? **fw5**

Fw6 How much did you spend during your last purchase? **fw6**

Fw7 How many total days will this purchase last? **fw7**

Fw8 What was the one-way distance traveled (in meters) to make this purchase? **fw8**

The following are questions for collected fuelwood. If household did not collect fuelwood, write [-8] in boxes fw9-fw14.

Fw9	What unit(s) of measure do you use in collecting fuelwood? [1] Bundle [2] Stack or pile [3] Sack or bag [4] Other, specify:	**fw9**	
Fw10	Enumerator: Ask respondent to show you typical stack/bundle/sack. Weigh it and note the weight (in kilogram). Enter value as the weight of the typical stack/bundle/sack.	**fw10**	
Fw11	During last collection, how many units (given in fw10) did you collect?	**fw11**	
Fw12	How much time (hrs./wk.) did members use to collect fuelwood?	**fw12**	
Fw12.1	Adult male	**fw12.1**	
Fw12.2	Adult female	**fw12.2**	
Fw12.3	Children	**fw12.3**	
Fw13	How many total days did this collected fuelwood last?	**fw13**	
Fw14	What was the one-way distance traveled in collecting fuelwood (in meters)?	**fw14**	

(LW) LUMBER WASTE

If household did not use lumber waste, write [-8] in boxes lw1-lw7.

Lw1	Last month, were lumber wastes used for the following purposes? [0] No [1] Yes [-1] No response [-8] Not applicable	**lw1**	
lw1.1	Cooking and boiling water for drinking	**lw1.1**	
Lw1.2	Heating water (for bathing, washing clothes)	**lw1.2**	
Lw1.3	For home business	**lw1.3**	
Lw1.4	Other, specify:	**lw1.4**	
Lw2	What unit(s) of measure do you use in collecting lumber waste? [1] Bundle [2] Stack or pile [3] Sack or bag [4] Other, specify	**lw2**	

Lw3	Enumerator: Ask respondent to show you typical stack/bundle/sack. Weigh it and note the weight (in kilogram). Enter value as the weight of the typical stack/bundle/sack.	**lw3**	
Lw4	During last collection, how many units (given in lw3) did you collect?	**lw4**	
Lw5	How much labor was used in collecting lumber waste?	**lw5**	
Lw5.1	Adult male	**lw5.1**	
Lw5.2	Adult female	**lw5.2**	
Lw5.3	Children	**lw5.3**	
Lw6	How many days did this collected lumber waste last?	**lw6**	
Lw7	What was the one-way distance traveled (in meters) to collect lumber waste?	**lw7**	

(CHA) CHARCOAL

If household did not use charcoal, write [-8] in boxes cha1-cha7.

cha1	Last month, was charcoal used for the following purposes? [0] No [1] Yes [-1] No response [-8] Not applicable	**cha1**	
cha1.1	Cooking and boiling water for drinking	**cha1.1**	
cha1.2	Heating water (for bathing, washing clothes)	**cha1.2**	
cha1.3	Ironing	**cha1.3**	
cha1.4	For home business	**cha1.4**	
cha1.5	Other, specify:	**cha1.5**	
cha2	What unit(s) of measure do you use in purchasing charcoal? [1] Bundle [2] Stack or pile [3] Sack [4] Other, specify:	**cha2**	
cha3	Enumerator: Ask respondent to show you typical stack/bundle/sack. Weigh it and note the weight (in kilogram). Enter value as the weight of the typical stack/bundle/sack.	**cha3**	
cha4	During your last purchase, how many units (given in cha3) of charcoal did you buy?	**cha4**	

cha5	How much did you spend during your last purchase?	**cha5**	
cha6	How many total days will this purchase last?	**cha6**	
cha7	What was the one-way distance traveled (in meters) to make this purchase?	**cha7**	
cha8	Do you produce your own charcoal? [0] No. If No, go to KER. [1] Yes	**cha8**	
cha9	During the last production, how many units (given in cha3) did you produce?	**cha9**	
cha10	How much did you spend to produce this charcoal?	**cha10**	
cha11	How many total days did this own-produced charcoal last?	**cha11**	
cha12	What proportion of the charcoal that you produced did you consume?	**cha12**	
cha13	What proportion of the charcoal that you produced did you sell?	**cha13**	
cha14	At what average price did you sell this own-produced charcoal?	**cha14**	

(KER) KEROSENE

If household did not use kerosene, write [-8] in boxes ker1-ker5.

ker1	Last month, was kerosene used for the following purposes? [0] No [1] Yes [-1] No response [-8] Not applicable	**ker1**	
ker1.1	Cooking and boiling water for drinking	**ker1.1**	
ker1.2	Heating water (for bathing, washing clothes)	**ker1.2**	
ker1.3	Lighting	**ker1.3**	
ker1.4	For home business	**ker1.4**	
ker1.5	Other, specify:	**ker1.5**	
ker2	During your last purchase, how many liters of kerosene did you buy?	**ker2**	
ker3	How much did you spend during your last purchase?	**ker3**	
ker4	How many total days will this purchase last?	**ker4**	

ker5 What was the one-way distance traveled (in meters) to make this purchase? **ker5** [ ]

(LPG) LPG

If household did not use LPG, write [-8] in boxes lpg1-lpg6.

lpg1 Last month, was LPG used for the following purposes? **lpg1**
[0] No
[1] Yes
[-1] No response
[-8] Not applicable

lpg1.1 Cooking and boiling water for drinking **lpg1.1** [ ]
lpg1.2 Heating water (for bathing, washing clothes) **lpg1.2** [ ]
lpg1.3 Lighting **lpg1.3** [ ]
lpg1.4 For home business **lpg1.4** [ ]
lpg1.5 Other, specify: **lpg1.5** [ ]

lpg2 What size of LPG tank does your household usually use? **lpg2** [ ]
[1] 7 kg
[2] 11 kg
[3] Other, specify:

lpg3 How many LPG tanks do you have? **lpg3** [ ]

lpg4 How much did you spend during your last purchase? **lpg4** [ ]

lpg5 How many total days will this purchase last? **lpg5** [ ]

lpg6 What was the one-way distance traveled (in meters) to make this purchase? **lpg6** [ ]

(BMR) BIOMASS RESIDUE

If household did not use biomass residue, write [-8] in boxes bmr1-bmr7.

bmr1 Last month, was biomass residue used for the following purposes? **bmr1**
[0] No
[1] Yes
[-1] No response
[-8] Not applicable

bmr1.1 Cooking and boiling water for drinking **bmr1.1** [ ]
bmr1.2 Heating water (for bathing, washing clothes) **bmr1.2** [ ]
bmr1.3 Ironing **bmr1.3** [ ]
bmr1.4 Home business **bmr1.4** [ ]
bmr1.5 Other, specify: **bmr1.5** [ ]

bmr2 What unit(s) of measure do you use in collecting biomass residue? **bmr2**
[1] Bundle
[2] Stack or pile
[3] Sack or bag
[4] Other, specify:

bmr3 Enumerator: Ask respondent to show you typical stack/bundle/sack. Weigh it and note the weight (in kilogram). Enter value as the weight of the typical stack/bundle/sack. **bmr3**

bmr4 During last collection, how many units (given in bmr2) did you collect? **bmr4**

bmr5 How much total time did following members use to collect biomass residue? **bmr5**
bmr5.1 Adult male **bmr5.1**
bmr5.2 Adult female **bmr5.2**
bmr5.3 Children **bmr5.3**

bmr6 How many total days did this collected biomass residue last? **bmr6**

bmr7 What was the one-way distance traveled (in meters) to collect Biomass residue? **bmr7**

(SOL) SOLAR ENERGY

sol1 Does your household own any small solar PV system? **sol1**
[0] No
[1] Yes. If Yes, go to sol6.

sol2 Have you heard about this small size solar PV system? **sol2**
[0] No
[1] Yes, from newspaper or magazine.
[2] Yes, from radio or TV.
[3] Yes, from neighbors and friends.
[4] Yes, saw it in store.
[5] Yes, saw a system installed at friend's, government's, or neighbor's
[6] Yes, other source, specify:

sol3 Are you interested in buying such a small solar PV system with cash? **sol3**
[0] No
[1] Yes
[2] Never heard of it/Don't know

sol4 Are you interested in buying this small solar PV system with down payment and credit? **sol4**
[0] No
[1] Yes
[2] Never heard of it/Don't know

sol5 What are your main and secondary reasons for not purchasing? **sol5**
[0] No reason
[1] Main reason
[2] Secondary reason

sol5.1 System costs too much **sol5.1**
sol5.2 No convenient location to buy **sol5.2**
sol5.3 Do not want to buy **sol5.3**
sol5.4 Do not know about the system **sol5.4**
sol5.5 Cannot get credit to buy system **sol5.5**

The next section is for solar PV system owners only. If household does not have solar PV system, write [-8] in boxes sol6-sol34.

sol6 How many solar PV systems does your household have? **sol6**

sol7 What do you think about the price of your solar PV system? **sol7**
[1] Very expensive
[2] Expensive
[3] Right price
[4] Cheap

I will ask you about the size of each solar PV system that you have. If you only have one system, answer only the first system; if you have two systems, first and second systems etc. (Fill in 20 if the system is 50 watts peak (Wp); if the system is 75 Wp, fill in 30; interviewer must ask and check for the correct size.)

sol8 What is the size (in Wp) of your first solar PV system? **sol8**

sol9 How long (in months) has it been since your household had your first solar PV system installed? **sol9**

sol10 How much did you pay (in Pesos) for the up-front costs of the first system? **sol10**
(If paid in full, fill in "full payment" and go to sol13)

sol11 How much (in Pesos) is the monthly installment payment? **sol11**

sol12 For how many months? **sol12**

sol13 What is the size (in Wp) of your second solar PV system? **sol13** sol14 How long (in months) has it been since your household had your second solar PV system installed? **sol14**

sol15 How much did you pay (in Pesos) for the up-front costs of the second system? **sol15**
(If paid in full, fill in "full payment" and go to sol18)

sol16 How much (in Pesos) is the monthly installment payment? **sol16**

sol17 For how many months? **sol17**

sol18 What is the size (in Wp) of your third solar PV system? **sol18**

sol19 How long (in months) has it been since your household had your third solar PV system installed? **sol19**

sol20 How much did you pay (in Pesos) for the up-front costs of the third system? **sol20**
(If paid in full, fill in "full payment" and go to sol23)

sol21 How much (in Pesos) is the monthly installment payment? **sol21**

sol22 For how many months? **sol22**

sol23 How many times has your solar PV system broken down since you bought it? **sol23**

sol24 Do you have to change any of your solar PV panels? **sol24**
[0] No
[1] Yes
[-8] Not applicable

sol25 When the system has broken down, which of the following parts have broken down? **sol25**
[0] No
[1] Yes
[-8] Not applicable

sol25.1 Battery **sol25.1**
sol25.2 Lamp (light bulb/tube) **sol25.2**
sol25.3 Battery control unit **sol25.3**
sol25.4 Solar panel **sol25.4**
sol25.5 Inverter **sol25.5**
sol25.6 Wiring **sol25.6**

sol26 What is the average cost of repair? **sol26**

sol27 How long (in months) has your last battery lasted? **sol27**

sol28	How long (in months) has your light bulb/tube lasted?	**sol28**
sol29	Last year, what was the total number of days your solar PV system was out of order?	**sol29**
sol30	Why does your household have to live without electricity from solar PV system for that many days? [0] No [1] Yes	**sol30**
sol30.1	Normal waiting time for repair when it is out of service	**sol30.1**
sol30.2	Difficult to find spare parts	**sol30.2**
sol30.3	Could not find any repair person or repair person is not available	**sol30.3**
sol30.4	Repair is too costly	**sol30.4**
sol30.5	Have to travel long distance to repair or buy part	**sol30.5**
sol30.6	System is under warranty and service provided is slow	**sol30.6**
sol30.7	Other, specify:	**sol30.7**
sol31	If solar PV system breaks down, how do you have it repaired? [1] Technician/repair person comes to our house to repair. Go to DRY. [2] Take it to repair shop. Go to sol32 [3] Other, specify: Go to DRY.	**sol31**
sol32	Means of transportation [1] Bicycle [2] Motorcycle [3] Bus/truck [4] Horse [5] Cart [6] Other, specify:	**sol32**
sol33	Distance to repair shop (in kilometers)	**sol33**
sol34	What is the total transportation cost (to and from) for each repair?	**sol34**

(DRY) DRY-CELL BATTERIES

If household did not use dry-cell batteries, write [-8] in boxes dry1-dry5.

dry1	What do you use drycell batteries for? [0] No [1] Yes [-1] No response [-8] Not applicable	**dry1**	
dry1.1	Radio/cassette player	**dry1.1**	
dry1.2	Electric fan	**dry1.2**	
dry1.3	Lighting	**dry1.3**	
dry1.4	Clock	**dry1.4**	
dry1.5	Toys	**dry1.5**	
dry1.6	Television	**dry1.6**	
dry1.7	Flashlight	**dry1.7**	
dry1.8	Other, specify:	**dry1.8**	
dry2	How many times per month do you usually purchase drycell batteries?	**dry2**	
dry3	During your last purchase, how many batteries did you buy?	**dry3**	
dry4	How much did you spend during your last purchase?	**dry4**	
dry5	What was the one-way distance traveled (in meters) to make This purchase?	**dry5**	

(BAT) OTHER BATTERIES – VEHICULAR

If household did not use vehicular batteries, write [-8] in boxes bat1-bat9.

bat1	Do you use vehicular batteries for: [0] No [1] Yes [-1] No response [-8] Not applicable	**bat1**	
bat1.1	Radio/cassette player	**bat1.1**	
bat1.2	Electric fan	**bat1.2**	
bat1.3	Lighting	**bat1.3**	
bat1.4	Television	**bat1.4**	
bat1.5	Other, specify:	**bat1.5**	
bat2	How much is the acquisition cost of the battery (Pesos)?	**bat2**	
bat3	How many years do you expect the battery to last?	**bat3**	

bat4 How often do you charge the battery per month? **bat4** [ ]

bat5 What is the primary charging source? **bat5** [ ]
[1] Power line
[2] Cooperative
[3] Commercial source
[4] Other, specify:

bat6 How many days does one charge last? **bat6** [ ]

bat7 How many hours per day do you use the battery? **bat7** [ ]

bat8 What was the one-way distance traveled (in meters) to have the battery recharged? **bat8** [ ]

bat9 What is the average round-trip cost of transportation to the recharge station? **bat9** [ ]

(CAN) CANDLES

If household did not use candles, write [-8] in boxes can1 to can5.

can1 What do you use candles for? **can1**
[0] No
[1] Yes
[-1] No response
[-8] Not applicable

can1.1 Lighting **can1.1** [ ]
can1.2 Religious rites **can1.2** [ ]
can1.3 Other, specify: **can1.3** [ ]

can2 How many candles do you use per month? **can2** [ ]

can3 For your last purchase, how many sticks of candles did you buy? **can3** [ ]

can4 How much did this purchase cost? **can4** [ ]

can5 How many days did this purchase last? **can5** [ ]

(OTH) OTHER

If household did not use other types of energy, write [-8] in boxes oth1-oth4.

oth1 What other type of energy source do you use? **oth1** [ ]
[1] Water
[2] Dendrothermal/Geothermal

oth2 For what purpose do you use this type of fuel? **oth2**
[0] No
[1] Yes
[-1] No response
[-8] Not applicable
oth2.1 Cooking and boiling water for drinking **oth2.1**
oth2.2 Heating water (for bathing, washing clothes) **oth2.2**
oth2.3 Ironing **oth2.3**
oth2.4 Home business **oth2.4**
oth2.5 Other, specify: **oth2.5**

oth3 How many times per month do you usually purchase this type Of energy? **oth3**

oth4 How much does it cost you per month to use this type of energy? **oth4**

(ELE) ELECTRICITY

If household is not electrified, write [-8] in boxes ele1-ele26.4

ele1 How many years has your household used electricity? **ele1**

ele2 What type of service do you have? **ele2**
[1] 24-hour service
[2] 12-hour service
[3] Other, specify:

ele3 Do you share your electric appliances with people outside your household? **ele3**
[0] No. If No, go to **ele5**.
[1] Yes

ele4 Which electric appliance is shared with people outside your household? **ele4**
[0] No
[1] Yes
ele4.1 Refrigerator **ele4.1**
ele4.2 Television **ele4.2**
ele4.3 Electric iron **ele4.3**
ele4.4 Cooking appliance **ele4.4**
ele4.5 Washing machine **ele4.5**
ele4.6 Other, specify: **ele4.6**

ele5 To whom do you pay the electric charges/bill? **ele5**
[0] None (no meter or illegal connection). If None, go to **ele11**.
[1] Electric cooperative

[2] Electric company other than cooperative
[3] Landlord
[4] Neighbor
[5] Other, specify:

ele6	How often are you supposed to pay? [1] Twice a month [2] Monthly [3] Every other month [4] Other, specify:	**ele6**	
ele7	Can you provide the following information from your latest electric bill?	**ele7**	
ele7.1	Total days for last electric bill	**ele7.1**	
ele7.2	Total charges for last bill	**ele7.2**	
ele7.3	Total kilowatt hours consumed for last bill	**ele7.3**	
ele8	How many households are sharing the electricity bill?	**ele8**	
ele9	If tapped to neighbor, how much do you pay per month?	**ele9**	
ele10	How is this rate determined if electricity is tapped from neighbor? [1] Number of appliance [2] Incremental meter use [3] Do not know. [-8] Not applicable.	**ele10**	
ele11	How many times did the power fail for more than 30 minutes last month?	**ele11**	
ele12	How often did the power trip for more than 30 seconds last month? [1] Often [2] Rarely [3] Never	**ele12**	
ele13	How often did you experience dimming of lights last month? [1] Often [2] Rarely [3] Never	**ele13**	
ele14	What do you miss most when there is a brownout? [1] Lighting [2] Watching TV [3] Listening to radio/music [4] Attending social gatherings [5] Sewing/cooking	**ele14**	

[6] Using fan/cooling appliance
[7] Using refrigerator
[8] Reading, studying
[9] Other, specify:

ele15	What is the second thing you miss most when there is a brownout? [1] Lighting [2] Watching TV [3] Listening to radio/music [4] Attending social gatherings [5] Sewing/cooking [6] Using fan/cooling appliance [7] Using refrigerator [8] Reading, studying [9] Other, specify:	**ele15**	

The next section is about emergency lighting.

ele16	What do you use for lighting when there is no electricity? [0] No [1] Yes	**ele16**	
ele16.1	Generator. If Yes, go to **ele17**.	**ele16.1**	
ele16.2	Emergency light/rechargeable lamps. If Yes, go to **ele18**.	**ele16.2**	
ele16.3	Kerosene lamp. If Yes, go to **ele19**.	**ele16.3**	
ele16.4	LPG appliance. If Yes, go to **ele20**.	**ele16.4**	
ele16.5	Vehicular battery. If Yes, go to **ele21**.	**ele16.5**	
ele16.6	Candles. If Yes, go to **ele22**.	**ele16.6**	
ele16.7	Flashlight and dry-cell lamp. If Yes, go to **ele23**.	**Ele16.7**	
ele16.8	Other, specify: If Yes, go to **ele24**.	**Ele16.8**	
ele17	Generator	**ele17**	
ele17.1	Power generation capacity in kilowatt hours	**Ele17.1**	
ele17.2	How many years have you been using a generator?	**Ele17.2**	
ele17.3	Acquisition cost of generator	**Ele17.3**	
ele17.4	Type of fuel used: [1] Gasoline [2] Diesel	**ele17.4**	
ele17.5	Monthly expenditure on fuel	**ele17.5**	
ele18	Emergency light/rechargeable lamps	**ele18**	
ele18.1	Total acquisition cost of emergency lights/lamps	**ele18.1**	
ele18.2	Expenditures incurred per month (bulb and charging)	**ele18.2**	
ele19	Kerosene lamp	**ele19**	
ele19.1	Total acquisition cost of kerosene lamp	**ele19.1**	
ele19.2	Expenditures incurred per month	**ele19.2**	
ele19.3	Liters of kerosene used per month	**ele19.3**	

ele20	LPG appliance	**ele20**	
ele20.1	Total acquisition cost of LPG appliance	**ele20.1**	
ele20.2	Expenditures incurred per month	**ele20.2**	
ele20.3	Kilograms of LPG used per month	**ele20.3**	
ele21	Vehicular battery	**ele21**	
ele21.1	Total cost of vehicular batteries	**ele21.1**	
ele21.2	Expenditures incurred per month (e.g. charging)	**ele21.2**	
ele22	Candle	**ele22**	
ele22.1	Expenditures incurred per month	**ele22.1**	
ele23	Flashlight and drycell lamp	**ele23**	
ele23.1	Total acquisition cost of flashlight/drycell lamp	**ele23.1**	
ele23.2	Expenditures incurred per month	**ele23.2**	
ele24	Other energy source	**ele24**	
ele24.1	Total cost of other energy source	**ele24.1**	
ele24.2	Expenditures incurred per month	**ele24.2**	

The next section is about electricity used in home business. If household does not have a home business, write [-8] in boxes ele25-ele26.4.

ele25	Do you use electricity in your home business? [0] No. If No, go to **INC**. [1] Yes. [-8] Do not have home business; go to **INC**.	**ele25**	
ele26	What do you use electricity for in your home business? [0] No [1] Yes [-1] No response [-8] Not applicable	**ele26**	
ele26.1	Lighting	**ele26.1**	
ele26.2	Refrigeration and cold storage	**ele26.2**	
ele26.3	Food processing	**ele26.3**	
ele26.4	Other, specify:	**ele26.4**	

(INC) INCANDESCENT BULBS
(only bulbs used for more than 30 minutes per day)

inc1	25 W	**inc1**	
inc1.1	Number of bulbs	**inc1.1**	
inc1.2	Total hours used per day	**inc1.2**	
inc2	40 W	**inc2**	
inc2.1	Number of bulbs	**inc2.1**	
inc2.2	Total hours used per day	**inc2.2**	
inc3	50 W	**inc3**	

inc3.1	Number of bulbs	**inc3.1**	
inc3.2	Total hours used per day	**inc3.2**	
inc4	60 W	**inc4**	
inc4.1	Number of bulbs	**inc4.1**	
inc4.2	Total hours used per day	**inc4.2**	
inc5	100 W	**inc5**	
inc5.1	Number of bulbs	**inc5.1**	
inc5.2	Total hours used per day	**inc5.2**	

(TUB) FLUORESCENT TUBES–STRAIGHT AND CIRCULAR
(only tubes used for more than 30 minutes per day)

tub1	10 W straight	**tub1**	
tub1.1	Number of tubes	**tub1.1**	
tub1.2	Total hours used per day	**tub1.2**	
tub2	20 W straight	**tub2**	
tub2.1	Number of tubes	**tub2.1**	
tub2.2	Total hours used per day	**tub2.2**	
tub3	40 W straight	**tub3**	
tub3.1	Number of tubes	**tub3.1**	
tub3.2	Total hours used per day	**tub3.2**	
tub4	22 W circular	**tub4**	
tub4.1	Number of tubes	**tub4.1**	
tub4.2	Total hours used per day	**tub4.2**	
tub5	32 W circular	**tub5**	
tub5.1	Number of tubes	**tub5.1**	
tub5.2	Total hours used per day	**tub5.2**	

(COM) COMPACT FLUORESCENT TUBES SL
(only tubes used for more than 30 minutes per day)

com1	Less than 12 W	**com1**	
com1.1	Number of tubes	**com1.1**	
com1.2	Total hours used per day	**com1.2**	
com2	12 W	**com2**	
com2.1	Number of tubes	**com2.1**	
com2.2	Total hours used per day	**com2.2**	
com3	18 W	**com3**	
com3.1	Number of tubes	**com3.1**	
com3.2	Total hours used per day	**com3.2**	

com4	20 W	**com4**	
com4.1	Number of tubes	**com4.1**	
com4.2	Total hours used per day	**com4.2**	
com5	25 W	**com5**	
com5.1	Number of tubes	**com5.1**	
com5.2	Total hours used per day	**com5.2**	

(NEA) NON-ELECTRIC APPLIANCES

Do you have/use any of the following at home?

nea1	Clay stove/efficient stove using fuelwood	**nea1**	
nea1.1	Number	**nea1.1**	
nea1.2	Hours used per day	**nea1.2**	
nea2	Traditional/improvised clay stove using fuelwood	**nea2**	
nea2.1	Number	**nea2.1**	
nea2.2	Hours used per day	**nea2.2**	
nea3	Kerosene stove	**nea3**	
nea3.1	Number	**nea3.1**	
nea3.2	Hours used per day	**nea3.2**	
nea4	Charcoal stove	**nea4**	
nea4.1	Number	**nea4.1**	
nea4.2	Hours used per day	**nea4.2**	
nea5	Biomass residue stove	**nea5**	
nea5.1	Number	**nea5.1**	
nea5.2	Hours used per day	**nea5.2**	
nea6	Kerosene lamps	**nea6**	
nea6.1	Number	**nea6.1**	
nea6.2	Hours used per day	**nea6.2**	
nea7	Candle lamps	**nea7**	
nea7.1	Number	**nea7.1**	
nea7.2	Hours used per day	**nea7.2**	
nea8	Charcoal flat iron	**nea8**	
nea8.1	Number	**nea8.1**	
nea8.2	Hours used per day	**nea8.2**	

(EA) ELECTRIC APPLIANCES

Do you have/use any of the following at home?

ea1	Radio	**ea1**	
ea1.1	Number	**ea1.1**	
ea1.2	Total watts	**ea1.2**	
ea1.3	Hours used per day	**ea1.3**	
ea2	Black-and-white TV	**ea2**	
ea2.1	Number	**ea2.1**	
ea2.2	Total watts	**ea2.2**	
ea2.3	Hours used per day	**ea2.3**	
ea3	Color TV	**ea3**	
ea3.1	Number	**ea3.1**	
ea3.2	Total watts	**ea3.2**	
ea3.3	Hours used per day	**ea3.3**	
ea4	Electric flat iron	**ea4**	
ea4.1	Number	**ea4.1**	
ea4.2	Total watts	**ea4.2**	
ea4.3	Hours used per week	**ea4.3**	
ea5	Electric fan	**ea5**	
ea5.1	Number	**ea5.1**	
ea5.2	Total watts	**ea5.2**	
ea5.3	Hours used per day	**ea5.3**	
ea6	Water heater	**ea6**	
ea6.1	Number	**ea6.1**	
ea6.2	Total watts	**ea6.2**	
ea6.3	Hours used per day	**ea6.3**	
ea7	Refrigerator	**ea7**	
ea7.1	Number	**ea7.1**	
ea7.2	Total watts	**ea7.2**	
ea7.3	Hours used per day	**ea7.3**	
ea8	Electric stove/burner	**ea8**	
ea8.1	Number	**ea8.1**	
ea8.2	Total watts	**ea8.2**	
ea8.3	Hours used per day	**ea8.3**	

ea9	Toaster/turbo broiler	**ea9**	
ea9.1	Number	**ea9.1**	
ea9.2	Total watts	**ea9.2**	
ea9.3	Hours used per day	**ea9.3**	
ea10	Electric oven/range	**ea10**	
ea10.1	Number	**ea10.1**	
ea10.2	Total watts	**ea10.2**	
ea10.3	Hours used per day	**ea10.3**	
ea11	Washing machine	**ea11**	
ea11.1	Number	**ea11.1**	
ea11.2	Total watts	**ea11.2**	
ea11.3	Hours used per week	**ea11.3**	
ea12	Electric water pump	**ea12**	
ea12.1	Number	**ea12.1**	
ea12.2	Total watts	**ea12.2**	
ea12.3	Hours used per day	**ea12.3**	
ea13	Power tools (e.g., power drills)	**ea13**	
ea13.1	Number	**ea13.1**	
ea13.2	Total watts	**ea13.2**	
ea13.3	Hours used per day	**ea13.3**	
ea14	Generator	**ea14**	
ea14.1	Number	**ea14.1**	
ea14.2	Total watts	**ea14.2**	
ea14.3	Hours used per day	**ea14.3**	
ea15	Other, specify:	**ea15**	
ea15.1	Number	**ea15.1**	
ea15.2	Total watts	**ea15.2**	
ea15.3	Hours used per day	**ea15.3**	

(ACT) HOUSEHOLD ACTIVITIES

act1 Does the household leave lights on throughout the entire evening for security purposes? **act1**

[0] Never
[1] Sometimes
[2] Always

act2	Does the household leave lights on throughout the entire evening for your livestock/crops? [0] Never [1] Sometimes [2] Always [-8] Does not raise livestock/crops	**act2**	
act3	Does the household use any form of lighting for household work? [0] Never [1] Sometimes [2] Always	**act3**	
act4	How many hours did the family spend for the following activities yesterday?	**act4**	
act4.1	Cooking	**act4.1**	
act4.2	Washing	**act4.2**	
act4.3	Hobbies	**act4.3**	
act4.4	Other, specify:	**act4.4**	
act5	How many hours does the family spend each week watching TV programs?	**act5**	
act5.1	Sports (PBA, NBA, boxing, etc.)	**act5.1**	
act5.2	Drama/soap opera/telenovela (Maalala mo Kaya, Esperanza, La Duena, etc.)	**act5.2**	
act5.3	Cartoons	**act5.3**	
act5.4	Variety/musical (ASAP, Eat Bulaga, etc.)	**act5.4**	
act5.5	Talk show (Showbiz Linggo, Startalk, Mel and Jay, etc.)	**act5.5**	
act5.6	Game show (Gobingo, etc.)	**act5.6**	
act5.7	Public affairs (Dong Puno Live, Firing Line, Public Life, etc.)	**act5.7**	
act5.8	Educational (Ating Alamin, etc.)	**act5.8**	
act5.9	Other, specify:	**act5.9**	
act6	How many hours does the family spend each week listening to radio programs?	**act6**	
act6.1	Drama/soap opera	**act6.1**	
act6.2	News	**act6.2**	
act6.3	Talk show	**act6.3**	
act6.4	Music	**act6.4**	
act6.5	Religion	**act6.5**	
act6.6	Education	**act6.6**	
act6.7	Other, specify:	**act6.7**	
act7	How many movies did the family watch last month?	**act7**	

act8 How much did the family spend on movies last month? **act8** [ ]

act9 How many video movies (home movies) did the family watch At a relative's or neighbor's house last month? **act9** [ ]

act10 How much did the family spend per video movie (home movie) watched at a relative's or neighbor's house last month? **act10** [ ]

act11 How many persons in your household watched TV shows at a relative's or neighbor's house last month? **act11** [ ]

act12 How much did each person pay to watch TV shows at a relative's or neighbor's house last month? **act12** [ ]

(ATT) ATTITUDE

Interviewer: I am going to read to you a list of statements concerning energy use and other issues. I would like you to tell me if you agree or disagree with these statements and how strong your feelings are.

[1] Strongly agree [3] Indifferent/Neutral [5] Strongly disagree
[2] Agree [4] Disagree

att1 Having electricity in a household is important for children's education. **att1** [ ]

att2 Television takes study time away from children. **att2** [ ]

att3 Because of good light, children would study more at night. **att3** [ ]

att4 My children study during the evening after it is dark outside. **att4** [ ]

att5 My family feels very secure at night. **att5** [ ]

att6 My family is extremely happy with the light we get from our current fuel. **att6** [ ]

att7 In my house, it is easy to read in the evening. **att7** [ ]

att8 Lighting with kerosene can cause health problems. **att8** [ ]

att9 Lighting with diesel fuel can cause health problems. **att9** [ ]

att10	Reading is easier with electric lamps compared to kerosene lamps.	**att10**	☐
att11	It is difficult for my family to get news and information.	**att11**	☐
att12	Watching TV would provide my family great entertainment.	**att12**	☐
att13	I complete work in my house during the evening after it is dark outside.	**att13**	☐
att14	We often receive guests in the evening after it is dark outside	**att14**	☐
att15	We feel safe in our house in the evening.	**att15**	☐
att16	Car batteries are a good source of electricity for lighting.	**att16**	☐
att17	Compared to15 years ago, life is better today.	**att17**	☐
att18	Today, life is better than it was 5 years ago.	**att18**	☐
att19	I am optimistic that life will get better in the future.	**att19**	☐
att20	Electricity is important for our local water supply.	**att20**	☐
att21	I prefer to pay cash for my major purchases.	**att21**	☐
att22	Solar PV system is a good source of energy for lighting.	**att22**	☐
att23	Watching TV is a great source of news and information.	**att23**	☐

Education

att24 Do you have children still in school? **att24** ☐

[0] No
[1] Yes. If yes, proceed to the following questions

att25 What type of career do you expect your children to have when they are older? **att25**

[1] Government Official
[2] Professional, Manager, Corporate Executive
[3] Technician, Associate Professional
[4] Clerk
[5] Service Worker, Shop, or Market Sales Worker
[6] Farmers, Forester, or Fisher
[7] Trade person or Related Worker
[8] Plant or Machine Operator or Assembler
[9] Laborer or Unskilled Worker

[10] Housewife
[11] Special Occupation, specify:
[-1] No response
[-8] Not applicable

att25.1	Oldest Male (above 10 years)	**att25.1**	
att25.2	Oldest Female (above 10 years)	**att25.2**	

att26 What level of education do you expect your children to have when they are older? **att26**

[0] No schooling
[1] Primary school (1-6 years)
[2] High school (7-10 years)
[3] Vocational
[4] College education
[5] Post-graduate education
[-1] No response
[-8] Not applicable

att26.1	Male Children	**att26.1**	
att26.2	Female Children	**att26.2**	

(HLT) HEALTH

The following questions should be directed to the respondent.

hlt1 Do you smoke? **hlt1**

[0] No
[1] Yes

hlt2 During the last 3 months, did you suffer from the following symptoms/illnesses? **hlt2**

[0] No
[1] Yes

hlt2.1	Coughing	**hlt2.1**	
hlt2.2	Wheezing	**hlt2.2**	
hlt2.3	Shortness of Breath	**hlt2.3**	
hlt2.4	Intermittent Fever	**hlt2.4**	
hlt2.5	Diarrhea	**hlt2.5**	

BARANGAY SURVEY

Barangay Questionnaire

Philippines–1998

Date: ______________

Name of Barangay Captain: ______________________________

Name of Interviewer: ___________________________________

Q1	Region: ______________________	**Q1**	
Q2	Province: ______________________	**Q2**	
Q3	Municipality: ______________________	**Q3**	
Q4	Barangay: ______________________	**Q4**	

GC	**GENERAL CHARACTERISTICS**			
GC1	Distance from the poblacion/town center (km)		**GC1**	
GC2	Distance from the nearest city (km)		**GC2**	
GC3	Distance from the main market (km)		**GC3**	
GC4	Distance from the main highway (km)		**GC4**	
GC5	Barangay population		**GC5**	
GC6	Average per-capita income of barangay		**GC6**	
GC7	Source of barangay population data [01] Socioeconomic profile [02] Municipality survey [03] Barangay survey [04] Government department [05] Rural health center [06] National Statistics Office [07] Other, specify:		**GC7**	
GC8	Source of barangay per-capita income data [01] Socioeconomic profile [02] Municipality survey [03] Barangay survey [04] Government department [05] Rural health center [06] National Statistics Office [07] Other, specify:		**GC8**	
GC9	Year of barangay population data		**GC9**	
GC10	Year of barangay per-capita income data		**GC10**	
GC11	Total area of forested land (ha)		**GC11**	
GC12	How far is the forest from the barangay (km)		**GC12**	
GC13	Does the area have an agricultural extension service? [0] No. If No, go to GC15 [1] Yes		**GC13**	
GC14	If Yes to GC13, what key government agency/non-government agency is providing this extension? [0] No [1] Yes		**GC14**	
GC14.1	Department of Agriculture		**GC14.1**	
GC14.2	Department of Agrarian Reform		**GC14.2**	
GC14.3	Other, specify:		**GC14.3**	
GC15	Have new roads or pathways been constructed in the area since 1983? [0] No [1] Yes		**GC15**	

GC16	Condition of main barangay road [1] Good—few or no potholes or the pavement has not yet shown any signs of cracking [2] Fair—not more than 5 potholes per 100 meter stretch of road and/or slightly corrugated [3] Bad—more than 5 potholes per 100 meter stretch of road and/or have corrugated ruts. The pavement, if any, is starting to break up. Drivers don't stay in proper lane. Maximum travel speed for a non-reckless driver is about 20-30 km per hour [4] Very bad—not passable during the rainy season. During the dry season, maximum travel speed is 10-20 km per hour		**GC16**	
GC16.1	Concrete		**GC16.1**	
GC16.2	Asphalt		**GC16.2**	
GC16.3	Gravel		**GC16.3**	
GC16.4	Dirt		**GC16.4**	
SC	**SANITARY CONDITIONS**			
SC1	Common type of toilet facility used in the barangay [0] None (open field, river, etc.) [1] Flush [2] Water-sealed (pour flush) [3] Antipolo/open pit [4] Wrap-and-throw [5] Other, specify:		**SC1**	
SC2	Common type of bath facility used in the barangay [0] None (open field, river, etc.) [1] Shower/faucet [2] Drums/containers (fetch water) [3] Other, specify:		**SC2**	
SC3	General sanitary conditions of the barangay [1] No excreta visible [2] Very little excreta visible [3] Some excreta visible in the barangay [4] Heavy excreta in the barangay		**SC3**	
SC4	General conditions in the barangay as regards garbage disposal [1] No visible garbage accumulation/collected by garbage collector [2] Some garbage accumulation/burning/ dumping [3] A lot of garbage accumulation/dumping		**SC4**	

SC5	Whether there are open drainage ditches [0] No [1] Yes		**SC5**	
SC6	Whether water supply is available in the wet season [1] Always adequate for all household needs [2] Usually adequate for household needs [3] At times in short supply [4] Always in short supply		**SC6**	
SC7	Whether water supply is available in the dry season [1] Always adequate for all household needs [2] Usually adequate for household needs [3] At times in short supply [4] Always in short supply		**SC7**	
ED	**AVAILABILITY OF EDUCATION AND HEALTH FACILITIES**			
ED1	**Are the following types of schools available in the community?**		**ED1**	
ED1.1 ED1.1A	**Public Primary** [0] No. If No, go to ED1.2 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.1** **ED1.1A**	
ED1.2 ED1.2A	**Private Primary** [0] No. If No, go to ED1.3 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.2** **ED1.2A**	
ED1.3 ED1.3A	**Public High School** [0] No. If No, go to ED1.4 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.3** **ED1.3A**	
ED1.4 ED1.4A	**Private High School** [0] No. If No, go to ED1.5 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.4** **ED1.4A**	

ED1.5 ED1.5A	**Public Vocational** [0] No. If No, go to ED1.6 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.5** **ED1.5A**	
ED1.6 ED1.6A	**Private Vocational** [0] No. If No, go to ED1.7 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.6** **ED1.6A**	
ED1.7 ED1.7A	**Public College** [0] No. If No, go to ED1.8 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.7** **ED1.7A**	
ED1.8 ED1.8A	**Private College** [0] No. If No, go to ED1.9 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the city		**ED1.8** **ED1.8A**	
ED2	**Are the following types of services/clinics/ hospitals/centers available in the village?**		**ED2**	
ED2.1 ED2.1A	**Rural health unit/office (Puericulture center)** [0] No. If No, go to ED2.2 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.1** **ED2.1A**	
ED2.2 ED2.2A	**Private medical clinic** [0] No. If No, go to ED2.3 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.2** **ED2.2A**	

ED2.3 ED2.3A	**Herbolario (herbal-medicine doctor)** [0] No. If No, go to ED2.4 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.3** **ED2.3A**	
ED2.4 ED2.4A	**Manghihilot (physical therapist)** [0] No. If No, go to ED2.5 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.4** **ED2.4A**	
ED2.5 ED2.5A	**Private hospital** [0] No. If No, go to ED2.6 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.5** **ED2.5A**	
ED2.6 ED2.6A	**Government hospital** [0] No. If No, go to ED2.7 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.6** **ED2.6A**	
ED2.7 ED2.7A	**Family planning center** [0] No. If No, go to ED2.8 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.7** **ED2.7A**	
ED2.8 ED2.8A	**TB Center** [0] No. If No, go to ED2.9 [1] Yes Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.8** **ED2.8A**	

ED2.9	**Barangay health center** [0] No. If No, go to ED2.10 [1] Yes		**ED2.9**	
ED2.9A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.9A**	
ED2.10	**Maternity clinic** [0] No. If No, go to ED2.11 [1] Yes		**ED2.10**	
ED2.10A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.10A**	
ED2.11	**Day care center** [0] No. If No, go to ED2.12 [1] Yes		**ED2.11**	
ED2.11A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.11A**	
ED2.12	**Private physician** [0] No. If No, go to ED2.13 [1] Yes		**ED2.12**	
ED2.12A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.12A**	
ED2.13	**Private nurse** [0] No. If No, go to ED2.14 [1] Yes		**ED2.13**	
ED2.13A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.13A**	
ED2.14	**Private midwife** [0] No. If No, go to ES [1] Yes		**ED2.14**	
ED2.14A	Location from barangay [01] Poblacion in the same municipality [02] Municipality outside barangay [03] Within the community		**ED2.14A**	

ES	**AVAILABILITY OF ENERGY SERVICES**			
ES1	What is the common type of energy in the village? [01] Fuelwood [02] Kerosene [03] Charcoal [04] LPG [05] Electricity [06] Agricultural residue [07] Generators [08] Other, specify:		**ES1**	
ES2	How many hours is electric service available?		**ES2**	
ES3	How many streetlights are present in the village?		**ES3**	
ES4	What recreational facilities are found in the village?		**ES4**	
ES4.1 ES4.1A ES4.1B	**Movie house** [0] No. If No, go to ES4.2 [1] Yes Type of energy used [01] Electricity [02] Generators [03] Car batteries [04] Other, specify: Cost of entrance		**ES4.1** **ES4.1A** **ES4.1B**	
ES4.2 ES4.2A ES4.2B	**Private VCR facilities** [0] No. If No, go to ES4.3 [1] Yes Type of energy used [01] Electricity [02] Generators [03] Car batteries [04] Other, specify: Cost of entrance		**ES4.2** **ES4.2A** **ES4.2B**	
ES4.3 ES4.3A ES4.3B	**Cabarets** [0] No. If No, go to ES4.4 [1] Yes Type of energy used [01] Electricity [02] Generators [03] Car batteries [04] Other, specify: Cost of entrance		**ES4.3** **ES4.3A** **ES4.3B**	

ES4.4	**Beer gardens**		**ES4.4**	
	[0] No. If No, go to ES4.5			
	[1] Yes			
ES4.4A	Type of energy used		**ES4.4A**	
	[01] Electricity			
	[02] Generators			
	[03] Car batteries			
	[04] Other, specify:			
ES4.4B	Cost of entrance		**ES4.4B**	
ES4.5	**Local parks**		**ES4.5**	
	[0] No. If No, go to ES4.6			
	[1] Yes			
ES4.5A	Type of energy used		**ES4.5A**	
	[01] Electricity			
	[02] Generators			
	[03] Car batteries			
	[04] Other, specify:			
ES4.5B	Cost of entrance		**ES4.5B**	
ES4.6	**Other, specify**:		**ES4.6**	
	[0] No. If No, go to PC			
	[1] Yes			
ES4.6A	Type of energy used		**ES4.6A**	
	[01] Electricity			
	[02] Generators			
	[03] Car batteries			
	[04] Other, specify:			
ES4.6B	Cost of entrance		**ES4.6B**	
PC	**PRICE OF CROP AND OTHER ITEMS**			
PC1	What is the retail price of rice (milled)?		**PC1**	
PC1.1A	Store 1		**PC1.1A**	
PC1.1B	Store 2		**PC1.1B**	
	What is the unit of measure?			
PC1.2A	Store 1		**PC1.2A**	
PC1.2B	Store 2		**PC1.2B**	
PC2	What is the retail price of corn on the cob?		**PC2**	
PC2.1A	Store 1		**PC2.1A**	
PC2.1B	Store 2		**PC2.1B**	
	What is the unit of measure?			
PC2.2A	Store 1		**PC2.2A**	
PC2.2B	Store 2		**PC2.2B**	
PC3	What is the retail price of coconut?		**PC3**	
PC3.1A	Store 1		**PC3.1A**	
PC3.1B	Store 2		**PC3.1B**	
	What is the unit of measure?			
PC3.2A	Store 1		**PC3.2A**	
PC3.2B	Store 2		**PC3.2B**	

PC4	What is the retail price of fertilizer (urea)?		**PC4**	
PC4.1A	Store 1		**PC4.1A**	
PC4.1B	Store 2		**PC4.1B**	
	What is the unit of measure?			
PC4.2A	Store 1		**PC4.2A**	
PC4.2B	Store 2		**PC4.2B**	
PC5	What is the retail price of fuelwood?		**PC5**	
PC5.1A	Store 1		**PC5.1A**	
PC5.1B	Store 2		**PC5.1B**	
	What is the unit of measure?			
PC5.2A	Store 1		**PC5.2A**	
PC5.2B	Store 2		**PC5.2B**	
PC6	What is the retail price of kerosene?		**PC6**	
PC6.1A	Store 1		**PC6.1A**	
PC6.1B	Store 2		**PC6.1B**	
	What is the unit of measure?			
PC6.2A	Store 1		**PC6.2A**	
PC6.2B	Store 2		**PC6.2B**	
PC7	What is the retail price of charcoal?		**PC7**	
PC7.1A	Store 1		**PC7.1A**	
PC7.1B	Store 2		**PC7.1B**	
	What is the unit of measure?			
PC7.2A	Store 1		**PC7.2A**	
PC7.2B	Store 2		**PC7.2B**	
PC8	What is the retail price of LPG?		**PC8**	
PC8.1A	Store 1		**PC8.1A**	
PC8.1B	Store 2		**PC8.1B**	
	What is the unit of measure?			
PC8.2A	Store 1		**PC8.2A**	
PC8.2B	Store 2		**PC8.2B**	
PC9	What is the retail price of agricultural waste?		**PC9**	
PC9.1A	Store 1		**PC9.1A**	
PC9.1B	Store 2		**PC9.1B**	
	What is the unit of measure?			
PC9.2A	Store 1		**PC9.2A**	
PC9.2B	Store 2		**PC9.2B**	

PC10	What is the retail price of batteries?		**PC10**	
PC10.1A	Store 1		**PC10.1A**	
PC10.1B	Store 2		**PC10.1B**	
	What is the unit of measure?			
PC10.2A	Store 1		**PC10.2A**	
PC10.2B	Store 2		**PC10.2B**	
PC11	What is the retail price of candles?		**PC11**	
PC11.1A	Store 1		**PC11.1A**	
PC11.1B	Store 2		**PC11.1B**	
	What is the unit of measure?			
PC11.2A	Store 1		**PC11.2A**	
PC11.2B	Store 2		**PC11.2B**	