The Impact of Energy on Women's Lives in Rural India

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Preface

The project was implemented by the Energy Sector Management Assistance Programme (ESMAP), with fieldwork cofinanced by the World Bank and the Government of The Netherlands.

The fieldwork consisted of a household energy survey of more than 5,000 households in 180 villages in six states, surveys of commercial and small-scale industrial establishments, field visits to rural areas, interviews with representatives of selected stove programs, a survey of renewable energy manufacturers, and an assessment of rural biomass resources based on secondary sources. During the course of the study, numerous government officials generously shared their time with both the local and international teams. The staff of the Ministry of Non-Conventional Energy Sources was especially supportive of this work.

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Abbreviations and Acronyms

ARI	acute respiratory infection
Cal	kilocalorie
COPD	chronic obstructive pulmonary disease
ESMAP	Energy Sector Management Assistance Programme
GOI	Government of India
IAP	indoor air pollution
kg	kilogram
KgOE	kilogram of oil equivalent
kWh	kilowatt hour
km	kilometer
l	liter
LPG	liquefied petroleum gas
MJ	megajoule
Na	not available
NCAER	National Council for Applied Economic Research
OBC	other backward castes
ORG	Operations Research Group
PREM	Poverty Reduction and Economic Management
Rs.	rupees
sq km	square kilometer
SC	scheduled caste
ST	scheduled tribe
TERI	Tata Energy Research Institute
USAID	United States Agency for International Development
WHO	World Health Organization

Currency Equivalents

1996 US$1 (dollar)	=	Rs. 35.7 (Indian rupees)
1997 US$1 (dollar)	=	Rs. 35.9 (Indian rupees)
1998 US$1 (dollar)	=	Rs. 39.4 (Indian rupees)
1999 US$1 (dollar)	=	Rs. 42.5 (India n rupees)
2000 US$1 (dollar)	=	Rs. 43.5 (Indian rupees)
2001 US$1 (dollar)	=	Rs. 56.5 (Indian rupees)

Glossary of Terms

Fuel Type	*Energy Content*			*Efficiency*
	MJ	*KgOE*	*Cal*	*for Cooking (%)*
LPG (kg)	45.0	1.059	10,800	60
Electricity (kWh)	3.6	0.085	860	75
Kerosene (1)	35.0	0.824	8,400	35
Charcoal (kg), 5% moisture content, 4% ash	30.0	0.706	7,200	22
Wood (kg), 15% moisture content, 1% ash	16.0	0.376	3,840	15
Coal (kg), (can vary significantly)	23.0	0.541	5,520	?
Dung (kg), 15% moisture content, 20% ash	14.5	0.341	3,480	?
Straw (kg), 5% moisture content, 4% ash	13.5	0.318	3,240	?

Executive Summary

1. Domestic energy concerns loom large for women in a country where 74 percent of the population resides in rural areas with uneven access to infrastructure. Cooking for the family, processing grain, doing household chores, reading or watching television during leisure hours all become major challenges. In a majority of the households, a typical day begins at the break of dawn with women and sometimes children walking some distance to fetch water in pots or walking even longer distances to collect wood and other biofuels for firing their traditional stoves. Just cooking meals occupies a good part of a woman's day, because not only does she have to physically procure the water and the biofuel, but the grains and spices used in Indian cooking often have to be manually processed before they can be used.

2. For households that have no access to electricity, household chores are often limited to daylight hours. In colder regions, firewood also has to be collected for keeping homes warm. This leaves little time for engaging in paid work or enjoying some degree of leisure. Moreover, reading for school or leisure is also often dependent on daylight hours as the commonly used kerosene lamps provide very poor quality lighting. Thus the opportunity costs of poor access to domestic energy have profound effects for all members of the family, but even more for women who are the main managers of household biomass energy.

3. This report highlights the tremendous difference that access to improved energy services in the form of biomass stoves, petroleum fuels, and household electrification makes for the life of rural women. Of course, the benefits of rural energy services can differ by region, class, caste, education, and household occupation, but the overall pattern that emerges is that the benefits of improved rural energy services for rural women in India are substantial.

An Overview of Women's Time Use

4. The focus of this study is on the implication of energy services for time spent by women on various daily activities. The behavior includes food preparation, childcare, work for income, fuel and water collection, and many others. The overall pattern of time spent on such activities is analyzed for over 5,000 women in rural India. The results are based on a household energy survey conducted in 1996 in which the main cooks in a household were asked about their time use the previous day. Thus, in interpreting these findings, it is important to keep in mind that some of the activities are performed daily while others are engaged in once every couple of days. For instance, since the women are the primary cooks in their households, they all engage in some kind of cooking-related task virtually every day. However, there are some activities such as fuel collection that women do not have to perform every day.

5. Some of the main findings, across all six states, can be summarized as follows. Women spend about 40 minutes per day collecting fuel and almost one hour fetching water (table E-1). They spend almost three hours cooking and close to six hours on other housework. They spend almost two hours pursuing income-earning activities, about 30

minutes watching TV, 8.5 hours sleeping or engaging in other leisure activity and personal care, and about 40 minutes on miscellaneous activities. However, there is much variation among states, particularly with reference to the time spent by women collecting fuel. Reflecting local resource conditions, women in Rajasthan, much of which is covered by desert, spend over an hour collecting fuel compared to women in Andhra Pradesh who spend only 20 minutes a day.

Table E-1 Women's Time Allocation in Rural Areas

(Hours of activity for the previous 24 hours)

Work/activities	*All households*		*Only households pursuing activities*		
	Mean	*Std. dev.*	*% of all*	*Mean time*	*Std. dev.*
Collecting fuel	.67	1.21	32.7	2.06	1.27
Fetching water	.93	0.63	93.1	1.00	0.60
Income production	1.90	1.96	63.9	2.98	1.67
Cooking and servicing	2.72	1.20	96.9	2.81	1.12
Household work	5.80	1.96	100.0	5.80	1.96
Food processing	*1.79*	*1.10*	*88.9*	*2.02*	*0.95*
Cleaning, dishes, house	*2.17*	*.93*	*98.6*	*2.21*	*0.90*
Childcare	*1.23*	*1.00*	*73.1*	*1.67*	*0.77*
Shopping	*0.62*	*0.96*	*40.8*	*1.52*	*0.93*
Watching TV	0.48	0.92	26.7	1.79	0.91
Reading	0.14	0.48	10.8	1.27	0.82
Other leisure activity	10.47	2.00	100.0	10.58	1.70
Taking meals	*0.65*	*0.31*	*99.0*	*0.66*	*0.31*
Bathing	*0.54*	*0.33*	*99.1*	*0.54*	*0.33*
Leisure	*0.87*	*1.09*	*52.4*	*1.66*	*0.98*
Sleep	*8.42*	*1.49*	*100.0*	*8.51*	*1.22*
Miscellaneous	0.64	1.18	29.7	2.17	1.18

Source: ESMAP Energy Survey 1996

6. Particularly striking, compared to other measures of women's labor force participation which reflect overall low participation among women in India, is that 64 percent of the surveyed women engage in some kind of income-generating activity.

The Energy Ladder and Women's Lives

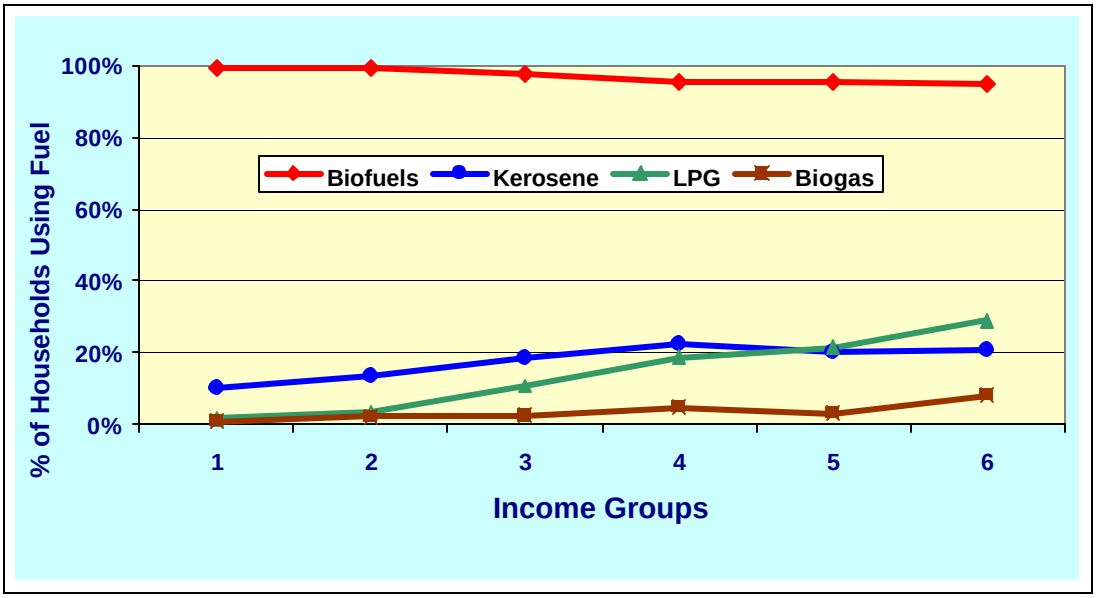
7. Moving up the energy ladder from biofuels to petroleum fuels and electricity for cooking is a distant dream in most parts of rural India. Biofuels are collected from the local environment and therefore viewed as a cheap, if not a "free" source of energy in most households. Electricity, on the other hand, is increasingly being used for lighting in households, as almost all villages in India now have access to an electricity grid. Women play an especially important role in managing domestic energy when biofuels are the principal domestic energy source. Their lower status in a largely patriarchal society renders them ideal candidates for this back-breaking, time-consuming, and in many cases unhealthy but essential "survival work."

8. The reluctance of households to move up the energy ladder has to be partially understood in light of this cultural perception of the value of women. As long as women or children are the ones primarily involved in the collection and use of biofuels, they do not require outlays of cash income by the households. Likewise, the value of collecting water and fuelwood goes unrecognized in most national accounts, but they are well recognized as a necessity for the family. As households move up the energy ladder to the use of kerosene, electricity, and LPG, one sees that the burden of collecting and using these fuels eases substantially and women devote their time to more "productive" activities as well as spending some of their day pursuing leisure. However, there is a puzzling lack of use of appliances that could lessen the time involved in such activities as grinding spices and assisting with other kitchen activities.

Implications of Biofuel Use

9. The most significant findings with regard to biofuels are that their use is pervasive, even among the wealthier rural households (Figure E-1). Second, there is a more worrying trend in some regions toward an increasing use of poor quality fuels, such as crop residues, in the mix of domestic fuels used for cooking. This has a detrimental impact on women's lifestyles, status, health, and the environment (Table E-2).

Figure E-1 Women's Cooking Fuel Use by Income Class, 1996



Source: ESMAP Energy Survey 1996

10. Nearly 80 percent of rural domestic energy needs are derived from biomass. Typically, biomass fuels such as fuelwood, dung, or crop residues are burned in traditional stoves, which are highly inefficient and harmful to health. The type of biofuel used varies by the local access to wood, agricultural residues, and dung, as illustrated in

Table E-2. While the negative impact of fuel collection on the local environment is quite well known, a factor often overlooked is the longer distance that women have to travel in deforested areas to forage for fuel. In other areas, women are compelled to use crop residues that burn more quickly and require constant attention. The poor quality of the fuel burned in combination with the use of traditional stoves result in longer cooking times and prolonged exposure to harmful smoke detrimentally impacting women's health.

Table E-2 Distribution of Fuels Used for Cooking and Heating

States	*Fuels Used for Cooking and Heating (%)*					
	Wood	*Crop*	*Dung*	*Kerosene*	*LPG*	*Biogas*
Maharashtra	92.7	31.2	71.7	25.3	2.4	7.2
Andhra Pradesh	72.5	39.8	19.5	17.9	4.7	0.8
West Bengal	38.4	55.0	78.1	22.5	1.1	4.9
Punjab	46.3	36.3	81.5	3.5	14.9	2.5
Himachal Pradesh	96.3	0.4	5.5	12.5	48.5	0.4
Rajasthan	77.4	18.4	86.1	7.0	1.0	0.0

Source: ESMAP Energy Survey 1996

11. Women in rural households spent almost three hours cooking daily meals and an additional hour or two more processing food to make it ready for cooking. Though collecting fuel may not be a daily activity, on the particular day that fuel is collected it may take up about two hours of the women's time. Of the three biofuels most commonly used in rural India, firewood was the preferred choice for its high thermal efficiency that substantially reduced cooking time, despite the fact that it involved more effort and time to collect.

12. Despite regional variation of fuel availability, overall women from higher strata of society in terms of income, education, or caste were more likely to use firewood, while crop residues were most commonly found in the mix of fuels used by the lower strata households. Poorer women also had to travel longer distances to collect fuel and thus spend more time than others. The use of improved chulhas (stoves) reduced cooking time as well as time spent collecting firewood. Because most improved chulhas also have a chimney, at least theoretically the exposure to cooking smoke also was reduced for the households that used them. Unfortunately, few households had one. Biogas stoves are also rare, but women who use them save themselves the drudgery of collecting fuel as well as cook in a much cleaner environment.

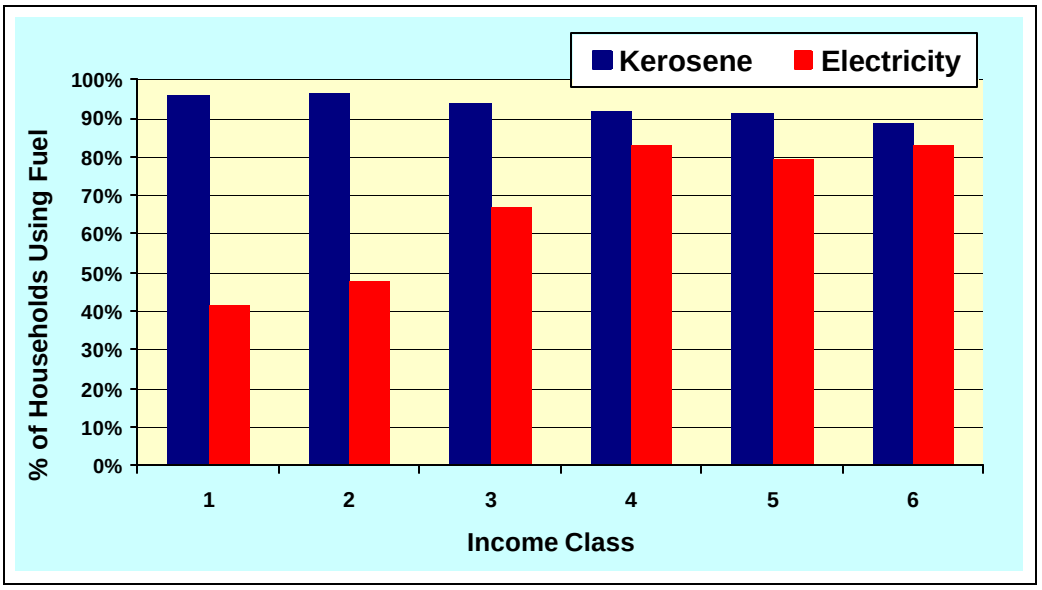
Petroleum Fuels and the Potential for Interfuel Substitution

13. Unlike urban households in India where the use of liquefied petroleum gas (LPG) and kerosene are the dominant cooking fuels, petroleum fuels are not commonly used for cooking in rural areas. According to the survey about 15 percent of rural households use kerosene stoves, with the major concentrations reported in the states of Maharashtra and West Bengal. Cooking with kerosene saves women substantial drudgery (in terms of time saved on fuel collection) and allows for a much cleaner cooking environment. The use of kerosene does free up women for the pursuit of other, more pleasant activities.

14. Remarkably, 10 percent of the households reported using LPG as a cooking fuel, but its use was limited mainly to two states. Although very clean and convenient, its relatively high price has deterred markets from extending its distribution network into remote areas. The exceptions were mainly in the more wealthy states of Himachal Pradesh and Punjab.

15. Kerosene is the most widely used fuel for lighting in rural areas (see Figure E-2). Even in households with electricity, it often serves as a backup during the frequent power outages common in India. Kerosene is distributed nationally through a government controlled public distribution system, whereby consumers are entitled to a fixed monthly quota at subsidized rates, only enough for lighting needs. It is also available at a higher price in the market for those who would like to use it as a cooking fuel. The main drawback to using kerosene for lighting is that it is very inefficient compared to electricity, resulting in a price which is sometimes 20 times higher per unit of light compared to electricity. The small quantities of kerosene used for lighting, approximately 4 liters per month, do not provide lighting quality that permits women in households to read or do other close work

Figure E-2 Percentage of Households Using Electricity or Kerosene for Lighting



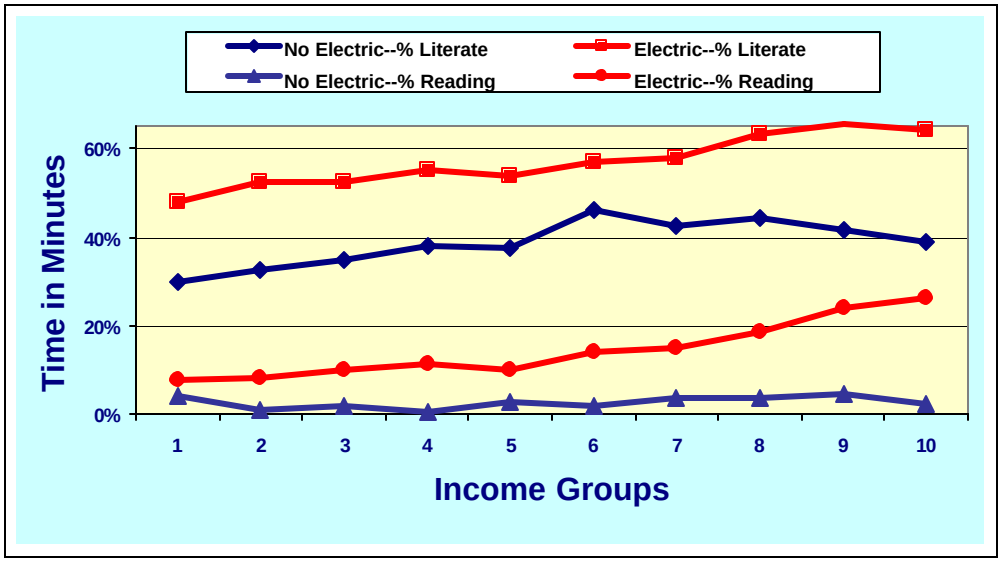
Source: ESMAP Energy Survey 1996

Impact of Household Electrification

16. While most villages in India have access to a grid, only 60 percent of the households in this study had electricity at the time of this survey. This rate is somewhat above the national average because of the influence of having in the study both Punjab and Himachal Pradesh—states with household electricity rates above 90 percent. Because of low levels of cash income, electricity is used in small quantities compared to urban households. It is used by all households for lighting, and by a large number for entertainment in the form of radio and television and for space cooling with fans.

17. Among the most significant findings in relation to the benefits of electrification were those that related to reading and watching television. Ninety percent of the women who spent some time reading resided in homes with electricity. In fact, across all levels of education the chances of women reading during a day were much higher for homes with electricity. This is illustrated in Figure E-3, in which both the level of literacy in the family and reading by women is related to electricity status and the income of the households. The level of literacy is somewhat lower in households without electricity, but the very interesting finding is that virtually no reading is going on in these households regardless of the level of family literacy. Thus, electrification has important consequences for the continuing education of women. In general, women from homes with electricity were better able to balance paid work, household chores and leisure than women from homes without electricity. However, social and economic background does make a difference with regards to the benefits of electricity for rural households.

Figure E-3 Electricity, Women's Reading and Household Level of Literacy, 1996

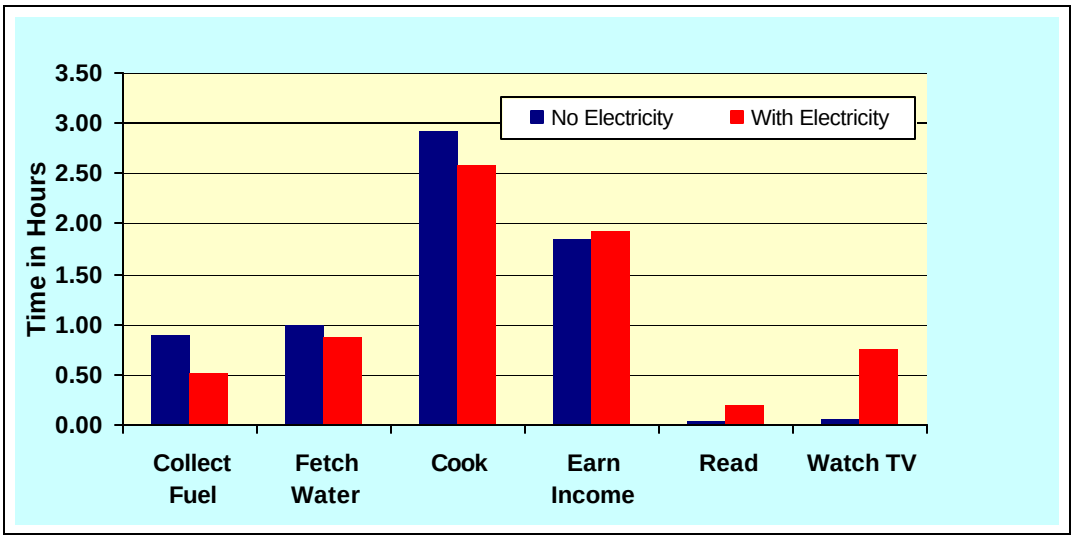


Source: ESMAP Energy Survey1996

18. As indicated, TV ownership was surprisingly widespread, given the cost of the appliance relative to incomes. More than 40 percent of homes with electricity had invested in a set. And while the entire family may enjoy it, it is striking how the majority of women despite their many responsibilities seemed to make the time to watch TV, if the household owned a set. On average, they spent almost two hours a day pursuing this form of leisure (Figure E-4). Though there is no indication of the programs they watched, this use of electrification has promising potential for continuing education or information dissemination.

19. While it is undeniable that household electrification has a positive impact on women's lives, in some ways it could have done more for rural women. Appliances such as grinders and refrigerators are rare in rural areas. The considerable amount of time women spend processing food in rural India could be easily reduced through the use of a simple, inexpensive grinder. However, less than 10 percent of households had invested in one, a number equal to those that own a refrigerator, which is far more expensive. Thus, as households add new appliances, the impact of electricity on rural households will become even greater.

Figure E-4 Women's Time Use During Waking Hours in Households With and Without Electricity



Source: ESMAP Energy Survey 1996

Conclusion and Policy Implications

20. Many of the policy recommendations to improve the lives of women in India actually involve enhancing already established programs. The shift to petroleum fuels for cooking is highly beneficial and much desired by women, but the absence of markets and distribution networks, along with the low levels of cash income in most rural households, makes this difficult for most. The continued development of the effectiveness of improved biomass stoves is important. Finally, household electrification already is a reality for many and has tremendous potential to enhance the status of women and improve their lives. The findings on the benefits of electrification are quite encouraging, so greater efforts are necessary to expand household coverage in rural areas. Improving electricity and petroleum policies and distribution will help all individuals, but have particularly important implications for women.

21. Although improving existing policies is important, the need to more widely approach domestic energy policy from a gender perspective has still to gain widespread acceptance. These include generating opportunities for income for women through skill training and extending microcredit facilities, encouraging market development for technologies that ease women's burdens, involving beneficiaries in projects and using the influence of television as a medium for change.

22. Unfortunately, the long, unrecognized hours spent by women on arduous, unhealthy, and unpleasant tasks are rarely perceived as a central issue in most countries. The continuing use of biomass fuels and unhealthy traditional stoves is inextricably linked with women's low social status and lack of economically rewarding work. Survival work consumes their lives, leaving little energy to focus on status enhancement activities such as education or paid work. Therefore more attention is necessary to enhance the household benefits of major sectoral programs such as those providing electricity and LPG, which would complement programs to improve biomass use in rural areas.

1

Introduction

1.1 The type of energy used in a household has significant consequences for the environment, for the health of family members, and for the lives of women. In most of the developing world, people rely on traditional fuels for cooking and heating owing to the fact that it can be collected without any expense on the part of the household. Nearly 80 percent of India's domestic energy needs are derived from biomass. Typically biomass fuels such as fuelwood, dung, or crop residues are burned in traditional stoves, which are highly inefficient and harmful to health. Also, the effort and time spent collecting biofuels has been increasing throughout the developing world because of shortages caused by localized deforestation. The primary group that is affected by this increasing drudgery is women, as in most regions they are largely responsible for collecting and using the fuels—and therefore play a crucial role in biomass management. Similarly the widespread dependence on kerosene for lighting in rural areas limits the possibility of reading by family members, and this might possibly lead to lower levels of education for children. Access to the use of lights, television, and energy-saving appliances through household electrification then becomes important for improving the lives of women. Thus, energy strategies have both short- and long-term impacts on poverty alleviation and the health of rural people, and consequently on the lives of women.

1.2 The primary goal of this study is to identify the impact of various fuels on specific tasks for which women are primarily responsible and seek solutions that will enhance their quality of life. The issues are addressed in a quantitative way and are based on about 5,000 household energy interviews that were conducted in six states of India in 1996 (see chapter 2 for details). The survey covered all aspects of rural energy use, and also contained a section on women's time use, allowing the researchers to relate the use of women's time to the utilization of energy.

1.3 The study examines the impact of various household energy types and the availability of village infrastructure on women's lives. The potential impact of improved reliability of electricity supply on women's use of time also is explored. Finally, in addition to examining institutional and policy constraints involving rural energy, we conclude by outlining potential strategies and policies related to household energy use with a view to improving the welfare of women. But before turning to the results of the analysis, a background is provided on the extensive literature involving women, energy, and development.

Background on Women and Energy

1.4 One of the first studies to recognize the impact of the fuelwood crisis on Indian women was undertaken by Bina Agarwal (1986), who documents the hours women spend on collecting fuel on a daily basis. She implicates various developmental projects that lead to severe deforestation. As forests were cleared for the expansion of railways, pastures, mining, industries, and agriculture, access to wood by some rural household became difficult. She reports that in the severely depleted forest areas of Gujarat, women and children spend as much as five hours a day collecting fuel. Reviewing various studies on firewood collection in India, she found that the distance traveled averaged between 4 and 10 kilometers in search of firewood, depending on the ecological environment. In forested areas, the collection may have been done once in four days, while in depleted areas it was a daily activity. Since wood is the predominant fuel used for cooking and fuel collection is a woman's responsibility in most of the developing world, the implications for their well-being are serious. Apart from the drudgery, the time and effort spent collecting fuel limits women's opportunity to spend time on income-generating activities or educational and leisure pursuits.

1.5 More recently studies on traditional stoves using biomass fuels have examined the health impact on women exposed to continuous smoke while cooking. The prolonged exposure to respirable suspended particles and carbon monoxide has been found to have severe detrimental effects on the lungs and eyes of anybody in the proximity to such stoves. Studies across various developing countries have also documented that women who cook on an indoor open fire using biofuels suffer from chronic obstructive pulmonary diseases (Ostro, Aranda, and Eskeland 1995; Parikh and Laxmi 2000; Smith 1987, 1998; Smith and Mehta 2000; NFHS 1995).

1.6 However, traditional biomass fuels continue to be widely used for cooking in rural India. Evaluation surveys conducted by the National Council for Applied Economic Research (NCAER), New Delhi reflect this increasing use (Natrajan 1999). Between 1978 and 1993, while the allocation among the various biofuels (expressed as their percentage share) may have undergone some change, the total share of biofuel use by rural households in India remained unchanged at about 95 percent (Table 1.1). Another notable change over the years is the increasing use of logs over twigs.

1.7 While replacing traditional fuels with commercial fuels such as kerosene and LPG is desirable, poverty and lack of access to infrastructure inhibit such a shift in rural areas. The Government of India has therefore focused on promoting cooking devices that are fuel-efficient instead. Improved stoves not only have a much higher thermal efficiency, but also to some extent resolve the indoor air pollution (IAP) problems created by the use of traditional stoves. Higher efficiency means fewer quantities of fuel required, and hence there is less time and effort expended to collect the fuel. It also implies less time spent exposed to a polluted environment.

Table 1.1 Energy Consumption for Cooking and Heating of Rural Household, Rural India 1978-1992

	1978-79		*1992-93*	
	Quantity (thousand tons of coal replacement)	*% Share*	*Quantity (thousand tons of coal replacement)*	*% Share*
Coal/soft coke	1,713	1.92	584	0.38
Kerosene	2,279	2.55	6,831	4.44
Dung	20,109	22.51	26,151	17.00
Firewood, logs	16,905	18.95	49,989	32.49
Firewood, twigs	31,774	35.62	44,785	29.11
Crop residue	15,531	17.41	20,530	13.35
Others	913	1.03	4,971	3.23
Total	89,202	100.00	153,841	100.00

Source: National Council for Applied Economic Research, 1999

1.8 Studying women's time allocation thus becomes an important part of our understanding of the impact of the use of biomass energy sources. As in most developing countries, the tasks that are essential for the family's survival but remain monetarily unrewarded are the burden of women. These tasks range from collecting fuel and fetching water to household work and the rearing of children. As noted earlier, the longer time taken to accomplish such tasks means less time for women to generate income or to pursue leisure activities.

Traditional Fuel Use and Redefinition of Women's Work

1.9 Most studies have focused on the impact of traditional fuel use on the environment and on women's health. While these are meaningful topics, from a gender perspective, the time women spend collecting fuel and other subsistence activities becomes an important factor in understanding the constraints and choices they face in their everyday life. It opens another window to understanding their low status in most societies. For example, time spent on income-producing work, which may leverage a woman's status both inside and outside of the household, may be seriously compromised because of these unpaid, unrecognized responsibilities.

1.10 In its most widespread statistical conception, the term "work" has been used for activities that are undertaken for pay or profit. This definition becomes quite problematic in partially commoditized economies as many of the activities that are central to survival and well-being remain neglected. Moreover, since the hierarchical nature of the gender division of labor in all societies relegates more women than men to the unpaid and subordinate activities, such a definition renders invisible the long working hours of half of humanity (Beneria 1982).

1.11 Unless work is directly related to the market, it largely remains unrecorded or hidden (Jain 1996; UN 1995; Beneria 1982; Tomoda 1985). Some have argued that much of the invisibility is a result of the imposition of western paradigms of women's time use such as the "housewifization" of developing world women, who in reality are often more than equal partners in the subsistence of the household (Mies, 1986a; Mies et.al. 1988). Still others argue that there is a bias in the implementation of development projects (Boserup 1970; Beneria 1982; Mies and Shiva 1993) because they focus too much on income production in monetary terms.

1.12 Beginning with the feminist movement, scholars began to reevaluate the definition of work and the place of housework in such a schema. This initial debate fermented into various programs of scholarly research, one of which was the evaluation of women's work in developing countries. Women's labor force participation rates remained consistently much lower than men's in all countries using census and other large survey data. While this reflected the plight of women in the monetized economy, it also perpetuated an image of women as dependents and men as the "breadwinners." Women's household and subsistence work were seen as outside the economy, since it had no market value (Beneria 1982, p. 128). In fact, many economists used to link housework with consumption rather than production.

1.13 The mid-1970s witnessed a growing dissatisfaction with such interpretations and a search for better measures that would capture all activities, be they of "market" or "use" value. As a culmination of years of research, the United Nations Human Development Report in 1995 featured gender discrimination as its theme (UN 1995). Incorporating both work that had been conventionally classified as "economic activity" and work that was unpaid and outside the sphere of the System of National Accounts but had productive value, an attempt was made to uncover the invisible, unrecognized, and unvalued work performed by millions for human well-being. Utilizing time use studies from multiple nations across all levels of development, the report highlighted the fact that women actually perform more than 50 percent of the work in the world. Women in developing countries perform 53 percent of the work and yet get monetarily rewarded for only 34 percent of their labor. Men, on the other hand, perform only 47 percent of the work in developing countries, but get credit for as much as 74 percent as measured through the formal market sector. This report was the first important document to reveal the true contribution of women's work on a global scale. What is noteworthy here is that such a finding would not have been possible had it not been for two paradigm shifts, namely the redefinition of work to include nonmarket activities and the use of time allocation instead of census categories as the basis for labor force participation.

1.14 While recognizing the contribution of the United Nations Human Development Report (1995) in using time allocation to reveal gender disparity in the realm of work, Jain (1996, p. 55) has strongly challenged the valuation of work in terms of monetization. Advocating a need for more radical steps to further the cause of women's work she writes that time itself can be used to evaluate the value of women's work. Following Jain's lead, this research views women's time use as a measure of their labor.

Findings on Women's Time Use

1.15 It is quite clear that using census or occupational categories to document women's work and its implications on their lives is inadequate for a true understanding of their contribution to the economy, whether involving household production or market activities. As time allocation studies become more common, they help to unveil the burdensome and unrecognized work that women do, all over the developing world. By ignoring this work as analysts and policymakers, we risk the danger of initiating development programs that fail to solve the real problems and fail to target the right people.

1.16 Several studies in India have examined patterns of time use by rural women. In a time allocation study of rural Karnataka, women were documented as spending on average 8.73 hours a day on housework (Shailaja 2000). Women spent 55 to 171 minutes per day on cooking activities depending on the cooking practice. They spent 2.2 hours on average on fuel-gathering activities. Women also fetched water, cleaned, cared for children, and carried food to the farm as part of their household responsibilities. In addition, they spent an average of about 2.2 hours on animal care activities, such as shed cleaning, milking, harvesting, and transporting for livestock. In fact the study finds that women and children put in about 60 percent of the labor in various livestock maintenance activities. With respect to agricultural operations, the authors found that of every 100 "man hours," 74 are actually "women hours." They are mainly responsible for the activities that are arduous, time specific, and critical to the productivity of crops, such as transplanting, weeding, and harvesting.

1.17 Furthermore, women in some parts of India are involved in the collection of nontimber forest produce such as mushrooms, sal leaves, tendu leaves, flowers and seeds, medicinal herbs, and so on (Shailaja 2000). In Manipur, 87 percent of the total population depends on such nontimber forest produce as a major source of their income—and for 65 percent of the women, it is their only source of income (Kaur 1988). In other areas, selling headloads of fuelwood in nearby towns is women's sole source of income. Of the 2–3 million people engaged in this activity, it is estimated that the majority are women (Venkateswaran 1992).

1.18 A recent study on the health effects of the use of biofuels in rural Tamilnadu shows that women spend an average of 2 hours and 45 minutes on cooking activities, while they spend 2 hours and 30 minutes on average collecting firewood (Parikh and Laxmi 2000). The time spent collecting fuel of course varies with the agroclimatic region as well as the type of fuel commonly collected. Studies in urban slums near Delhi have also recorded that women spend an average of two hours per day cooking (Malhotra, Saksena, and Joshi 2000).

1.19 In higher altitudes, such as the Garhwal region of the Himalayas, a time allocation study documented that women on average spend between four and five hours a day cooking, depending on the season. They spend over three hours collecting wood and another three hours collecting fodder in monsoon and winter. In summer, women work an average of about five hours a day on the fields but spend less time collecting fuelwood. Women enjoyed only two hours of leisure per day during this season, while their male counterparts enjoyed over seven hours of the same. Throughout the year, women tend to sleep and enjoy leisure for much fewer hours than the men (Saksena, Prasad, and Joshi 1995).

The Importance of Household Energy for Women's Work

1.20 As noted above, household energy use has important implications for the life of women in rural areas in developing countries, owing to the importance of biofuels and the role women play in managing and using them. But other forms of energy, such as electrification for lighting and entertainment, also affect women's lives significantly. Women in hitherto remote rural areas have the opportunity to be exposed to knowledge and perspectives far beyond their limited horizons. Access to electrification in the household makes it possible for women and children to read and watch television in the evening. Both of these activities help to promote the knowledge and awareness of women in remote rural areas, apart from their leisure value. In developing countries such as India, electrification—because of its high cost and limited availability—is primarily used for lighting, running fans, and entertainment, and is not used much for cooking, even though it has the potential to change some of the time-consuming aspects of Indian cooking, such as food processing.

1.21 An increasing scarcity of locally available biofuels, especially wood fuels in developing countries, has led to an increase in the time spent on the collection of fuels. Furthermore, the declining quality of the available fuelwood tends to increase the net weight to be carried for cooking as well as the smoke pollution emitted by lower quality fuels. Smith (1998) has noted that in trying to cope with these conditions, women not only use their time inefficiently, but also adopt cooking practices that may lower the nutritional status of the family by reducing the number of meals, cooking less thoroughly, or changing the type of food cooked. They also find themselves carrying physical loads that are unhealthy in size and quantity.

1.22 Cooking fuels such as kerosene and LPG are recognized as good substitutes for traditional biofuels because of their higher thermal efficiency and the relative lack of pollutants. But in addition to these qualities, the use of such fuels also saves women time to pursue more productive tasks. Commercial fuels eliminate the need to walk long distances and gather wood or dung, thus reducing the drudgery in women's lives. They also reduce cooking time substantially. Time saved can be used either for income-earning pursuits or for some additional leisure.

1.23 The "real" energy crisis may be that of women's time (Tinker 1988). With all the burdensome survival tasks that women have to pursue in rural areas, technological solutions to energy problems that require even greater investments of women's time are bound to fail. Rural energy needs have to be identified not only with biomass fuel and other energy shortages, but with the scarcity of women's time. After spending hours processing food, gathering fuel, and fetching water, women find little time to work on adopting new practices suggested by development programs. Instead, if one has a good understanding of women's lives and needs, programs can be specifically designed to address them (Tinker 1988). Increasing income-earning opportunities may have a more positive impact on the adoption of cleaner fuels than imposing improved chulhas and biogas stoves through subsidies. Studies have shown that when women earn money, their income goes entirely toward household needs, whereas income from men is rarely spent on devices or appliances that would ease the subsistence burdens of women (Dixon 1978; Dube, Leacock, and Ardener 1986).

1.24 A better life for women with reduced drudgery, income-earning pursuits, and greater awareness of and access to information should have a definite effect on their status in society. It is the impetus of bringing about this change that makes it imperative that we study the effect of household energy use on rural women through an understanding of their time allocation.

Organization of This Report

1.25 The report opens with a broad overview of the socioeconomic reality that describes women's lives in the various agro?climatic zones of India. After analyzing the characteristics of the specific areas and women in the study sample, it narrows its focus to explaining the link between household energy use and women's lives.

1.26 The next chapter describes the individual-, household-, and village-level realities that emerge from the data. It provides an understanding of the age range of the women we are examining, their caste, household income, occupation, and level of education; the infrastructure available in their villages; the energy use patterns in their households; and how they allocate their time on a daily basis.

1.27 The report then moves on to analyzing the relationship between cooking fuels and women's time allocation. It tries to uncover the tradeoffs women make in their lifestyles when using a particular fuel and provides a basis for comparison. It also looks at the relative levels of indoor air pollution depending on the choice of fuel. Biomass fuels and petroleum fuels are analyzed in two separate chapters.

1.28 The next chapter focuses on understanding the direct or indirect relationship between household electrification and women's lives.

1.29 The final chapter lays out the scope, institutional strategies, and programs currently in place to improve the plight of women in rural India with respect to household energy use. Analyzing their strengths and drawbacks in view of our analysis, we conclude with recommendations for alternative strategies and policies that are better targeted to enhance the quality of women's lives.

2

Study Background for Women and Energy in Rural Areas

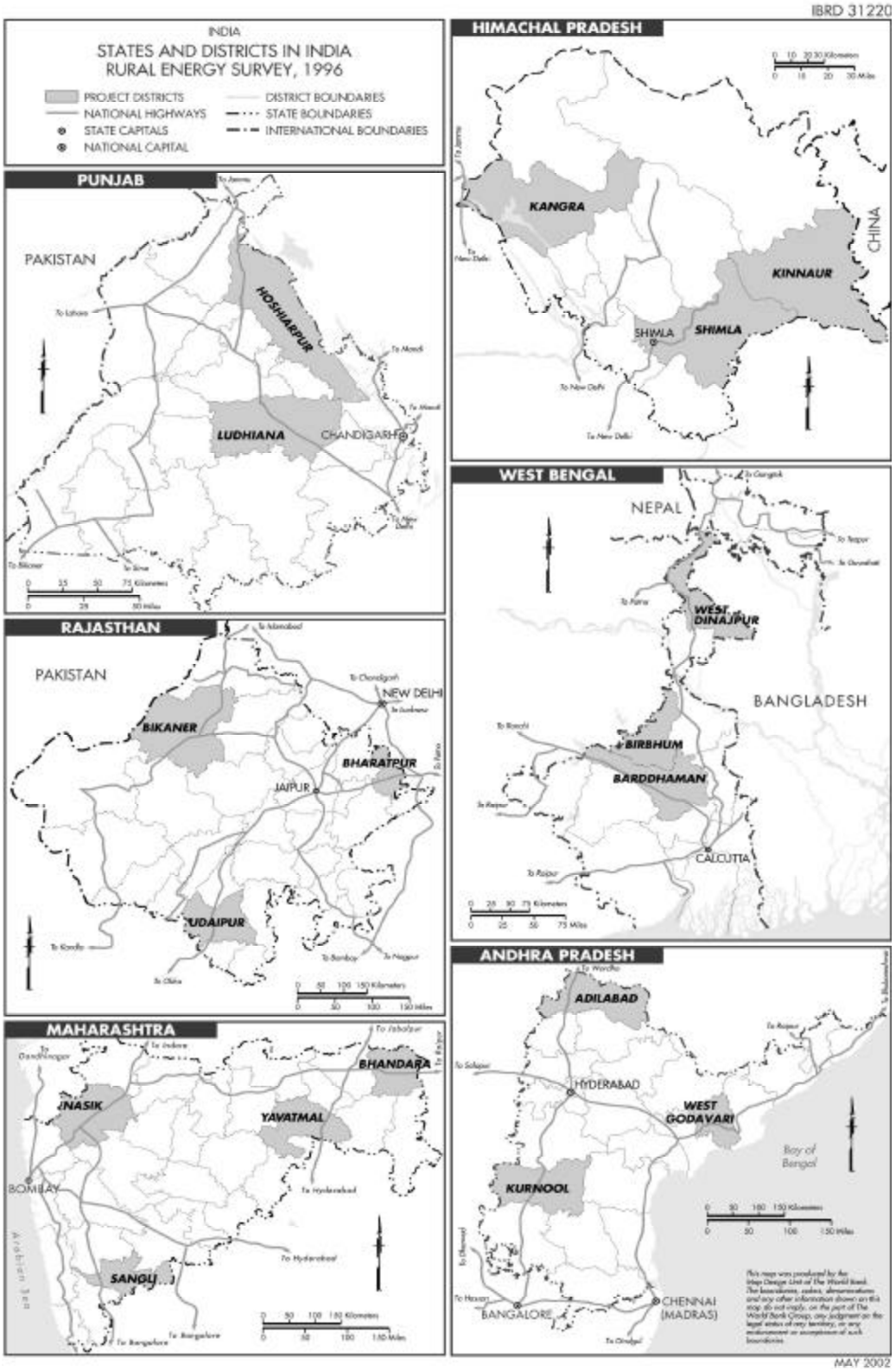
2.1 The large variation in terrain, climate, cultures, and economies has always been the hallmark of India. Language, diets, clothing, beliefs, and practices vary quite widely across the country. And yet the lives of rural women remain challenging in most regions. Gender disparity colors their lives by burdening them with most of the unpaid, unrecognized, burdensome tasks of daily living. Historically the northern states have tended to be more conservative in their attitudes toward women than the states in the south. Institutions of patriarchy still have a much stronger hold in the north (Kishor 1993; Malhotra and others 2000). Consequently the northern states have high rates of female infanticide and feticide, gender disparity in education and earning opportunities, and practices such as "purdah" (veiling of women) and the demand for large dowries at weddings (Dasgupta 1987; Desai and Jain, 1992; Kolenda and others 1996).

2.2 The six states examined in this study capture that diversity of socioeconomic, cultural, and agroclimatic zones. The regions selected are representative of the diverse climates, topography, soil, agricultural produce, and rural economies found in the country. In addition, the sample also purposively includes some districts to increase the representation of certain lower caste or tribal groups.

Background of the Six States in the Study

2.3 The six states surveyed were chosen to provide a wide range of climatic, topographic, and socioeconomic development. They are Andhra Pradesh, Himachal Pradesh, Maharashtra, Punjab, Rajasthan, and West Bengal (see Map 1). Population densities vary widely among these states, from 77 persons per square kilometer (sq km) in Andhra Pradesh to over 600 per sq km in West Bengal (Table 2.1). Likewise, the agricultural resource base varies considerably. For example, Andhra Pradesh, located in the southeast, contains a subhumid coastal region on the Bay of Bengal, which changes into the semiarid Deccan Plateau. Soils vary from coastal alluvial to red sandy and loamy in the highland areas. The state of Maharashtra, which adjoins Andhra Pradesh and stretches westward to the Indian Ocean, is largely semiarid. West Bengal, stretching from the Bay of Bengal northward to the Himalayas, has a humid climate, and the southern part benefits from the rich soils resulting from alluvial deposits of such major river systems as the Ganges and the Brahmaputra.

Map 1. Sample Districts in Rural Energy Survey, India, 1996



2.4 The three northernmost states—Punjab, Rajasthan, and Himachal Pradesh—though contiguous, also differ considerably. More than one-third of Rajasthan is desert, and shortage of water is a major obstacle to the region's development. Punjab, to the north of Rajasthan, is an agricultural success story. Though rainfall is minimal, irrigation has permitted much of the land area to be brought under efficient and productive cultivation. Himachal Pradesh, in the western Himalayas, has a largely temperate climate. It has significant water resources because of the many rivers that originate in the state and deposit alluvial soils in the valleys.

2.5 Labor productivity in Punjabi agriculture is five times higher than in the other states surveyed because there is less spread in productivity of land. Punjab is closely followed by West Bengal and Andhra Pradesh, where highly labor-intensive cropping patterns are practiced.

Table 2.1 Economic and Social Indicators of Six States, India 1991 and 1996

Column Headers	*Andhra Pradesh*	*Himachal Pradesh*	*Maharashtra*	*Punjab*	*Rajasthan*	*West Bengal*
Land area (millions of hectares)	27.5	5.6	30.8	5.0	34.3	8.9
Forest area (millions of hectares)	4.7	1.3	4.4	0.1	1.3	0.8
Total population (in millions)	72.2	5.7	85.8	23.3	47.6	74.1
Population density (per sq km)	195	77	204	333	100	615
Rural population (%)	77	92	65	72	79	74
Rural poverty (%)	39	25	42	11	37	40
Pucca housing (%)	14	15	2	52	15	9
Houses with electricity (%)	64	96	65	94	33	22
Mean annual household income (Rs)	17,322	40,724	24,236	41,149	34,551	20,427
Illiteracy (%)	18	6	9	4	18	13
Agricultural productivity (Rs/capita)	1,855	n.a.	2,133	10,009	2,349	5,275
Land productivity	4,734	2,344	3,022	6,372	1,424	5,275

Source: World Bank 2002a (from census of India 1991)

2.6 Differences in population densities, climatic resources, and agricultural development are reflected in the diverse social and economic environment of the rural populations. Punjab, Himachal Pradesh, and Rajasthan have the highest rural household incomes, roughly twice that of other states, which also have the highest rates of rural poverty (table 2.1). Rajasthan's rate of rural poverty, also high, suggests that this state has a more unequal income distribution than others, given its high mean income. Educational attainment tends to follow the level of household income, with two exceptions: Rajasthan, which has a higher illiteracy rate than might be predicted by its higher income; and Maharashtra, which has a lower rate of illiteracy. The comparatively high level of economic development in Punjab is illustrated by the higher quality of housing. In the Punjab 52 percent of houses are *pucca* (constructed of bricks or similar materials), compared with 10–20 percent in the other five states.

2.7 Finally, Punjab and Himachal Pradesh have by far the highest level of electricity connection rates (94 and 95 percent, respectively). In Andhra Pradesh and Maharashtra, about two-thirds of households have electricity connections. Rajasthan and West Bengal lag behind the others (34 and 23 percent, respectively). The low rate of connection in Rajasthan is primarily a function of the scattered population. In the case of West Bengal, the low level of income and policies by the state and central government have held back the rate of rural electrification. The vast differences among the states surveyed are typical of India's many differences, and help provide a balanced view of the country's rural energy use.

2.8 This report largely relies on the data gathered through the household- and village-level surveys conducted in India as part of a rural energy strategy, whose report titled *Energy Strategies for Rural India: Evidence from Six States* (World Bank 2002a) may be consulted for details of the sampling and the design of schedules. In all, 5,048 households in 180 villages across the six states were interviewed in 1996. Detailed data on household demographics, energy use, appliance ownership, consumption costs, attitudes to change in energy use were collected. Furthermore, the time allocation pattern of the primary cook in each household was recorded, along with that person's knowledge and attitude toward renewable energy devices. In addition to household-level data, the survey also collected information on access to infrastructure in the 180 villages.

Time Use of Primary Cooks—Women and Girls

2.9 One of the strengths of this study is the rich data on women's time allocation across culturally different parts of India. All primary cooks in the household are female and their age varies from only 10 years to 90 years of age, with a mean age of 35 years. Since the interest in the original research with respect to time allocation was on evaluating the impact of fuel use on the main managers of fuels, the time allocation sample is limited to women who shoulder the primary responsibility for cooking in the household. Time use of other members such as men and children is not available. However, there is considerable advantage in looking specifically at this category of women because all women spend a substantial part of their lives as primary cooks, and the impact of electricity and other fuel use may particularly affect this role. Moreover, when studying women's lives, time allocation data is one of the best ways to capture all the nonmarket work that women do (UN 1995).

2.10 Each respondent was asked to provide an estimate in minutes, of time spent on various precategorized activities, based on their experience the previous day. Thus, each respondent had to account for 24 hours or 1,440 minutes. For the purposes of this study, the activities pursued in a 24-hour day have been categorized as collecting fuel, fetching water, cooking, other housework, earning income, watching TV, reading,

other leisure, and other miscellaneous activities.[1/] Fuel collection often implies walking long distances to the nearest forest or brush growth for firewood or in search of cow dung and/or crop residues. Fetching water in rural India also involves in most cases walking relatively long distances to the water source and carrying several pots of water on the head or hip. Cooking time includes actual time cooking and serving, but it excludes time spent processing food. This is done specifically to analyze the relationship between fuel use and IAP exposure during cooking. Housework is defined as time spent on processing food, cleaning dishes, house and clothes, childcare and shopping. Income-producing activities can range from working for hours in the fields for wages or contributing to the family farm as well as tending animals that are a source of marketable milk or eggs. Time spent on leisure includes socializing, sleeping, and personal care activities such as bathing and eating. Reading and watching television are categorized separately owing to our specific interest in electricity impacts. The miscellaneous category is included to capture other activities that women may pursue apart from all those listed above and to account for what remains of the 24 hours in a day.

2.11 Time spent on an activity also has important implications for the study because while some women spend varying amounts of time participating in particular activities, others may spend none at all. Of course this excludes housework and leisure. Since the women are the primary cooks in their households, they all engage in some kind of household work. Similarly, all women spend time pursuing "other leisure," which includes sleeping and personal care activities. It is activities such as fuel collection, fetching water, income generation, watching TV, reading, and miscellaneous work that either do not have to be performed as a daily activity or do not have universal applicability.

2.12 As might be expected, according to the survey, fuel had been collected the previous day by less than 33 percent of the women in the sample (table 2.2). This reflects the fact that a small percentage of households do not rely on biofuel sources for cooking, but is mainly because fuel collection is often pursued only intermittently, and not necessarily every day. Unlike fuel, fetching water seems to be a more universal daily chore, with 93 percent of the sample reporting that they spent some time on it. On average, across all six states, women spend about 40 minutes collecting fuel, almost an hour fetching water, almost 3 hours cooking, and close to 6 hours on other housework. They spend almost 2 hours pursuing income-earning activities; about 30 minutes watching TV; 6 minutes reading; 10.5 hours sleeping, pursuing other leisure, and personal care; and finally about 40 minutes on miscellaneous activities. However, there

[1/] There are 15 categories of activities in the original survey: resting, bathing, taking meals, leisure, childcare, fetching water, collecting fuel, processing food, cooking, cleaning dishes/house/clothes, income-generating activity, shopping, watching television, reading, and other miscellaneous activities. Income-generating activities include all work related to agriculture, animal husbandry, household industry, and others that provide the family or woman with income. The detailed categories provide us with rich data not only on women's work but also their leisure pursuits and time spent on personal care. Similarly, the separation of watching TV and reading from other leisure allows us to capture directly the impact of electricity on time allocation involving leisure activities (Table 2.2).

is much variation among states, particularly with reference to the time spent by women collecting fuel. For example, on average, women in Rajasthan spend over an hour collecting fuel, while the women in Andhra Pradesh spend only 20 minutes a day.

2.13 Particularly striking is the percentage of women who engage in some kind of income-generation activity. Compared to other measures of women's labor force participation (which reflect overall low participation among women in India), the time allocation data used in this study reveals that 64 percent of our sample engage in some kind of income-generating activity. Only 27 percent and 11 percent of our sample spend time watching TV and reading, respectively. Finally, 30 percent of the women report engaging in miscellaneous activities.

Table 2.2 Women's Time Allocation in Hours, Rural India 1996

(N = 5,048)

Work/Activities	*All households*		*Only households pursuing activities*		
	Mean	*Std. dev.*	*% of all*	*Mean time*	*Std. dev.*
Collecting fuel	.67	1.21	32.7	2.06	1.27
Fetching water	.93	0.63	93.1	1.00	0.60
Income production	1.90	1.96	63.9	2.98	1.67
Cooking and servicing	2.72	1.20	96.9	2.81	1.12
Household work	5.80	1.96	100.0	5.8	1.96
Food processing	*1.79*	*1.10*	*88.9*	*2.02*	*0.95*
Cleaning, dishes, house	*2.17*	*.93*	*98.6*	*2.21*	*0.90*
Childcare	*1.23*	*1.00*	*73.1*	*1.67*	*0.77*
Shopping	*0.62*	*0.96*	*40.8*	*1.52*	*0.93*
Watching TV	0.48	0.92	26.7	1.79	0.91
Reading	0.14	0.48	10.8	1.27	0.82
Other leisure activity	10.47	2.00	100.0	10.58	1.70
Taking meals	*0.65*	*0.31*	*99.0*	*0.66*	*0.31*
Bathing	*0.54*	*0.33*	*99.1*	*0.54*	*0.33*
Leisure	*0.87*	*1.09*	*52.4*	*1.66*	*0.98*
Sleep	*8.42*	*1.49*	*100.0*	*8.51*	*1.22*
Miscellaneous	0.64	1.18	29.7	2.17	1.18

Source: ESMAP Energy Survey 1996

Note: This is data from a survey conducted in India in 1996, and reported in World Bank 2002a.

Household Fuel Use

2.14 The most common form of energy used for cooking and heating are the biomass fuels of firewood, dung cakes, and crop residues. For lighting, the most common fuel used is kerosene followed by electricity. The specific fuel used varies quite greatly by state (table 2.3). Households in states such as Maharashtra and Andhra Pradesh mainly depend on firewood for cooking, while in Himachal they use it both for cooking and space heating. In West Bengal and Punjab, households use dung cakes more than other fuels for cooking. Most households in Rajasthan seem to be using a combination of

firewood and dung cakes. A notable exception to the use of biofuels for cooking is the case of Himachal Pradesh. Almost half the households seem to use liquid petroleum gas. For lighting, kerosene is widely used across all states. However, it may also be used for cooking in some households. Himachal Pradesh and Punjab stand out in terms of the spread of electrification. Almost all households seem to have access to electricity. The implications of these fuel use patterns for time use are discussed in the following chapter.

Table 2.3 Fuels Used for Cooking, Heating, and Lighting by State, Rural India 1996

States	*Fuels used for cooking and heating*					*Fuels used for lighting*	
	Wood (%)	*Crop (%)*	*Dung (%)*	*LPG (%)*	*Biogas (%)*	*Kero (%)*	*Elect (%)*
Maharashtra	92.7	31.2	71.7	2.4	7.2	98.3	65.4
Andhra Pradesh	72.5	39.8	19.5	4.7	0.8	97.8	63.9
West Bengal	38.4	55.0	78.1	1.1	4.9	99.1	22.6
Punjab	46.3	36.3	81.5	14.9	2.5	78.8	94.3
Himachal Pradesh	96.3	0.4	5.5	48.5	0.4	96.6	95.4
Rajasthan	77.4	18.4	86.1	1	0	89.0	33.6

Source: ESMAP Energy Survey 1996

Socioeconomic Characteristics of Households and Women's Lives

2.15 Previous research has shown that family characteristics such as household income, level of education, caste, occupation, and household size have a substantial impact on women's lives. For example, leisure is a mark of privilege in India and the more wealthy the households, the more leisurely the women's lifestyles. Since manual labor is considered degrading, the rich often employ servants to perform household tasks. Thus, women from well off homes work much less than those from more modest households. The influences of these characteristics and the way they are measured are examined in this section. In addition, a background is provided on the households in the study, in conjunction with the main variables used for the analysis in this report.

Household Income

2.16 Household income influences women's lives both directly and indirectly. A higher standard of living generally means that women would be less likely to perform drudgework such as fetching water and fuel. This is because these activities may not be necessary, thanks to access to commercial fuels for cooking or better storage facilities for water. In addition, rich households can afford to employ paid labor to do these tasks.

Women from rich households are also not likely to pursue income-earning activities because of the value placed on leisure as well as sanskritized codes of conduct[2/] that restrict women to the house. The average household income is highest in Punjab, followed by Himachal Pradesh. On the other hand, states with the highest number of laborer households such as Andhra Pradesh and West Bengal have the lowest average household incomes (Table 2.4).

Table 2.4 Annual Household Income by State, Rural India 1996

States	*Income per household (average Rs/year)*			
	Minimum	*Maximum*	*Mean*	*Standard deviation*
Andhra Pradesh	1,000	160,000	17,322	17,483
Maharashtra	1,000	417,000	24,236	30,933
Rajasthan	600	210,400	34,551	32,968
Punjab	1,000	360,000	41,149	4,874
Himachal Pradesh	1,200	736,500	40,724	45,656
West Bengal	1,100	316,000	20,427	20,396
Total	600	736,500	27,999	32,911

Source: ESMAP Energy Survey 1996

Highest Level of Education in the Household

2.17 Education is expected to influence a woman's time allocation by providing her with more choices for leisure (such as reading), as well as providing her with alternatives to drudgework. Economists also argue that education increases efficiency. For woman's education we use as a proxy measure the highest level of education in the household because there is generally a high degree of correlation between the two. For the highest level of education in the household, there are eight categories, ranging from illiterate and informally literate through various levels of schooling to graduate and technically qualified. In about 32 percent of the households the most educated member had 8–10 years of standard schooling and 25 percent had up to primary level education (see Table 2.5). Andhra Pradesh and Rajasthan fare poorly in terms of education with the number of illiterate households as high as 18 percent. Punjab, Himachal Pradesh, and Maharashtra, by contrast, seem to have a high number of households with at least high school, if not better, education. The number of households with a person with technical education is quite low in rural areas.

[2/] A fairly significant literature exists on sanskritization as a means of social mobility (Srinivas 1970). As households from lower casts accumulate wealth, they begin to adopt some of the traditions and customs of the higher castes. This would include adopting a vegetarian diet, keeping a house ritually clean, and performing religious rituals as a way to improve their social status.

Table 2.5 Highest Level of Education in Households by State, Rural India 1996

States	*N*	*% Illiterate*	*% Literate*	*% Prim.*	*% Mid.*	*% High*	*% Higher secondary*	*% Grad*	*% Tech*
Andhra Pradesh	972	18.3	1.5	12.3	20.7	26.3	11.5	7.7	1.5
Himachal Prad.	672	5.8	0.6	4.5	13.1	34.8	20.1	20.1	1.0
Maharashtra	1,070	9.1	0.9	8.5	15.3	35.0	18.0	12.0	1.2
Punjab	650	3.5	0.9	4.3	11.1	43.8	19.8	15.1	1.4
Rajasthan	712	17.6	2.7	14.3	19.5	27.7	9.3	9.0	0.0
West Bengal	972	12.6	6.6	21.2	16.2	24.9	8.7	9.6	0.3
Total	5,048	11.6	2.3	11.4	16.3	31.5	14.3	11.7	0.9

Source: ESMAP Energy Survey 1996

Caste

2.18 An important socioeconomic factor influencing women's lives is their caste. Women belonging to twice born castes[3/] tend to observe more strict rules of conduct in relation to gender roles. They are more likely to refrain from working outside the homestead than the less privileged women of scheduled tribes (STs) and scheduled castes (SCs). In addition, certain facilities such as wells may be closed to the lower-caste women. We combine other backward castes (OBC) with the twice born castes as prior research has revealed that these women lead relatively similar lives (Sen 2000). The scheduled castes and scheduled tribes make up about one-third of the rural populations in this study (Table 2.6).

Table 2.6 Caste of Households by State, Rural India 1996

States	*Percentage of caste groups*		
	Number of households	*Twice born castes and OBCs*	*Scheduled tribes and castes*
Andhra Pradesh	972	69.9	30.1
Himachal Pradesh	672	56.8	43.2
Maharashtra	1,070	69.3	30.7
Punjab	650	56.3	43.7
Rajasthan	712	63.3	36.7
West Bengal	972	64.7	35.3
Total	5,048	64.3	35.7

Source: ESMAP Energy Survey 1996

[3/] Twice born castes are essentially higher caste groups whose male members are traditionally required to perform a type of caste initiation ritual on reaching puberty—hence they are "twice born."

Class or Household Occupation

2.19 Class is defined on the basis of the household's relationship to the means of production. A distinction is made between large and small farmers on the basis of the amount of land owned, because small landholders frequently have to sell their labor to make ends meet. Large landowners include those farmers that own two or more hectares of land. Small landowners are defined as those households whose land is under two hectares. However, almost two-thirds of these small landowners own less than one hectare of land.

2.20 The categories of agricultural and nonagricultural laborers have been collapsed because both are dependent on wage labor and the latter are a relatively small portion (6.3 percent) of the sample (Table 2.7). Apart from the two landed classes and landless laborers, households are also categorized into a professional class that includes all those who pursue some kind of business or provide some service. Landless laborers are the largest category of workers in the rural areas of the study. For the purposes of this research the artisan households are combined with the laborers as their numbers are too small and the lifestyles led by both groups of women are quite similar (Sen 2000).

Table 2.7 Occupation of Households by State, Rural India 1996

States	*No. of households*	*Large farm (%)*	*Small farm (%)*	*Labor (%)*	*Artisan (%)*	*Business (%)*
Maharashtra	972	11.7	17.8	40.8	4.2	15.4
Himachal Pradesh	672	10.9	68.2	7.8	0.9	12.4
Maharashtra	1,070	25.4	47.9	15.0	2.6	9.2
Punjab	650	15.0	25.4	30.6	2.6	26.3
Rajasthan	712	46.9	28.9	16.0	1.5	6.6
West Bengal	972	1.7	35.2	35.6	4.4	23.0
Total	5,048	18.0	38.7	25.1	2.9	15.3

Source: ESMAP Energy Survey 1996

Household Size

2.21 A final household characteristic that influences a woman's life is the size of the household. Women generally have more responsibilities in larger families. In keeping with the regional expectation of household size in India, Andhra Pradesh, a southern state, has the lowest mean household size of 5.1 members. Rajasthan and Punjab known for their joint family structures, averaging 6.9 and 6.4 members, respectively (Table 2.8). For the purposes of this research we include the proportion of children in a household in our analysis. Households vary quite a bit in the number of children present in the family. Almost 20 percent of the households in the sample have no children, while 61 percent have between one and three. The median number of children across all states is 2 and the mean is 2.4. Rajasthan has the largest average of 3.1 children per household while Andhra Pradesh has the smallest mean of 1.9 per household. This is again in keeping with the fertility expectations of the North versus South India. The proportion of

children is calculated by dividing the number of children in a family into the total household size. The mean for the sample is 0.34, which means that children on average are 34 percent of all household members.

Table 2.8 Household Size and Family Structure by State, Rural India 1996

States	*N*	*Family size*		*% children in household*	
		Mean	*Std. dev.*	*Mean*	*Std. dev.*
Maharashtra	1,067	6.01	2.79	0.33	0.22
Andhra Pradesh	972	5.13	2.31	0.33	0.23
West Bengal	971	5.41	2.70	0.33	0.22
Punjab	650	6.37	2.64	0.33	0.21
Himachal Pradesh	670	6.19	2.99	0.31	0.22
Rajasthan	706	6.88	3.59	0.42	0.21
Total	5,036	5.92	2.88	0.34	0.22

Source: ESMAP Energy Survey 1996

Village Infrastructure

2.22 The impact of access to village infrastructure is important for the analysis of women's living patterns in rural India. Greater access to infrastructure can enhance villagers' lives overall. Women from more developed areas are likely to have more options than their counterparts in other villages, regardless of their particular situation. Access to paved roads increases the economic and social integration of a village to the larger economy. Women may find employment or training outside the village if they have access to roads and thereby transportation. They may be able to sell their goods, even firewood, outside the village. Supportive social networks become easier to foster. Similarly, access to schools nearby increases the likelihood of receiving an education for all villagers, even girls and women. Access to towns and district headquarters makes it easier for women to participate in various kinds of economic activities, get health care, or make representations of their problems to governmental and nongovernmental agencies. Access to banks, especially *grameen* banks[4/], is important as they extend credit at attractive rates to the small-scale industry sector and encourage villagers to develop a habit of saving for the long term.

[4/] The Grameen Bank was set up in 1977 by Muhammad Yunus. Instead of insisting on personal collateral, the Grameen Bank asks landless villagers to form into groups of 50 people of the same sex - Bangladesh being a Muslim country - and then to form into smaller groups of five. The ten groups of five each meet regularly with a bank worker for training, and with each other to discuss their business ideas. Each loan has to be approved by a smaller group of five, by the larger group and finally by the bank's officer in the field. Women borrowers use their loans for such things as buying a milch cow, paddy husking and cattle fattening, while men tend to invest in paddy and rice trading, cattle fattening and setting up grocery shops. After six weeks, if the first two have been regular in their payments, the next two members get their loan, and after another six weeks, the final member. The loans are not analyzed by the bank - they leave it up to the villagers to do the analysis. As they depend on each other's success in repaying them, the system works. The default rate is only 2.7% - a 97.3% on-time repayment record, and in recent years the bank has made a profit on its activities.

2.23 For the purposes of our analysis, however, we only included distances to seven infrastructure facilities—the nearest paved road, district headquarters, town, primary school, high school, market place, and bank—because many of these facilities are located in the same place, which means the intercorrelation among some of the 27 infrastructure conveniences is very high.[5/]

2.24 Access to a paved road is quite good for the villages in the study, with Rajasthan and Punjab having the closest mean distance. Access to a primary school seems to be universal in villages across all states. Access to high schools is more variable, with villages in Andhra Pradesh, Maharashtra, and West Bengal having an advantage over those of Punjab, Rajasthan, and Himachal Pradesh. But of the latter three, quite clearly there is much greater variation in the distance to high schools among the villages of Punjab and Himachal Pradesh. While on average these villages seem to be almost 20 kilometers from the nearest town, Punjab fares exceptionally well, with a much smaller average distance and a smaller standard deviation. With respect to shopping or working at a marketplace, most villagers seem to have to travel some distance to reach one. Access to a bank for most villagers seems to involve traveling some distance, with villages in Punjab and Himachal Pradesh having greater access. Overall, villages in these two states seem to be in a better position in terms of infrastructure than the ones in other states. This is further evidence of the relative prosperity of these states.

Table 2.9 Distances to Various Infrastructure Facilities by State, Rural India 1996

States	*Distance from nearest (mean)*						
	Paved road	*District HQ*	*Town*	*Primary school*	*High school*	*Market-place*	*Bank*
Maharashtra	1.57	72.01	15.07	0.00	3.67	8.19	7.04
Andhra Pradesh	1.45	70.63	20.28	0.09	3.28	13.13	7.68
West Bengal	1.75	42.28	19.56	0.17	3.56	4.36	9.53
Punjab	1.33	23.77	11.36	0.17	10.55	7.28	4.54
Himachal Pradesh	2.07	53.17	15.49	0.53	7.32	10.78	5.17
Rajasthan	0.79	55.51	29.72	0.25	9.27	12.67	8.91
Total	1.51	54.29	18.64	0.18	5.83	9.22	7.34

Source: ESMAP Energy Survey 1996

5/ The village survey collected information on access to various infrastructure facilities, public conveniences, and the kind of agricultural and livestock development in an area. The level of development of a village should influence women's lives by improving their chances of getting an education, a job, access to credit and loans, and so on. Access and distance to 27 infrastructural facilities such as the closest paved roads, primary/middle/high schools, towns, health care centers and providers, ration shops, banks, post offices, markets, and district headquarters were recorded. Using Principal Component Analysis, we identified seven items that seemed to capture access to different types of infrastructure. A distance of zero implies that the facility is available within the village.

Conclusion

2.25 The socioeconomic background of the women in this set of data represents quite thoroughly the wide diversity that is found in rural India. Some of the more interesting findings that emerge from the chapter are that women are more involved in income-generating activities in rural areas than is evident from national employment studies, LPG use for cooking is more common than expected, and crop residues are extremely common for cooking despite their undesirable qualities.

2.26 The analysis of women and household energy use in the following chapters highlights how background factors such as education, income, and infrastructure affect women's choices or impinge upon them as constraints in women's lives. Having described the context within which women operate, and having presented a thumbnail sketch of their responsibilities, we now proceed to look more closely at the impact the use of various fuels and household electrification have on women's lives.

3

Impact of Biofuels on Rural Women's Lives

3.1 All over the developing world, the free availability of biofuels from nature makes them the primary fuel source for domestic purposes. The increasing use of biofuels in regions with local shortages of trees has a detrimental impact not only on the local environment, but also on women and children's health and life. As we have already discussed, women tend to be the managers of these fuels since they are primarily responsible for collecting and using it for cooking and heating water in the household.

3.2 In rural areas, the main cooking fuel generally is wood, if it is available. From wood families with sufficient income can move up the energy ladder to commercial fuels that burn more cleanly and are easier to use. Such movement has been common in urban areas, but in rural regions of developing countries the transition has been especially slow. In rural areas households are more likely to substitute one biofuel for another depending on availability and affordability. A pressing concern is whether rural households are moving down the energy ladder to fuels that are more smoky and harder to use, including straw and dung. This chapter analyzes the problems central to the use of biofuels as the main source of domestic energy, with an emphasis on their impact on women's lives.

Major Concerns Regarding Biofuel Use

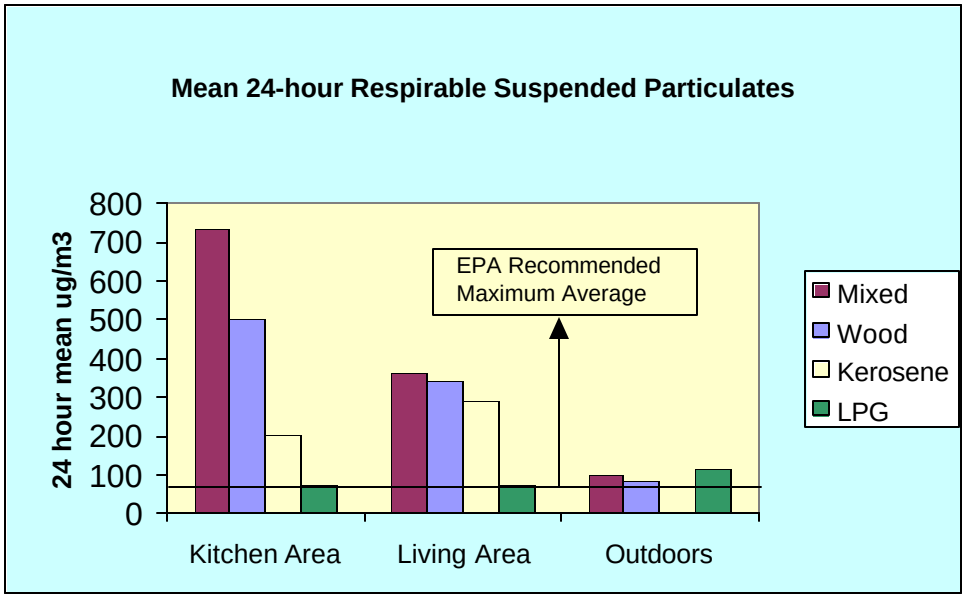
3.3 One of the major debates surrounding the use of biofuels is whether they have an impact on the environment (Ravindranath and Hall 1995; Seebauer 1992; Ranganathan, Rao, and Prabhu 1992). As households rely more and more on "free" firewood collected from the local environment, studies have noted increasing deforestation which in turn has led to soil erosion and reduced soil fertility. In a primarily agricultural economy, this has severe consequences on the livelihood and lives of the people. Other scholars argue that deforestation is caused mainly by the twin forces of expansion of farmland due to population growth and increasing animal populations (Shailaja 2000). This debate is not solved in this report, but we do present some evidence that rural people themselves perceive that fuelwood is fast disappearing from their local environment.

3.4 In addition, the growing scarcity of fuelwood in the local environment potentially can result in increasing the time and energy spent on fuel collection, as people have to walk farther and farther in their effort to procure this "free" fuel. Women and children pay the opportunity cost of this burdensome, time-consuming activity. While the hardship on women has been noted for decades now, the opportunity costs of time spent collecting and processing biomass fuels have received relatively little attention until recently. The scarcity has also led some households to substitute lower-grade fuels that tend to burn more inefficiently, such as crop residues for fuelwood. This again has implications of prolonged time spent cooking daily meals. The inefficient burning of biofuels has not only resulted in prolonging the cooking time, but it also means that women have to collect greater quantities of fuel to cook a meal.

3.5 Finally, some recent research indicates that the biofuel use has been found to have a dire impact on women and children's health because they are exposed for a long duration to the smoke emanating from the traditional stoves while the women cook (Agarwal and others 1999; Mavalankar 1991; Smith 1987 1993; Smith and Mehta 2000). Children are exposed as they often play in the proximity of their mothers. The polluting effect of this smoke, especially in unventilated interiors that are a common feature in rural houses, has become the subject of growing research in recent years. Only recently epidemiological studies have begun to document various kinds of chronic lung diseases including cancer, eye problems, and other illnesses from smoke inhalation and exposure (Mishra and others 1997; Smith 1987). Though biofuels are worse than commercial fuels in terms of the potential to release pollutants into the air when burned, the use of appropriate stove technologies with chimneys can possibly reduce their harmful effect. Unfortunately, a large majority of households continue to use traditional stoves, exacerbating the problem of exposure to harmful pollutants.

3.6 In a recent study of indoor air pollution in the state of Andhra Pradesh, for a sample of 420 rural households the pollution levels were measured over a 24-hour period (World Bank 2002b). The results of the measurements were reported for those households that cook with a combination of biofuels including dung, straw, and wood (mixed); those mainly using wood; and the remainder using either kerosene or LPG. The levels of pollution were measured in the cooking space, in the living area, and outside of the house. The results indicate that those using inferior biomass fuels such as straw have the greatest exposure to particulates, followed closely by households that use wood as their primary fuel. The exposure levels for the wood and mixed fuel users range from about 400 to 700 micrograms per cubic meter of air. As a comparison, the Environmental Protection Agency of the United States recommends average exposures to be no greater than 50 micrograms per cubic meter of air. Thus, women cooks in rural India are exposed to high levels of pollutants harmful to their health on a daily basis.

Figure 3.1 Indoor Air Pollution in Rural Andhra Pradesh 2001



Source: World Bank (2002b)

Patterns of Biofuel Use

3.7 The three most commonly used biofuels burned in India for domestic purposes include fuelwood, dung, and crop residues. Fuelwood in the form of sticks, twigs, and branches are not only the most commonly used, but the most preferred as well. The availability and use pattern quite naturally depends on the local environment. Biofuels are most commonly burned in traditional stoves that are constructed by the women themselves. But there has been a drive by the government and other agencies to promote the installation of better stoves designed for higher thermal efficiencies and less pollution. In this section we first examine the types of stoves in use and then turn to the mix of fuels used for cooking.

The Use of Biomass Stoves: Traditional and Improved Chulhas

3.8 In India, the stove that is most commonly used for cooking is the traditional chulha (Table 3.1). This stove has no chimney and consists of stones plastered with mud to form a rough cube that is one square foot on each side, leaving one side open to feed fuel. Smoke from the stove emits directly into the room. While primarily designed for fuelwood, the chulha has been adapted in some areas to burn charcoal, dung, and straw. Households often build more than one chulha, and even those that cook with LPG and kerosene invariably use one.

3.9 The type of stove used to burn the biofuels not only affects the time spent cooking or collecting fuel, but more significantly it determines whether the fuel burned has a harmful effect on the cooks and others in the room. As discussed earlier, the smoke carries many pollutants ranging from carbon monoxide to suspended particulate matter that can be extremely damaging to one's lungs over the long run. Traditional stoves have been found to be extremely polluting in this respect and much effort over the past two decades has been directed toward designing and disseminating alternative models of stoves, often referred to as improved chulhas.

3.10 Traditional stoves or chulhas have a low thermal efficiency—only 8–15 percent depending on how they are used. As a consequence, the Government of India has been actively promoting the use of improved stoves developed through the National Program for Improved Chulhas. Improved chulhas are low-cost stoves that increase the thermal efficiency of the biofuels commonly used to ranges of 24–28 percent, while at the same time diverting the smoke that is released through a chimney that vents outside the house. In terms of reduced drudgery alone, this should mean that if they have access to improved chulhas, women need only a third of the time they used to spend to collect fuelwood.

Table 3.1 Ownership of Cooking Stoves by State, Rural India 1996
(number per 100 households)

Type of cooking stove	*Andhra Pradesh*	*Himachal Pradesh*	*Maha-rashtra*	*Punjab*	*Rajasthan*	*West Bengal*
Wood						
Traditional chulha	114	84	124	111	125	146
Improved chulha (fixed)	6	19	6.5	10	10	2
Improved chulha (portable)	0.3	4	0	0.2	0	0
Sigri (metal charcoal grill)	1	2	3	2	1	0
Improved kerosene stove	18	12	26	4	7	24
Solar cooker	0	2	0	1	0	0
Biogas stove	1	0.5	9.8	2.5	0.3	4
LPG stove	4.9	49.3	2.8	15.5	1	1.2
Pressure cooker	3	105	0	60	4	10

Source: ESMAP Energy Survey 1996

3.11 While the penetration of improved chulhas is high today, the program has suffered substantially from implementation problems. According to a 1991 survey by NCAER, about 40 percent of the improved chulhas installed have become nonfunctional. Problems range from the training of the *gram sevaks*[6/] who install the devices, to the training of the cooks regarding maintenance of the devices (Natrajan 1999). These findings are generally supported by this study as well. According to this survey less than 10 percent of women used improved chulhas. Out of the 406 households with fixed

6/ Gram Sevaks are salaried village workers appointed by the Village Development Committees.

improved chulhas, 70 (or 18 percent) were not functional. But the results varied quite a bit among the states in the survey. Himachal Pradesh has the largest number of improved chulhas, all in working order. Only 1 out of the 58 improved chulhas in Andhra Pradesh was out of order at the time of the survey. At the other extreme, in Rajasthan only one-third of the few stoves installed in the state seem to be working. The implication is that there is a wide variation in the success of the programs among the states (World Bank 2002b).

3.12 From the above results, one might conclude that the program is not worth pursuing. However, the evidence also indicates that although cooking time declines a little with the use of improved chulhas, for the households that use them the time required to collect fuel is reduced substantially. While women spend slightly less time cooking if they have access to an improved chulha, they also spend substantially less time collecting fuel. Since fuel collection is not necessarily a daily activity, it is probably better to look at the mean time spent collecting fuel for only those who undertake the chore. Among women collecting fuelwood, there is more than a half hour advantage for those who use improve chulhas compared to those who use traditional chulhas (Table 3.2). Though the time saving is not as great as might be expected, the work of collecting fuel is arduous at best and improved chulhas definitely seem to cut down on the amount of drudgery women suffer. Unfortunately, the program to promote improved chulhas has only been successful in limited geographical areas.

Table 3.2 Stove Use and Women's Time Spent Cooking and Collecting Fuel, Rural India 1996

Stove type	*Mean time spent (hours per day)*					
	All users			*Only users who collect fuel*		
	N	*Cooking*	*Collect fuel*	*N*	*Collect fuel*	*Cooking*
Traditional chulha	4,654	2.73	.69	1,433	2.11	2.44
Improved chulha	336	2.60	.53	129	1.37	2.57

Source: ESMAP Energy Survey 1996

Biomass Fuels in Use : Wood, Crop Residues, and Dung

3.13 Most households have to rely on a combination of fuels to meet their domestic requirements, but the regional patterns of energy use vary considerably. Households in Maharashtra and Himachal Pradesh rely more heavily on fuelwood for cooking compared to households in West Bengal and Punjab (Table 3.3). Dung is the second most common fuel and is used quite extensively in Punjab, West Bengal, and Rajasthan. The size, shape, and mix of dung cakes vary by region. They are relatively large and heavy in Maharashtra compared to Punjab. In West Bengal, dung is mixed with charred residues of previous cooking and rolled into balls.

Table 3.3 Biofuels Used for Cooking and Heating by State, Rural India 1996

	% Fuels used for cooking and heating		
	Wood (%)	*Crop residues (%)*	*Dung (%)*
Maharashtra	92.7	31.2	71.7
Andhra Pradesh	72.5	39.8	19.5
West Bengal	38.4	55.0	78.1
Punjab	46.3	36.3	81.5
Himachal Pradesh	96.3	0.4	5.5
Rajasthan	77.4	18.4	86.1

Source: ESMAP Energy Survey 1996

3.14 Wood is preferred primarily for its relative thermal efficiency when used in traditional stoves. It does require collection, but little processing, and is available in the local environment that is accessible to all. Crop residues are the least preferred fuel, and their use implies a growing scarcity of other fuels. Also, as indicated above, those households that use straw or dung for cooking have higher concentrations of indoor air pollution. Dung is most commonly used in households that own cattle and requires at a minimum some processing and drying before it can be used for cooking. The poorer households may collect dung found lying on the roads and use it in combination with wood or crop residues. Both wood and dung cakes are often available in the local market as well for households who can afford it. In fact, more and more households are purchasing wood, and the selling of wood and dung cakes is a source of income for many rural women.

Opportunity Costs for Women: Tradeoff Between Biomass Fuel Collection and Cooking

3.15 Since biofuel management is primarily a woman's responsibility in India, the time spent collecting fuel and cooking has implications above and beyond her health and hardship. Women have to compromise their time spent on housework, paid work, and leisure in order to meet the energy needs of the household. In our survey of primary cooks in the household, we found that on average, of the 12 hours that women worked in a day, only 2 hours were spent pursuing paid work (Table 3.4).

3.16 Women's lives mainly revolved around nonmonetized work such as collecting fuel, fetching water, cooking, and housework. It should be remembered that the categories in the Table 3.4 are not mutually exclusive; for example, fuelwood users can use other fuels. But the activities of women are closely connected to performing household chores. Outside of other leisure activities, which include sleeping, the highest amount of time is spent doing other housework, which includes processing food, cleaning dishes and house, taking care of children, and other domestic activities. This is followed by cooking, earning income, fetching water, and fuel collection. The impact of using a particular type of biomass fuel is apparent for activities most closely related to fuel collection and cooking.

Table 3.4 Biofuel Use and Women's Time Allocation, Rural India 1996

Activities	*Average time spent depending on fuel used (hours per day)*					
	Fuelwood		*Crop residue*		*Dung*	
	Users	*Non-users*	*Users*	*Non-users*	*Users*	*Non-users*
N	3,569	1,479	1,626	3,422	2,896	2,152
Collect fuel	0.85	0.25	0.54	0.74	0.71	0.63
Fetch water	0.95	0.86	0.93	0.93	0.97	0.87
Cooking	2.59	3.03	3.01	2.59	2.82	2.59
Other housework	5.64	6.19	5.82	5.79	5.94	5.61
Earning income	2.08	1.46	1.95	1.88	1.78	2.07
Reading	0.14	0.14	0.09	0.16	0.10	0.18
Watching TV	0.46	0.53	0.34	0.54	0.40	0.59
Other leisure	10.42	10.61	10.50	10.46	10.37	10.61
Miscellaneous	0.65	0.64	0.66	0.64	0.68	0.60

Source: ESMAP Energy Survey 1996

3.17 The relationship between fuel use and the time spent collecting fuel and cooking involves some interesting tradeoffs. On average, women who use firewood spend about 50 minutes collecting fuel compared to about 45 minutes for cooks using dung and 30 minutes for those using crop residues. This pattern would appear to make sense because most crop residues are collected and processed on a family's own farm, whereas dung and fuelwood are collected outside of the immediate vicinity of the house. The implication is that fuelwood and dung collection require more informal labor than crop residues.

3.18 But the real differences between the fuels in this time-consuming activity are even larger once we factor in two common practices: fuel collection is not necessarily an everyday activity, and most households use a combination of fuels for cooking. Thus, even though only 33 percent of the households reported collecting fuel on the day surveyed, most households collect cooking fuel, rather than buy it on the market. Second, almost 70 percent of households use a combination of fuels for cooking. While 43 percent of firewood users cook with it exclusively, only 14 percent of households that use dung or crop residue report using it exclusively.

3.19 The preference for using fuelwood for cooking may be partly because it is easier to use than dung and straw, reducing the time required to prepare meals: the cooks that use fuelwood spend about 2.5 hours per day cooking, whereas those cooking with dung spend 2 hours and 45 minutes and those using crop residues cook for 3 hours. From the perspective of total time that is necessary for collecting and using the fuel for meal preparation, fuelwood requires the least amount of overall time and is the easiest to use—since dung often burns at too low of a temperature and straw burns too fast and requires constant attention. The state with the highest amount of dung use is the Punjab, where it is used for boiling milk, a task that requires a slow-burning fuel.

3.20 To summarize, the collection of firewood entails the most drudgery; however, when we look at the time women spend cooking, one notices a considerable advantage in using it. In terms of women's time, it is clearly the most efficient cooking fuel among the three considered here, and it may involve slightly lower levels of indoor air pollution. Dung and crop residues seem to be less efficient as women who use these fuels spend more time cooking. This is in keeping with previous studies (for instance, Shailaja 2000) that have noted the relative thermal efficiencies of various biofuels. Thus, using firewood for cooking saves women more time and energy than cooking with other biofuels. In addition, since the time spent cooking with traditional stoves has implications for women's health, the relative efficiencies of the various biofuels become a concern. This is quite serious as most households continue to use traditional stoves for cooking. Women from households using crop residues are in the worst position with respect to exposure to pollutants because of the longer time taken to prepare meals, the higher levels of indoor air pollution (World Bank 2002a), and the greater attention necessary to maintain cooking temperatures.

Paid Work

3.21 Access to paid work is important not only for women's status, but also for the well-being of the family, as several studies have found. When women earn, their entire income is most likely to be spent on fulfilling the needs of the family. However, traditionally, engaging in paid work is considered degrading for women and only families in dire need would allow their women to work for pay outside the homestead. In this study, we found 64 percent of rural women engaged in some sort of paid work. While on average these women worked only three hours per day, there is significant variation based on their backgrounds.

3.22 The longer time taken to collect fuelwood does not seem to inhibit time spent working for money. Though from table 3.4 crop residue users seem to average the least time spent earning an income, once socioeconomic factors are taken into account, the picture changes. Although firewood users seem to still spend the most time pursuing paid work, the amount of time spent by users of crop residue is a close second. This is quite understandable as crop residues collected are mostly a by-product of the agricultural work done during the day. In addition, women from households using fuelwood and crop residues are also more likely to engage in paid work than others. It does not appear that fuel collection reduces the amount of time that women work for wages. Further research is needed to clarify the reasons behind these trends.

Equity, Biofuels, and Women's Time

3.23 Income, occupation, caste affiliation, and education influence the access and use patterns of biofuels. Of the three main biofuels, we find that fuelwood is commonly used across all income groups while crop residue is less common among the richer households. Women from rich households are not only less likely to collect fuel, but when they do collect them, they spend less time doing so than women from the poorer households. This seems to be especially true in the case of households that use firewood or dung. The greater resources available to women from rich households seems to provide them with an opportunity to reduce the time spent on the most drudge-laden or unpleasant tasks. They either have access to firewood that grows within their own homestead or they are able to collect enough dung from their own animals. They also often employ servants to collect the fuel for them. In this section, we examine the impact of each of the factors on the use of biomass fuels.

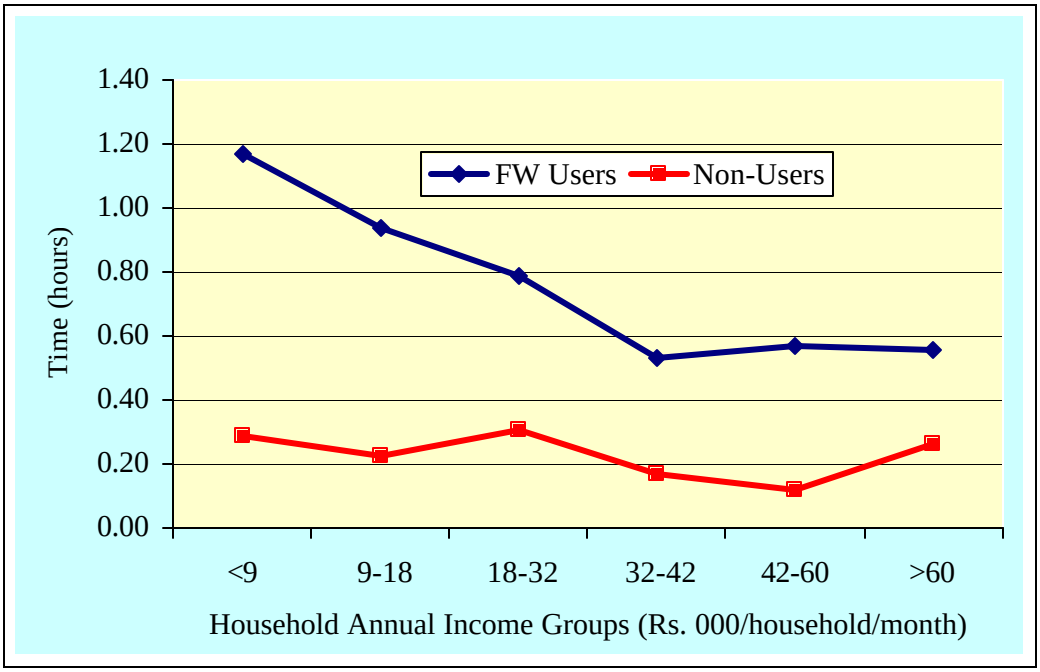
Table 3.5 Income and Households Using Biofuels for Cooking, Rural India 1996

Income group (Rs./household/year)	*Percentage of Households Using:*			
	Firewood	*Dung*	*Crop residue*	*Biogas*
Less than 9,000	70.9	56.4	36.7	1.0
9,001 – 18,000	69.1	58.1	35.1	2.4
18,001 – 32 ,000	71.2	58.1	30.0	2.7
32,001 – 42,000	74.6	54.7	21.2	4.7
42,001 – 60,000	72.5	54.8	25.8	2.8
Greater than 60,000	70.2	59.7	31.5	9.1

Source: ESMAP Energy Survey 1996

3.24 The pattern of fuelwood collection by education and by income class illustrates how fuel collection is influenced by these factors. Starting with income, the lower-income groups that are dependent on fuelwood for cooking spend a significant amount of their time collecting the fuel (Figure 3.2). This is true for all income classes, but diminishes at the higher income range—for a number of reasons. Households at the higher income range use a mix of fuels including LPG and kerosene. They are also able to purchase some of their fuelwood for cooking. And finally, richer households often have servants to collect fuelwood.

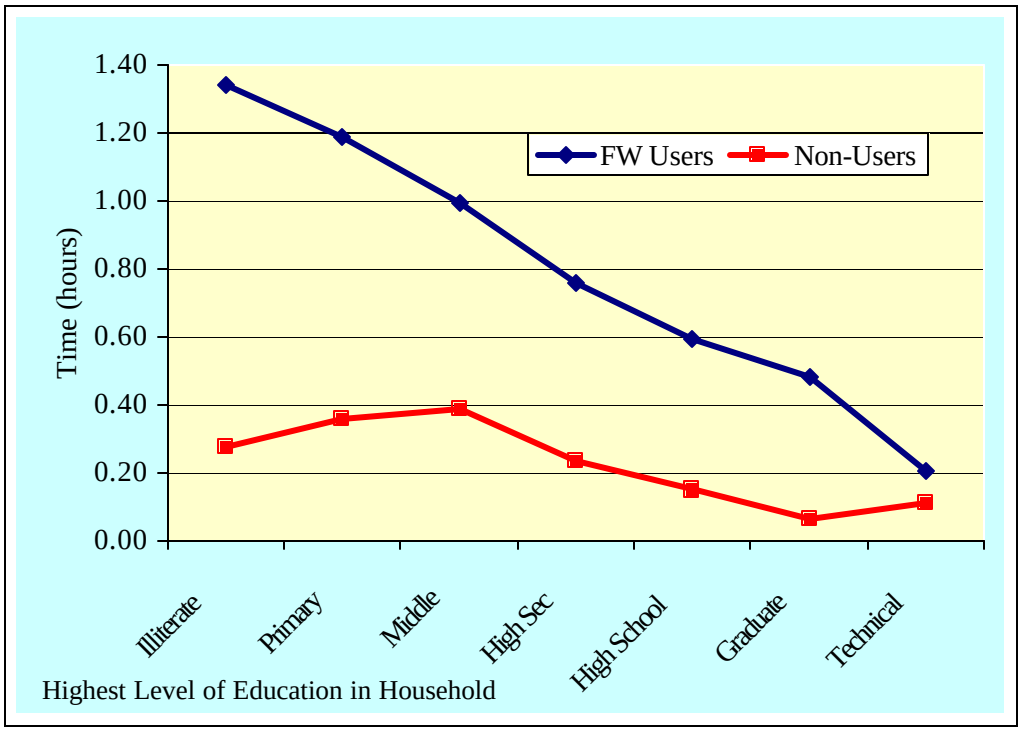
Figure 3.2 Income and Time Spent Collecting Fuels: Firewood Users Versus Non-Users, Rural India 1996



Source: ESMAP Energy Survey 1996

3.25 A similar but more pronounced pattern is found for education. With a rise in the highest educational level in the household we notice that women spend less time collecting fuel. However, across all educational levels the women who rely on firewood spend the most time collecting fuel, whereas those using crop residue spend the least. For the women who spend some time collecting fuel, we find that they spend 2 hours on average—with the least educated spending almost 2.5 hours and the most educated spending a little over an hour. This trend is most dramatic for firewood users, and less so for dung users. There is no clear trend between education and this onerous task among the crop residue users. This is probably because there are few households that use crop residue exclusively and households with higher levels of education rarely use it as a cooking fuel. Also, as indicated, biomass residue users often collect this from their farm, so they do not have to spend much time searching for it. Thus, of the biomass fuels, households prefer fuelwood, but must spend more time collecting it compared to those using other fuels.

Figure 3.3 Education and Time Spent Collecting Fuel: Firewood Users Versus Non-Users, Rural India 1996



Source: ESMAP Energy Survey 1996

3.26 Turning to occupation, we find that the families from higher-status occupational levels tend to spend less time collecting fuelwood than lower status households. Overall, more than 60 percent of landowning and professional households use firewood or a combination of firewood and dung for cooking (Table 3.6). Though firewood is quite commonly used in laboring households, it is more common to find crop residues and dung in their mix of fuels for cooking. Women from laboring households spend the most time collecting fuel across all fuel types. Even within fuel groups, occupational background continues to dictate the time spent collecting the various types of biomass energy. Laboring households spend more time collecting energy regardless of the type of fuel that they use for cooking. This contrasts with women from professional households who use firewood and dung but suffer the least drudgery in terms of time taken to collect fuel. As indicated above, this difference is probably a reflection of the long distances poorer women have to walk before having access to fuels and/or the ability of women from professional households to purchase at least part of their fuel.

Table 3.6 Occupation, Fuel Use, and Women's Time Allocation, Rural India 1996

Activities	*Professional*	*Large farmer*	*Small farmer*	*Laborer/ artisan*
Fuelwood				
% using fuel	61%	81%	78%	60%
Collect fuel (hrs)	.50	.67	.92	1.08
Cook (hrs)	2.79	2.53	2.58	2.56
Crop residues				
% using fuel	24%	31%	26%	45%
Collect fuel (hrs)	.41	.53	.44	.65
Cook (hrs)	3.15	2.57	3.12	3.07
Dung				
% using fuel	53%	66%	55%	58%
Collect fuel (hrs)	.40	.70	.78	.77
Cook (hrs)	2.98	2.52	2.85	2.91

Source: ESMAP Energy Survey 1996

3.27 As might be expected, the analysis of fuel collection according to caste reflects the economic differences among households already noted. Households belonging to the lower castes such as the scheduled castes and tribes tend to use crop residues and dung more extensively than other households (Table 3.7). But regardless of the fuel used, women from the lower scheduled caste and tribe households spend twice as much time collecting fuel as those from other castes. No other activity reveals such a disparity in time use. As observed above, the women who use crop residues as fuel spend the least time collecting it. Once again, crop residues, which are available on farms or as part of their farm work, require less collection time for both higher and lower castes. Thus, income, household education, occupation, and caste affiliation not only influence the access and choice of biofuels, but also significantly determine the lifestyle of rural women by imposing time constraints on them.

Table 3.7 Caste Affiliation, Fuel Use and Women's Time Allocation, Rural India 1996

Activities	*Firewood Uses*		*Crop residues Uses*		*Dung Uses*	
	Caste	*SC/ST*	*Caste*	*SC/ST*	*Caste*	*SC/ST*
Number of Users	3,253	484	1,080	546	1,912	984
Collect fuel (mean hours)	.63	1.22	.40	.81	.51	1.08
Cook (mean hours)	2.65	2.49	3.01	2.99	2.87	2.70

Source: ESMAP Energy Survey 1996

Implications for Women's Health and the Environment

3.28 Recent epidemiological studies have shown that the use of biofuels in traditional stoves leads to the emission of pollutants that have several adverse outcomes on the health of women and children (Agarwal and others 1999; Mavalankar 1991; Smith 1987, 1993; Smith and Mehta 2000). The stoves are usually located indoors, with inadequate ventilation. Additionally, small children are often in proximity to the mother as she prepares the meal. The smoke emanating from the stove thus affects not only the cook but her young children as well. Researchers have found a high incidence of acute respiratory infection (ARI), chronic obstructive pulmonary disease (COPD), chronic bronchitis, and damage to the eyes among women in such households (Smith 1987; Parikh and Laxmi 2000; Shailaja 2000). Furthermore, some studies indicate that there is a 50 percent greater chance of stillborn births for women cooking on traditional stoves (Mavalankar 1991).

3.29 A number of studies report that the indoor air pollution levels in homes using traditional stoves far exceeds levels recommended by the World Health Organization (Smith 1987). Studies of time spent in various micro-environments also show that women and children spend more time indoors than men and youth across seasons (Qing and others 2002; Saksena and others 1995). Exposure to respirable suspended particles is especially high during cooking in badly ventilated kitchens. A study involving 5,028 households in Tamilnadu, India (Parikh and Laxmi 2000) found that the respirable dust concentration levels were as high as 2,000 micrograms per cubic meter. The size of the home also matters, as does the number of members residing in it (Qing and others 2002). Small unventilated homes tend to trap high concentrations of respirable dust. Similarly a large family does a lot more cooking and thus the danger of exposure is much greater. Our data suggest that over 80 percent of the women use traditional stoves in indoor environments. In fact, almost 60 percent of the families live in *kuccha* or mud houses with only two rooms (or even a single room), which includes cooking space. This makes it difficult for most family members to avoid exposure to the smoke.

3.30 Research on the relationship between indoor air pollution and health outcomes has had to overcome several obstacles related to monitoring and measurement problems and the longitudinal time horizon required to study health outcomes. Risk research using sophisticated monitoring technologies in collaboration with local health centers holds much promise for such studies. A recent longitudinal study that traced the lives of a large cohort of over 20,000 people in Xuanwei county, China, from 1976 through 1992, found that exposure to smoky coal stoves since childhood in unventilated houses dramatically increased the risks of developing lung cancer (Qing and others 2002). There is a growing suspicion among experts that devastating epidemics such as tuberculosis may also be related to IAP. In addition, more research needs to be done on adverse pregnancy outcomes and cardiovascular diseases (Mavalankar 1991; Hughes and Dunleavy 2000; Sandoval and others 1993).

3.31 The growing shortage of fuelwood in the local environment has been documented in various developing nations of the world, including India. The shrinkage in forest cover has terrible consequences in a country where people are primarily dependent on agricultural pursuits. Soil erosion and fertility potentially are major problems created by deforestation.

3.32 According to a 1995 UN report, only 17 percent of India is under forest cover and 84 percent of rural women have been affected by fuelwood scarcity. In our survey, more than 90 percent of the respondents agreed not only that fuelwood was in great shortage, but also that there are fewer trees now than in the past in their villages. Studies on forestry programs claim that there has actually been an increase of forest cover by 0.8 percent annually since 1988 (Ravindranath and Hall 1995), but the respondents in this study on the future supply of fuelwood are not optimistic (Table 3.8).

Table 3.8 Opinion on Fuelwood Scarcity in the Local Environment, Rural India 1996

Opinion	*Percentage of respondents Who:*		
	Agree	*Disagree*	*Don't know*
Fuelwood is in great shortage	91.0	8.3	.7
There are fewer trees today	91.2	7.5	1.3
In the future there will be even more fuelwood scarcity	92.3	3.4	4.3
More trees should be planted in the future	92.2	2.8	5.0

Source: ESMAP Energy Survey 1996

3.33 Experts disagree about the extent to which the use of biofuels for domestic energy has led to deforestation. According to a 1988 State of Forests report, 22 percent of the total fuelwood used in India comes from forest harvests and degraded land, with 78 percent attributed to illegal cutting of trees. On the other hand, other studies claim that most of the deforestation underway is a product of urban and industrial demand. But as the NCAER study mentioned in the first chapter reveals, people are increasingly turning to logs instead of relying on twigs to meet their fuelwood needs. Log consumption to meet rural energy needs has almost doubled over the past two decades, while twig consumption has declined. Thus, concerns about land degradation are very real and valid.

The Use of Biogas Stoves

3.34 While improved chulhas are an extremely cost-effective way to use biofuels in rural India, the government has also been promoting the use of biogas, through a national program. The National Program for Biogas Development, initiated in 1981, aims to provide clean cooking fuel, produce enriched manure for agriculture, improve rural women's quality of life, and improve sanitation and hygiene. The program includes the promotion of both family- and community-based biogas plants.

3.35 A national study of 500 family-based plants found that almost 60 percent of them were owned by small and marginal farmers with less than two hectares of land and people from the scheduled castes and tribes (cited in Shailaja 2000). Evaluative studies done by NCAER in 1992, found that 77 percent of the family-based biogas plants installed were functional, the range varying from only 25 percent in Delhi to 100 percent in Punjab (NCAER 1992). In the case of community-based biogas plants, one evaluative study of 38 plants found that 65 percent were operational, 28 percent were out of commission, and 8 percent were not installed (Venkataramana 1997). In many cases, the energy generated by community biogas plants is not sufficient to provide enough clean cooking fuel for all of the households in a village. Problems related to costs, benefit sharing, and equitable distribution (stemming from differences in cattle ownership), as well as poor village organization with respect to regular maintenance of the plant have been cited as the main causes of failure. In the case of family-based biogas plants, the main problems relate to the capital cost, which can vary from Rs. 5,325 to Rs. 10,700; maintenance costs; dung availability; inadequate subsidy by Ministry of Non-Conventional Energy Sources (MNES); water scarcity; and lack of infrastructural facilities at the local level.

3.36 It is quite apparent that the biogas program is not as widespread as one would hope 20 years after its inception. In our 1996 survey, a little more than 3 percent of the households had individual biogas plants. Households in Maharashtra had the greatest number of biogas stoves, followed by West Bengal. While the majority in the former had double burner stoves, in West Bengal the women mostly used single burner stoves. Overall, more than 80 percent of the 161 biogas stoves were functional, with the range varying from 0 percent in Rajasthan to 95 percent in West Bengal (Table 3.9).

3.37 Comparing the use of biogas stoves with other types we find that women spend more time cooking and practically no time collecting fuel. They not only benefit from reduced levels of drudgework, but also enjoy cooking in a much cleaner environment. The women who do collect fuel despite having access to biogas stoves do so because they simultaneously use traditional chulhas. In fact, most households in our data have traditional chulhas, in addition to biogas stoves. This probably indicates that the operational problems with biogas plants make it necessary to have a back-up of inefficient but nonetheless reliable traditional stoves.

Table 3.9 Working Status of Biogas Stoves, Rural India 1996

States	*% Biogas use in households*	*Stoves Working (numbers)*	*Stoves Not working (numbers)*	*Total*
Maharashtra	9.8	68	24	92
Andhra Pradesh	1.0	9	1	10
West Bengal	4.0	36	2	38
Punjab	2.5	15	1	16
Himachal Pradesh	0.4	2	1	3
Rajasthan	0.3	0	2	2
	3.7	130	31	161

Source: ESMAP Energy Survey 1996

Conclusion

3.38 The picture that emerges from this research is that in relation to the use of biomass fuels there is a significant opportunity to improve the quality of women's lives. Even the wealthiest households continue to use biofuels because they are available for "free" from the local environment. Women's time and energy spent collecting fuel is not factored into the costs of using biofuels because in a largely patriarchal society, time or energy expended by women does not equate with money or value.

3.39 Of the three most commonly used fuels, firewood seems to take longest to gather. In terms of time spent on cooking, however, it is the most efficient. People's preference for firewood is illustrated by the relative distribution of fuel use across households of varying socioeconomic status. The higher-status households in terms of income, education, or caste are more likely to consume firewood rather than other biofuels. Though crop residue involves the least time collecting, it is a poor-quality fuel for cooking.

3.40 While the effort and time expended in collecting fuel indicates a burdensome life for most women in rural India, it is also of grave concern that these fuels continue to be burned using traditional chulhas. There is increasing and compelling evidence of the detrimental impact these stoves have on women and children's health. Although the magnitude of the problem varies from region to region, there clearly are opportunities for improvement. There are two ways to attack the problem—efficient use of biomass through improved stoves, which has already been discussed, and the use of petroleum fuels, which is the subject of the next chapter.

4

Impact of Petroleum Fuels on Women's Lives

4.1 The transition from biofuels to petroleum fuels for cooking purposes is a very slow process in rural India. Studies of the country's urban households have revealed that the first step up the energy ladder is a shift from biofuels to kerosene (World Bank 1999; Sathaye and Meyers 1985; Reddy and Reddy 1983; Bowonder, Prasad, and Raghuram 1987; Leach 1987; Alam, Dunkerley, and Reddy 1985). Kerosene is readily available in small quantities in rural areas and is used, mainly for lighting, on a very wide scale. A small percentage of households use kerosene for cooking. For some households with high incomes, kerosene or fuelwood is replaced by LPG for cooking, but most high-income households continue to use biomass fuels. The transition to petroleum fuels is a very uneven process in rural India even for the highest-income households. The problem in most of rural India is that LPG is simply not available in the local markets for a combination of reasons that include both policy issues and low levels of demand.

4.2 Although the process is slow, there are some signs that households are beginning to switch to kerosene or LPG for cooking. In the states of Himachal Pradesh and Punjab farmers have relatively high incomes, and in spite of distribution problems, many families are beginning to use LPG. In the state of Maharashtra, the availability of woodfuels has been declining, and some households are using both purchased wood and kerosene for cooking. In most cases, the use of LPG or kerosene for cooking does not mean an exclusive switch from one fuel to another, but rather that households use a combination of traditional and modern fuels for cooking.

4.3 In this chapter, we discuss the recent patterns of adoption of kerosene and LPG for cooking and how it affects women's responsibilities in rural India. Before turning to the usage patterns of these fuels, the next section reviews the policies of making them available in rural areas.

Background on LPG and Kerosene Access in Rural Areas

4.4 Kerosene is distributed nationally through a government-controlled public distribution system, whereby consumers are entitled to a fixed monthly quota of basic necessities such as sugar, flour, and kerosene at highly subsidized prices. Though previously only ration shops were allowed to sell kerosene, today it is available at a higher price through the market. Unlike urban households, consumption of kerosene in rural India is generally for lighting rather than for cooking. Regardless of income, virtually all households purchase at least their rationed quota of about four liters per

month, which is about the amount necessary for using a kerosene lamp. As incomes rise, however, kerosene may be used for other purposes, such as cooking. It also is interesting to note that the ration for subsidized kerosene in urban areas is generally about 15 liters per month, based on the assumption that people will use it for cooking rather than for lighting only.

4.5 As indicated, LPG is quite widely accepted as the preferred fuel for cooking in urban areas. However, until recently, it was distributed exclusively through retail dealers associated with the national petroleum companies at prices controlled and set by the government at below-international-market prices. Virtually all of the retailers are located in urban areas, resulting in levels of demand far exceeding the supply. Consequently there were long waiting lists for connections and limitations on the number of LPG cylinders per customer. Today the LPG market has been opened to private retailers who sell imported LPG at higher prices, though the price is still controlled. The two channels have significantly improved LPG availability and most households in urban India have switched to LPG as their primary cooking fuel. However, few retailers have expanded their territories into rural areas.

4.6 As well, the price subsidy for LPG does not address one of the barriers to household fuel switching to LPG, which is the upfront cost of LPG service. A new LPG user often has to pay Rs. 1,000 for a "LPG connection" in order to receive an LPG cylinder, and another Rs. 1,000 to purchase an LPG stove. This combined cost makes it difficult for many low-income households to start using LPG as a cooking fuel. In the state of Himachal Pradesh the government has promoted a subsidized LPG program to counteract deforestation, and as a result LPG consumption is very high. Another state that seems to be an exception is Punjab, where rural incomes are higher than in most other states, and rural people have found their own ways to gain access to LPG.

4.7 To alleviate this problem of connection expenses, the state of Andhra Pradesh experimented with a program to provide the stove and the connection to rural people for free, and then make LPG available to them at the same price as for urban areas. The program is called the Deepam Scheme. The result of this experiment is that many rural households adopted LPG, but used it for only part of their cooking needs. Through waiving the connection fee, the Deepam Scheme facilitated the uptake of LPG by the poor households. However, the challenge is to sustain this effort and facilitate the development of a viable market of LPG in rural areas. Currently the development of such markets is constrained by the limited number of rural customers and the low consumption level estimated at an average consumption of 30 kg of LPG per year. Given the dietary habits and energy needs of the target group, the consumption level might, at best, reach 60 kg per year. The fundamental issue is how to get the majority of the rural households to the point of consuming much more LPG without overstretching the state's fiscal resources.

4.8 This very short summary is necessary to put the findings from the survey and other research into the context of an uneven policy environment for providing rural people with access to petroleum fuels for cooking. Although the adoption rate of petroleum fuels for cooking in rural areas is low, a policy to encourage retailers to market fuels in rural areas would increase the number of people using these fuels.

Kerosene and LPG Stoves

4.9 Ownership of kerosene stoves is widespread in rural India, especially in Maharashtra. Government subsidies and distribution networks make kerosene an attractive alternative for people who can afford to pay for cooking fuel. Though the quota available through rations is only enough to cover a household's lighting needs, both the fuel and the stoves are easily available through regular markets. It is a fuel that burns in a relatively clean manner and thus is less harmful to women who use it for cooking. However, the cost compared to traditional fuels is a limiting factor for most people and rarely do households rely solely on it.

4.10 In the survey, we found that households in Maharashtra, West Bengal, and Andhra Pradesh owned most of the kerosene stoves, with a few households owning more than one stove (Table 4.1). We found that 92 percent of the 822 kerosene stoves were in good working order, which reflects a high level of overall reliability.

Table 4.1 Working Status of Kerosene Stoves, Rural India 1996

State	*Percentage of households*	*Status of kerosene stoves (numbers)*		*Total*
		Working	Not working	
Maharashtra	25.3	247	24	271
Andhra Pradesh	17.9	166	9	175
West Bengal	22.5	197	22	219
Punjab	3.5	21	2	23
Himachal Pradesh	12.5	80	4	84
Rajasthan	7.0	46	4	50
Total	15.0	757	65	822

Source: ESMAP Energy Survey 1996

4.11 Liquefied petroleum gas is probably one of the most convenient and clean cooking fuels available and has been readily adopted in urban areas, where distribution networks are widespread, government subsidies are extended and disposable incomes are higher. Unlike improved chulhas, which women have to learn how to maintain according to the original specifications and learn how to cook with to take advantage of their efficiency, LPG stoves have minimal learning curves. They need little maintenance, rarely break down, and the highly controllable flame is excellent for all types of cooking needs.

4.12 Unfortunately, despite subsidies, LPG remains the most expensive cooking fuel. In rural India, the high cost of LPG has deterred the market from extending distribution networks into remote areas. This scenario is slowly changing as the policies of liberalization lead to developed markets.

4.13 However, in 1996, only over 10 percent of the rural households in the survey used LPG. The wide variation of distribution of LPG use among states reflects the importance of the overall living standard of households as well as the deliberate

promotion of LPG use by some state governments. Himachal Pradesh has the highest penetration rate with almost 50 percent of the rural women surveyed using LPG stoves for cooking. In order to preserve its forest cover, the state government has actively promoted the use of LPG. Punjab is a far second with approximately 15 percent of households using LPG. All other states show minimal usage of LPG, with Rajasthan lagging behind the furthest (Table 4.2).

Table 4.2 Working Status of LPG Stoves, Rural India 1996

States	*Percentage of households*	*Status of kerosene stoves (numbers)*		*Total*
		Working	Not working	
Maharashtra	2.5	27	0	27
Andhra Pradesh	4.9	48	0	48
West Bengal	1.1	11	0	11
Punjab	15.0	98	0	98
Himachal Pradesh	49.0	330	0	330
Rajasthan	1.0	5	2	7
Total	10.2	519	2	521

Source: ESMAP Energy Survey 1996

Use of Petroleum Fuels and Time Use

4.14 Comparing the lifestyles of women who use petroleum fuels for cooking with those who use biomass, we find that the former have a definite advantage. Since these women generally belong to households that have a higher standard of living, they spend less time on onerous tasks and more time on activities such as reading and watching TV. Although LPG or kerosene use may not necessarily relieve all women of the drudgery of fuel collection, the amount of time spent is much reduced. Fuel is collected for primarily two reasons. First, women often use petroleum fuels in combination with biofuels to save energy expenses. Second, we find that since most of the LPG-using households are in Himachal Pradesh, fuel collection remains an important part of women's lives despite the convenience of LPG (see table 4.3). Since Himachal Pradesh is a cold, mountainous state, space-warming needs often make it necessary for women to collect fuel for purposes other than cooking. But it is important to note that women using LPG in households in other states do not collect fuel at all.

4.15 Similarly, women who use kerosene for cooking are less likely to spend time collecting fuel. The longer time spent cooking is typical of women's time allocation in the better-off households that tend to use these stoves. Switching to kerosene as a cooking fuel is definitely more attractive in terms of reducing the hardships of rural women's lives and improving their health. However, its use is dependent on the availability of disposable income, as the costs of both the fuel and the stove are higher than the traditional fuel and stoves.

Table 4.3 Stove Type and Women's Time Spent Cooking and Collecting Fuel, Rural India 1996

Stove type	*Mean time spent (hours per day)*					
	All users			*Only users who collect fuel*		
	N	*Cooking (Hours)*	*Collect fuel (Hours)*	*N*	*Collect fuel (Hours)*	*Cooking (Hours)*
Traditional chulha	4,654	2.73	.69	1,433	2.44	2.11
Kerosene stove	757	2.79	.37	134	2.24	2.07
LPG stove	518	2.30	.52	200	2.37	1.33

Source: ESMAP Energy Survey 1996

4.16 Use of LPG stoves also significantly reduces the time spent cooking. This is surprising at first—since we know that women from better-off households generally tend to spend more time cooking and LPG users tend to be precisely from such households. But since most of the LPG users are from the two wealthy states of Himachal Pradesh and Punjab, access to amenities may provide a clue as to why women spend less time cooking. There is a close correlation between electrification and LPG use. Households with electrification are far more likely to use LPG for cooking. With access to electrification in most households, women try to accommodate a tradeoff between housework and leisure by spending some of their time watching TV and reading (Table 4.4).

Table 4.4 Fuel Type and Women's Time Allocation, Rural India 1996

Activities	*Average time spent depending on fuel used (Mean Hours)*					
	LPG		*Kerosene*		*Biomass Only*	
	Users	*Non-users*	*Users*	*Non-users*	*Users*	*Non-users*
No. of Cases	518	4,528	757	4,226	3,694	1,313
Collect fuel	0.52	0.69	0.39	0.73	0.76	0.42
Fetch water	0.66	0.96	0.94	0.92	0.96	0.83
Cooking	2.30	2.77	2.80	2.70	2.74	2.66
Housework	6.33	5.74	5.60	5.85	5.79	5.83
Income	1.45	1.95	1.70	1.94	1.99	1.65
Read	0.38	0.11	0.19	0.12	0.09	0.26
Watch TV	1.37	0.37	0.73	0.42	0.31	0.93
Leisure	10.53	10.47	10.74	10.42	10.41	10.64
Miscellaneous	0.46	0.67	0.72	0.63	0.66	0.62

Source: ESMAP Energy Survey 1996

4.17 Thus we find that women who have access to petroleum fuels for cooking have a much better quality of life. In the next section, we examine how this matter relates to household status and income.

Equity, Petroleum Fuels, and Time Use

4.18 A household's socioeconomic status in terms of income, education, occupation, and caste clearly affects access to petroleum fuels for cooking. Even though they may be the most convenient for cooking and the cleanest in terms of combustion, these fuels require disposable income to procure, unlike most biomass fuels (Table 4.5). As a result, only a little over 10 percent of the women who belong to households in the lowest-income group use kerosene for cooking and less than 2 percent can afford to use LPG. But at higher levels of income, both LPG and kerosene are more commonly used. In the case of LPG, the inverse relationship between income and fuel use is quite dramatic. A very low 1.5 percent of the women from the lowest-income group use LPG stoves, but almost 30 percent of the women in the richest households take advantage of it.

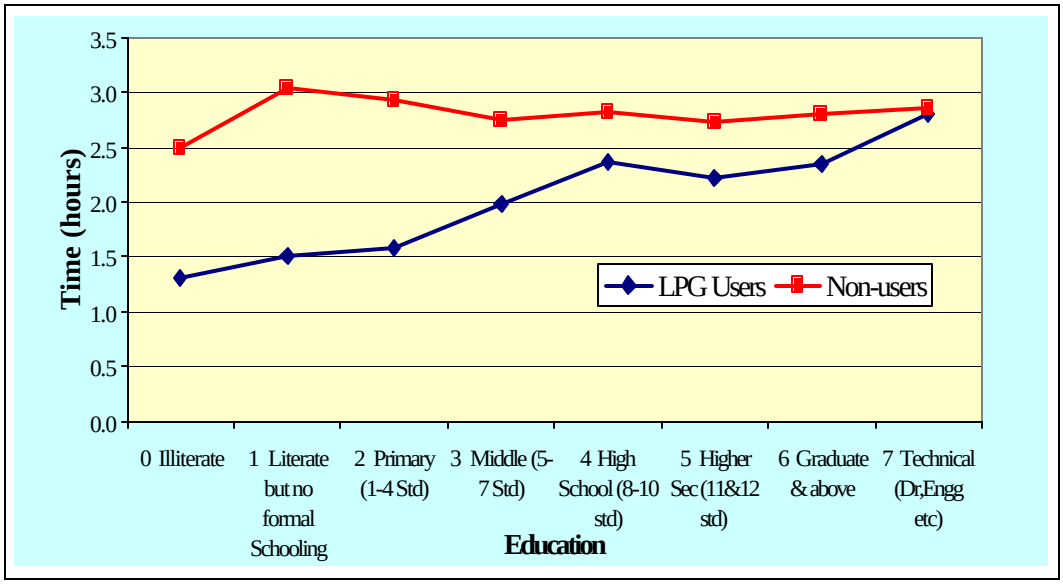
Table 4.5 Income Class and Households Using Petroleum Fuels for Cooking, Rural India 1996

Income group (Rs./household/year)	*Percentage of households using:*	
	LPG stoves	*Kerosene stoves*
Less than 9,000	1.5	10.5
9,001 – 18,000	4.0	14.6
18,001 – 32,000	12.2	18.0
32,001 – 42,000	19.0	23.0
42,001 – 60,000	22.5	21.0
Greater than 60,000	29.0	20.0

Source: ESMAP household Survey, 1996

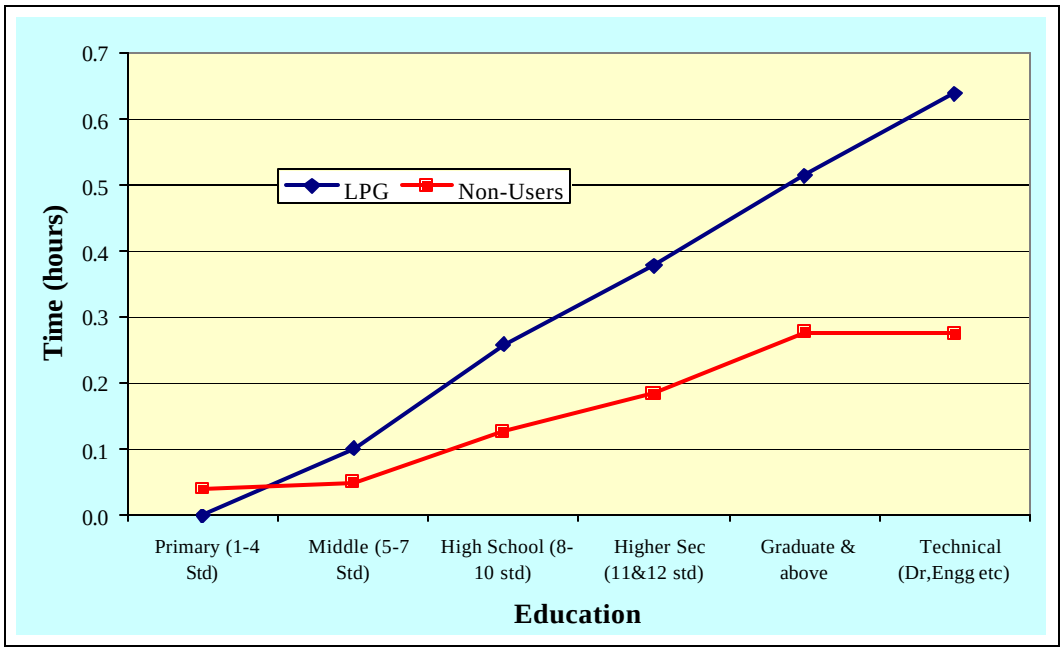
4.19 However, once households have access to LPG, women enjoy a more balanced life between onerous tasks and leisure compared to women who use biomass fuels at almost every status level. Figures 4.1 and 4.2 illustrate this with respect to the relationship between household educational status and time spent cooking and reading.

Figure 4.1 Education Level and Time Spent Cooking: LPG Users Versus Non-Users, Rural India 1996



Source: ESMAP Energy Survey 1996

Figure 4.2 Education Level and Time Spent Reading: LPG Users Versus Non-Users, Rural India 1996



Source: ESMAP Energy Survey 1996

4.20 Earlier we had noted that women from more educated households in India spend less time on onerous tasks and income-generating work and more time on housework and leisure. Here we see that with access to LPG for cooking, women at lower levels of education are able to save considerable time spent cooking and devote it to other activities such as paid work. At the uppermost educational levels we notice little difference.

4.21 While education is definitely related to the time women spend reading we note here that LPG users enjoy considerably more time doing this compared to non-users. The high correlation between LPG use and access to electrification is largely responsible for this extra time.

4.22 Although occupation is related to access to petroleum fuels, it is less so than income or education. What is clear is that laborer and artisan households have almost zero access. The poverty and mobility of these households are among the principal reasons for their inability to take advantage of these fuels.

Table 4.6 Occupation and Percentage of Households Using Petroleum Fuels for Cooking, Rural India 1996

Occupation	*Percentage of households using:*	
	LPG	*Kerosene*
Large landlord	10.5	13.7
Small landlord	14.4	17.5
Professional	16	1.8
Laborer and artisan	.8	.9

Source: ESMAP Energy Survey 1996

4.23 Finally, with respect to caste differences, households from twice born castes are more likely to use kerosene for cooking (Table 4.7). In the case of LPG, the twice born caste households do adopt LPG more than others, but it is notable that ST households do not lag far behind. Since 64 percent of LPG users live in Himachal Pradesh, a look at the distribution in the state provides an explanation for this greater equity. As we have discussed above the government has taken a lead role in promoting LPG use and it seems to have succeeded in giving greater access to ST households than would be expected otherwise. However, SC households still seem to lag far behind others in the state.

4.24 Unfortunately, in the aggregate, caste affiliation still seems to matter unless a deliberate intervention is made on behalf of SC and ST households.

Table 4.7 Caste and Percentage of Households Using Petroleum Fuels for Cooking, Rural India 1996

Castes	*Percent of households using:*		*Only Himachal Pradesh*
	LPG	*Kerosene*	*LPG*
Twice born castes	12.3	18.5	62%
Scheduled tribes	11.4	7.3	53%
Scheduled castes	4.4	9.4	17%

Source: ESMAP Energy Survey 1996

Trends in Switching to Petroleum Fuels

4.25 Household income levels in rural India are a strong inhibitor to switching fuels. However, when households do have the ability and opportunity to move up the energy ladder, the trends show that LPG and kerosene are the preferred fuels for cooking. The households in the six-state survey were asked whether or not they switched cooking fuels during the last five years, and only a little over 10 percent of rural households reported that they had. For those that did switch to another fuel, the majority involved moving from traditional fuels to LPG or kerosene (Table 4.8).

Table 4.8 Cooking Fuel Transitions by Households in Rural India, 1990–96

Fuel Used in 1990	*Percentage of households that switched fuel by 1996*						
	Wood	*Straw*	*Dung*	*Kerosene*	*LPG*	*Biogas*	*Percentage of all households that switched 1990-96*
Fuelwood	n.a.	1.3	3.2	25.6	35.8	10.2	8.4
Straw	0.2	n.a.	0.4	1.3	1.7	0.9	0.5
Dung	0.6	0.2	n.a.	1.3	4.6	2.0	1.0
Kerosene		?	?	?	2.6	0.7	0.5

Source: ESMAP Energy Survey 1996

4.26 For four of the states a comparison can be made between the years 1980 and 1996 because the survey was conducted for the same villages (Table 4.9). With the longer time period, the movements from fuelwood to kerosene or LPG and down the energy ladder to straw are evident. The findings confirm that about 10 percent of households are moving toward the modern fuels, but there also is an increase in the use of straw in one state. These findings reinforce that at least for the higher-income rural households the availability of LPG is an important factor in its adoption by a significant percentage of the population.

Table 4.9 Comparing Fuel Types Used by Rural Households in Four States, India 1980-1996
(Percentage of households)

Fuel type	*Andhra Pradesh*		*Maharashtra*		*Punjab*		*West Bengal*	
	1980	*1996*	*1980*	*1996*	*1980*	*1996*	*1980*	*1996*
Fuelwood	94	60	93	95	83	48	82	47
Straw	17	49	39	37	50	36	57	50
Dung	44	33	71	78	72	83	87	91
Charcoal	0	1	2	1	1	0	1	13
Kerosene	98	98	94	100	81	80	81	96
LPG	0	8	0	3	0	13	0	2
Electricity	_	66	_	65	_	92	_	26
Biogas	0	0	_	9	0	2	0	0

Source: ESMAP Energy Survey 1996

Note: Percentages are limited to the 132 villages surveyed in 1980.

Conclusion

4.27 It would not be overly pessimistic to conclude that most rural women in India will continue using biofuels for cooking for a long time to come. Even households that use kerosene or LPG seem to use biofuels in combination with them. Switching solely to other cooking fuels, especially LPG, requires a quantum jump in disposable incomes, however clean and convenient these alternatives may be.

4.28 The relatively thin spread of LPG in rural areas implies that despite its being the most clean-burning and convenient fuel, and one that can greatly improve the lives of rural women, the prohibitive cost and the relative lack of infrastructure for supply and distribution prove to be major obstacles to its penetration. The overall development of the state and its markets seem to be imperative before it can be widely adopted. Some recent developments with regard to the market availability of LPG seem promising, but there is a long way to go before the average rural women begins to substitute biofuels for LPG.

4.29 The convenience introduced by even this limited use of LPG, and especially the amount of time saved for the cooks, should not be underestimated, even if the overall consumption of fuelwood does not decline markedly. Indeed, the beneficiaries universally cited time savings in cooking as the primary benefit of LPG use. The discussions held with beneficiaries also indicated that there are nonquantifiable benefits, the most important of which is perhaps increased self-esteem. However, with the current consumption pattern, the health and other social benefits of LPG are not fully realized.

5

The Impact of Household Electrification on Rural Women's Lives

5.1 Household electrification has great potential to impact people's lives in a positive manner. At the national level, it is strongly related to higher rates of literacy and education, better health, and in general higher levels of development. However, in rural areas, poorly developed markets, poverty, and the lack of complementary infrastructure can lessen the potential impact of rural electrification. Even when access exists, the reliability and high cost of supply compel people to use other traditional or less appropriate commercial energy sources to fulfill their daily needs such as lighting, cooking, or pumping water for domestic and agricultural uses. Thus, when available, household electrification is used mainly for lighting, space conditioning, or entertainment.

5.2 Electricity is often characterized as a necessary but insufficient condition for development. This means that it is not the only factor related to development, but it does provide basic energy important for rural development in certain situations. Electricity is instrumental in expanding agricultural pumping and driveshaft power for villages that are close to the electricity distribution system and have the proper complementary conditions (Barnes 1986; Bose 1993; ORG 1991). Electricity and education are mutually reinforcing programs, since electric lights make reading in the evenings much easier (Barnes 1986; Chaieb and Ounalli 2001). Both small and large farms appear to benefit from rural electrification programs with a significant focus on agricultural development, and electrification also may stimulate the use of agricultural innovations. Rural electrification programs that stress the multiple uses of electricity can have a broad impact on social and economic development. The number of households adopting electricity continues to grow for years after a village receives electricity, reinforcing the argument for evaluating these programs from a long-term perspective. Electricity makes possible some new uses of energy, including household appliances such as fans and televisions.

5.3 This chapter examines the impact of household electrification in rural India on women's work and lives. Though electricity is not likely to be used for cooking in rural areas, it may allow women to cook in the evening rather than during the daytime. Also, the lighting and appliances that are possible because of the availability of electricity can have important consequences for women. Electricity can have an impact by providing lighting so that women can take advantage of the evening hours for reading, productive work, and leisure. It also may eliminate arduous tasks by mechanizing the

processing of grains and other foods. Electricity can also provide access to distance education or entertainment through radio and television. To determine the impact of electricity, the allocation of women's time is compared for households with electricity to those without electricity that typically use kerosene for lighting.

Domestic Uses of Electricity in Rural Areas

5.4 Because of the low levels of cash income in the rural areas of India, electricity is used in relatively small quantities compared to urban households. The consumption level also is closely related household income. States with the highest rural household income levels have the highest level of electricity adoption and consumption. The households that do adopt electricity use it for a variety of different domestic uses.

5.5 Rural households typically possess several different kinds of devices and appliances (Table 5.1). Minimally, all houses that have electricity have some type of lighting fixture. After lights, quite understandably, in a hot, tropical country such as India, the most common use for electricity is for fans. Around 57 percent of the households own a ceiling and/or table fan. The next most common use for electrification is for television viewing. Despite the high cost, television ranks among the top three uses of electrification with 41 percent of the households owning a set. The adoption of irons by households with electricity is only slightly lower than televisions.

Table 5.1 Distribution of Appliances in Rural Households, India 1996

Appliance or device	*Percentage of households with electricity*	*Percentage of households without electricity*	*Percentage of all households*
Electric lights	100	0	60
Kerosene lamps	43	55	48
Television	41	0	25
Ceiling fan	41	0	25
Table fan	37	0	23
Iron	37	0	23
Tape recorder	27	2	16
Radio	36	5	24
Transistor	19	28	22
Refrigerator	7	0	4
Mixer/grinder	7	0	4
Electric cooking Stove	2	0	1

Source: ESMAP Energy Survey 1996

5.6 Indian cooking involves hours spent processing foods, and the adoption by women of mixers or grinders, along with refrigerators and electric stoves would greatly reduce this work. Unfortunately, the ownership of these appliances are rare. One can understand the reluctance of households to invest in refrigerators and cookstoves owing to the high cost and problems in using them in an unreliable electricity-supply environment, but the reason for not purchasing mixers or grinders is less clear.

5.7 As indicated earlier, the main appliances of lights, fans, and television sets can have important impacts on education, health, and communications. Thus, in rural areas electricity is used in small quantities in the domestic sector when compared to urban areas in India, but it is used for relatively important activities such as lighting, communications, and space cooling. The potential future benefits of electricity include air conditioning, vacuum cleaning, and washing, but they must wait for dramatically higher rural incomes.

Electricity and Women's Time Use

5.8 Women from households with electricity clearly lead a more balanced life between work and leisure activities. Compared to households without electricity they spend less time collecting fuels, fetching water, and cooking and instead spend more time on earning an income, reading, and watching television (table 5.2). They also spend a little more time engaged in housework and other miscellaneous activities. The use of lights in such households enables women to pursue housework even after sunset. Of all the activities, electrification seems to most strongly affect their time devoted to collecting fuel, reading, and watching television. The presence of a television in a household increases the differences even further, resulting in more TV viewing and less fuel collection (Table 5.2).

Table 5.2 Electricity and Women's Time Allocation, Rural India 1996

Activities	*Mean time spent (hours)*		
	Households without electricity	*Households with electricity*	
	N = 2,012	*All N = 3,036*	*With TV N = 1,249*
Collecting fuel	0.90	0.53	0.32
Fetching water	1.00	0.88	0.71
Cooking	2.93	2.58	2.53
Other housework	5.75	5.83	6.01
Earning income	1.86	1.93	1.38
Reading	0.03	0.20	0.32
Watching TV	0.06	0.76	1.63
Other leisure	10.49	10.46	10.42
Miscellaneous	0.52	0.72	0.60

Source: ESMAP Energy Survey 1996

5.9 Reading is an activity that requires a good quality of light during the evening hours. About 90 percent of the women who pursue some reading during a typical day are in households with electricity, compared to 2 percent in households without electricity. Women who read, on average, do so for more than an hour. Thus, electrification has important consequences for the continuing education of women.

The Effect of Income

5.10 Electricity benefits women at all levels, bringing relief even to those at the lowest levels of income who have it. However, in previous sections socioeconomic status was revealed to have significant effects on the lifestyles of women. Women from higher-status households lead a life less filled with drudgery. In this section we examine whether the benefits of having electricity extend beyond those that are related to higher standards of living or merely mirror them.

5.11 The issue to be examined is how household income affects the time use of women when it is combined with electricity. At all levels of income, women from households with electricity lead a life that is more balanced between hard work and leisure (Table 5.3). *In fact, an important finding is that women from households with electricity in the lowest-income group seem to have an easier and more balanced life than those from the highest-income group in households without electricity.*

Table 5.3 Income Class, Electricity and Women's Time Allocation, Rural India 1996

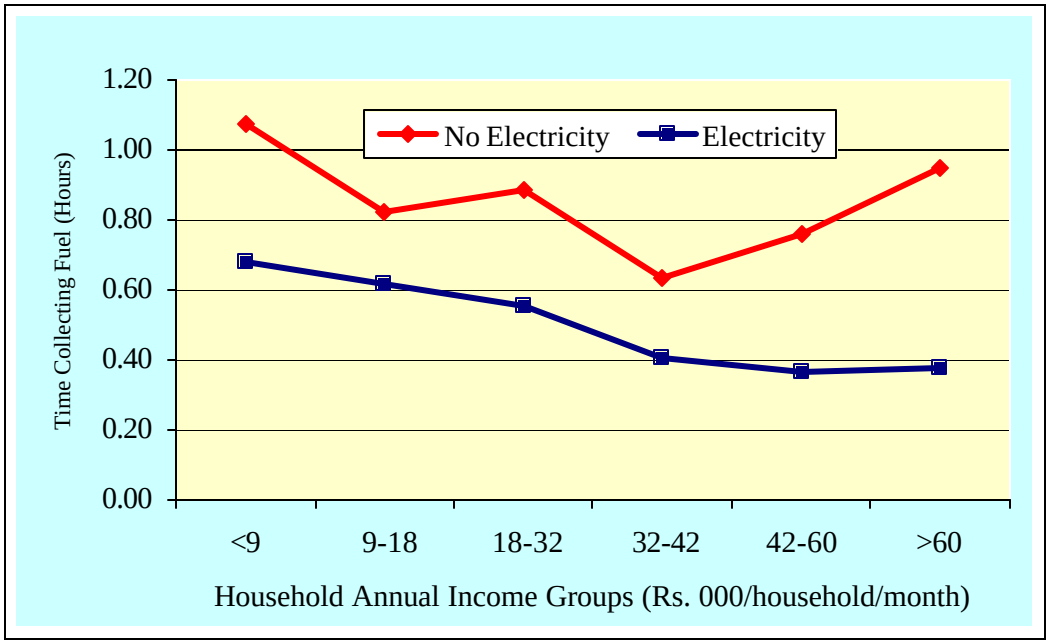
Income group (Rs./household/ month)	*Mean time spent (hours per day)*								
	Collect fuel	*Fetch water*	*Cook*	*Other house-work*	*Earn income*	*Read*	*Watch TV*	*Other leisure*	*Misc.*
Households without electricity									
<9,000	1.07	1.02	2.75	5.51	2.05	0.04	0.06	10.49	0.63
9,001–18,000	0.82	0.95	3.04	5.83	1.78	0.02	0.05	10.50	0.53
18,001–32,000	0.89	1.03	3.04	5.64	1.83	0.05	0.04	10.52	0.47
32,001–42,000	0.63	1.00	3.07	5.55	1.83	0.05	0.19	10.67	0.29
42,001–60,000	0.76	1.10	2.69	6.03	1.63	0.02	0.11	10.37	0.41
>60,000	0.95	1.19	2.61	6.64	1.73	0.01	0.08	10.31	0.19
Households with electricity									
<9,000	0.68	1.03	2.56	5.42	2.21	0.10	0.32	10.65	0.91
9,001–18,000	0.61	0.92	2.62	5.72	2.11	0.15	0.48	10.45	0.83
18,001–32,000	0.55	0.86	2.60	5.96	1.90	0.19	0.79	10.39	0.65
32,001–42,000	0.40	0.82	2.58	6.04	1.57	0.26	1.02	10.57	0.66
42,001–60,000	0.37	0.76	2.51	5.97	1.61	0.31	1.23	10.52	0.64
>60,000	0.37	0.81	2.54	5.99	1.87	0.30	1.13	10.31	0.56

Source: ESMAP Energy Survey 1996

5.12 In general women from richer households spend less time on burdensome tasks. Women from households with electricity also seem to have more time for productive and leisure activities. Since there are only 24 hours in a day, women have to make tradeoffs between survival tasks such as collecting fuel, fetching water, cooking, and housework and income-earning and leisure pursuits. At almost every level of income, women in households without electrification seem to spend less time not only on leisure activities, but on income-generating pursuits as well.

5.13 The time spent collecting fuel is related both to having electricity and to household income (Figure 5.1). At all levels of income, the time spent collecting fuel in households with electricity is lower than for those households without electricity. There are several reasons that might account for this difference. The households with electricity might possibly be able to cook the evening meal just before it is consumed. With the exception of fresh breads and rice, households without electricity often prepare the evening meal during the daylight hours and then reheat it in the evening. Thus they are using more fuel and must spend more time collecting fuel than households with electricity. In addition, households with electricity may be more likely to cook with kerosene or electricity, an issue that was addressed in the previous chapter.

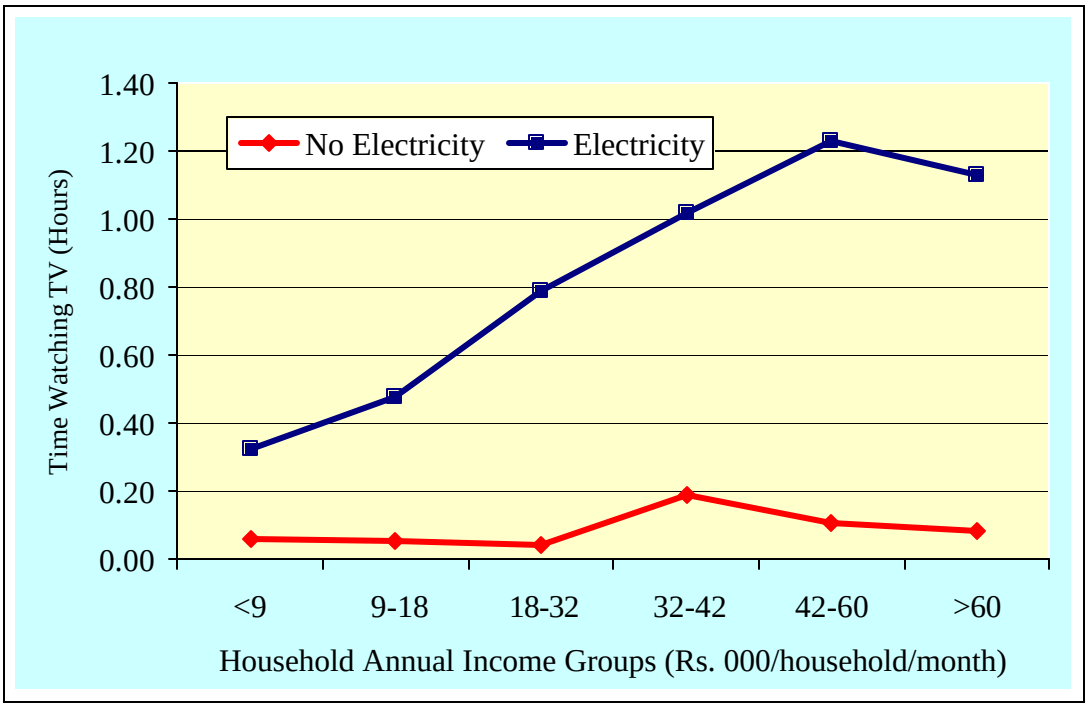
Figure 5.1 Household Income, Electricity and Time Spent Collecting Fuel, Rural India 1996



Source: ESMAP Energy Survey 1996.

5.14 Watching television also has an impact on the use of women's time, even for the poorest households. As illustrated in Figure 5.2, households with electricity spend a considerable amount of time watching television. However, the figure does not take into consideration the presence of a television in the household. For the day that the time use questions were asked, only 27 percent of the women reported spending some time watching television. As indicated, only about 60 percent of all households have a television, and those in the lower-income groups are less likely to have a television. Those women who watch some television during the day spend almost two hours doing so. The differences in the amounts of TV-watching time among the various income groups lessens considerably for households that watch some television (in other words, when non-TV-watching households are excluded from the sample calculations). Obviously, there is wide literature on the effects of watching television, and not all of it is positive. However, for a country in which communications in rural areas is poor at best and literacy rates are low, the entertainment and educational value of television should not be underestimated.

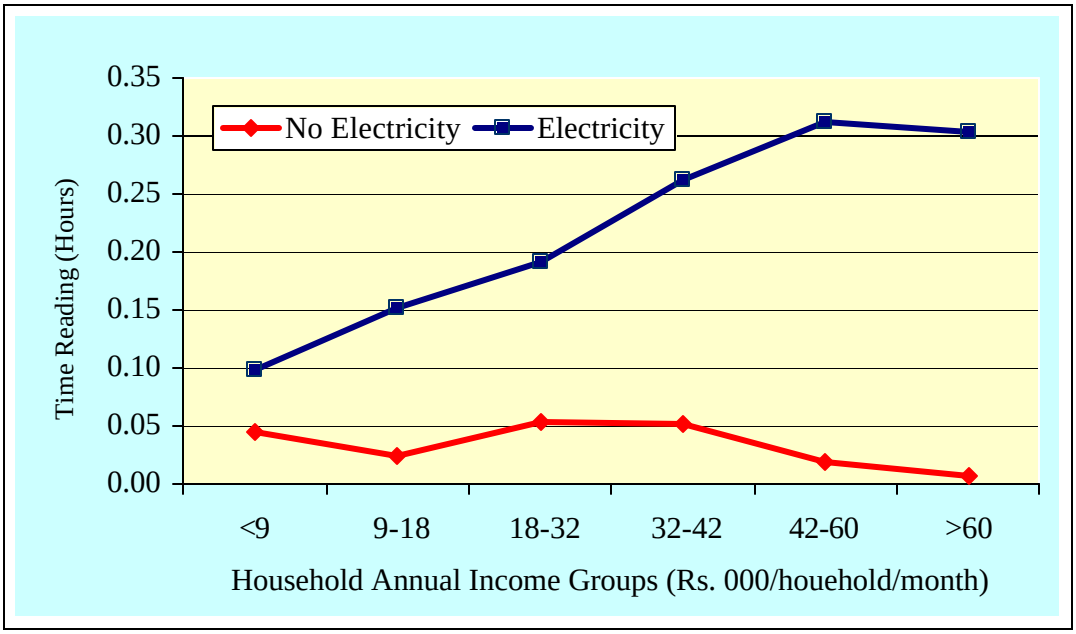
Figure 5.2 Household Income, Electricity and Time Spent Watching TV, Rural India 1996



Source: ESMAP Energy Survey 1996

5.15 Probably the most interesting result on the impact of electricity involves the time spent reading by rural women. The probability that a woman in a household will read is very highly related to the presence or absence of electricity in the home. In fact, regardless of income class, there is virtually no reading that takes place in households without electricity. About 11 percent of our sample reported spending some time reading on the day surveyed. On average, women who spent some time reading did so for about one hour a day. When this time is averaged across all of the households, the pattern is that higher-income women do spend more time reading than their counterparts in the lower-income classes. However, lower-class households with electricity have a much greater likelihood of reading than the ones without electricity. It should also be pointed out that women in lower-income households have lower rates of literacy than those in the higher-income groups, and therefore would have a lower possibility of reading. Thus, it would appear that the high-quality lighting made possible by having electricity makes it more likely that women will read in the evening regardless of their income class (Figure 5.3).

Figure 5.3 Household Income, Electricity and Time Spent Reading, Rural India 1996



Source: ESMAP Energy Survey 1996.

5.16 To sum up, the general pattern is that women at higher levels of income take greater advantage of the benefits of electricity than their poorer counterparts in the lower-income groups. However, even in the lowest-income groups, households with electricity lead easier lives than do those without electrification.

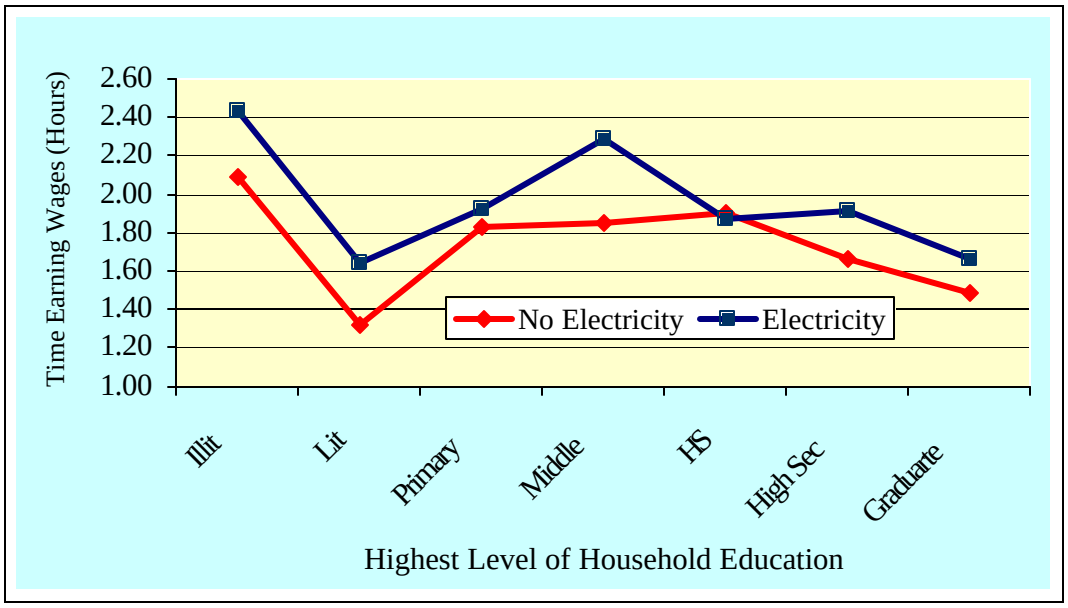
The Impact of Education

5.17 The level of education in a household has an effect that is similar to that of household electrification on women's lives. Women in households with generally higher levels of education should be able to strike a better balance among work, leisure, and the more onerous survival tasks. This section examines how household education combined with access to electricity impacts the allocation of women's time use.

5.18 The time spent collecting fuel declines with higher levels of education, but women from households without electricity spend more time collecting fuel at each educational level compared to women from households with electricity. Thus, electrification significantly reduces the time spent on the onerous task of fuel collection over and above the influence of education (Table 5.4). This finding is further strengthened when considering only those women who collected fuel on the day the survey was completed, as electricity seems to become even more important for reducing fuel collection by rural households.

5.19 Access to electricity does seem to free up some time for earning income, especially for women with lower levels of education. As indicated previously, there is a trend for women from better-educated households to spend less time working for wage income. This trend is confirmed in Figure 5.4, which shows that the women with the lowest level of education tend to work more than those with more education. However, whether this is because of more diverse opportunities made possible by having electricity or for some other reason, in general households that have electricity spend more time earning income than those without electricity. This is a very promising effect, in light of the vast amount of research that points to the importance of women's income for the well-being of the family (Dixon 1978; Dube, Leacock, and Ardener 1986).

Figure 5.4 Education, Electricity and Time Spent Earning Wages, Rural India 1996



Source: ESMAP Energy Survey 1996

5.20 The relationship between education and reading follows the pattern established earlier by income groupings. Virtually no reading takes place in households without electricity, regardless of the highest level of education in the household. By contrast, women in households with electricity steadily increase the time that they read with an improvement in the education level. Unfortunately, the education level of the women reporting time use was not recorded, but in any event the high degree of relationships between having electricity and reading are confirmed by this analysis.

Table 5.4 Education, Electricity and Women's Time Allocation, Rural India 1996

Highest education level in household	*Time spent on activity (mean hours per day)*								
	Collect fuel	*Fetch water*	*Cook*	*Other house-work*	*Earn income*	*Read*	*Watch TV*	*Other leisure*	*Misc.*
Households without electricity									
Illiterate	1.11	1.00	2.60	5.45	2.09	0.01	0.03	10.29	0.59
Literate	0.51	0.81	3.15	6.19	1.32	0.00	0.03	10.34	0.39
Primary (1-4 std)	0.93	0.90	3.04	5.93	1.83	0.01	1.03	10.46	0.49
Middle (5-7 std)	0.97	1.06	2.92	5.79	1.85	0.03	0.04	10.52	0.53
High School (8-10 std)	0.80	1.04	3.02	5.65	1.90	0.06	0.09	10.53	0.52
Higher Sec (11 & 12 std)	0.77	1.17	2.95	5.80	1.66	0.05	0.07	11.04	0.49
Graduate & above	0.52	0.88	3.13	6.09	1.49	0.16	0.24	10.54	0.63
Households with electricity									
Illiterate	1.00	1.04	2.22	5.51	2.43	0.07	0.34	10.59	0.67
Literate	0.70	0.93	2.36	6.36	1.64	0.12	0.45	10.52	0.91
Primary (1-4 std)	0.79	0.95	2.63	5.77	1.92	0.06	0.27	10.30	0.76
Middle (5-7 std)	0.63	0.96	2.50	5.84	2.29	0.07	0.44	10.40	0.69
High School (8-10 std)	0.52	0.90	2.66	5.97	1.87	0.17	0.67	10.44	0.77
Higher Sec (11 & 12 std)	0.43	0.80	2.58	5.72	1.91	0.25	1.01	10.51	0.71
6 Graduate & above	0.33	0.79	2.59	5.81	1.66	0.38	1.19	10.51	0.65
7 Technical	0.07	0.78	2.85	5.70	1.62	0.43	1.13	10.60	0.82

Source: ESMAP Energy Survey 1996

5.21 As for cooking-related activity, there is a slightly greater likelihood of women from households without electricity to spend more time on these tasks than others. However, the group that benefits the most from electricity is made up of those women at the higher educational levels. This points out the complementarity between programs for education and rural electrification.

The Effect of Caste

5.22 In India, women belonging to higher-caste families tend to lead less burdensome lives than the women from the lowest-scheduled castes and tribes. This section examines whether electricity eases the life of only those from the higher castes or whether it also has a favorable impact on the lowest castes. Lower-caste households are less likely to have electrification. From a policy standpoint it is important to understand whether having access to electricity even in the poorer castes has a benefit for the lives of the woman in those castes. Table 5.5 sums up the results of the survey in this regard.

Table 5.5 Caste, Electricity and Women's Time Allocation, Rural India 1996

Caste of household	*Time spent on activity (mean hours per day)*								
	Collect fuel	*Fetch water*	*Cook*	*Other house-work*	*Earn income*	*Read*	*Watch TV*	*Other leisure*	*Misc.*
Households without electricity									
Caste	0.64	1.01	3.04	5.84	1.77	0.03	0.08	10.54	0.52
SC and ST	1.24	0.99	2.78	5.62	1.96	0.04	0.03	10.43	0.53
Households with electricity									
Caste	0.41	0.89	2.63	5.76	2.01	0.22	0.80	10.49	0.68
SC and ST	0.79	0.84	2.48	6.00	1.75	0.18	0365	10.42	0.82

Source: ESMAP Energy Survey 1996

Note: Caste includes all the higher castes and backward castes which are relatively more privileged. SC and ST stands for scheduled caste and scheduled tribe.

5.23 Access to household electrification reduces the burdensome tasks for women from scheduled caste and tribe households, just as it does for those from the higher castes. In households without electricity, women from the higher castes spend more time collecting fuel than in households with electrification. But it is also true that the amount of time saved collecting fuel for scheduled caste and tribe households with electricity is even greater than the higher-caste households.

5.24 The pattern for income-generating work reveals that the low-caste women in households with electricity are doing less labor for wages than similar families without electricity, but women from higher castes spend more time earning if they have electricity. The higher-caste families generally are involved with work on the farm. This is an interesting finding because it parallels much work in developing countries on women's labor force participation. Among poor, traditional households, women tend to withdraw from the workforce as their incomes rise. When households can afford to have only one income earner, the women stay at home and tend to the traditional role of taking care of the family. However, women are back in the workforce once a family reaches

higher levels of income. These are families that own fairly substantial farms, and women are significantly involved in farm work.

The Impact of Occupation

5.25 As we saw in the last chapter, household occupation influences women's time allocation such that women from professional households lead the least burdensome lives, while those from laboring households spend the most time on onerous tasks. In this section we examine whether having electricity affects only women who are already privileged, or whether women in laboring households who have electricity also manage to strike a better balance between the burdensome tasks of providing for the family and more leisure or productive tasks.

5.26 Electrification reduces the burdensome drudge tasks for women from all occupational backgrounds, but seems to benefit women from the professional households the most (Table 5.6). As indicated, these women lead the least burdensome lives whether they live in homes with or without electricity. Women from professional households seem to spend the most time on both housework and cooking regardless of the electrification status of the household but significantly less time on other tasks such as collecting fuel and fetching water. However, they are also able to take the most advantage of the various uses of electrification owing to their higher income and greater accumulation of electricity appliances. Thus they lead a more relaxed and leisurely lifestyle than their counterparts in other households.

Table 5.6 Occupation, Electricity and Women's Time Allocation, Rural India 1996

Occupation	*Time spent on activity (mean hours per day)*								
	Collect fuel	*Fetch water*	*Cook*	*Other house-work*	*Earn income*	*Read*	*Watch TV*	*Other leisure*	*Misc.*
Households without electricity									
Professionals	0.65	0.91	3.28	6.34	1.29	0.09	0.12	10.75	0.47
Large landowners	0.92	1.18	2.53	5.80	2.05	0.01	0.02	10.32	0.42
Small landowners	1.01	1.03	2.95	5.62	2.04	0.03	0.06	10.55	0.50
Laborers	0.88	0.94	2.95	5.66	1.80	0.03	0.05	10.43	0.59
Households with electricity									
Professionals	0.23	0.77	2.67	6.04	1.12	0.34	1.09	10.72	0.79
Large landowners	0.46	0.98	2.52	5.65	2.31	0.21	0.77	10.33	0.62
Small landowners	0.64	0.86	2.60	5.77	2.15	0.17	0.73	10.34	0.66
Laborers	0.60	0.90	2.54	5.98	1.78	0.15	0.49	10.65	0.91

Source: ESMAP Energy Survey 1996.

5.27 The gains of reducing burdensome work for women from both small-landlord households and laboring households are substantial, but not as great as they are for the other two groups. Women from farm households both small and large spend a significant amount of their time earning income. With household electrification, women from such large- and small-landlord households actually increase their time pursuing such activities even further, while women from professional households see a decrease in income-generating time.

5.28 Thus, electrification seems to benefit women across all occupational groups, but it does seem to benefit those from professional and large-landed households more than it does others.

Access to Village Infrastructure and Rural Electrification

5.29 Electricity is available in almost all villages in India today. However, because of several reasons (difficulty in getting a connection from the power distribution company, lack of reliability of service, location of the households in areas of the village that are not close to the distribution lines, and so on) about 40 percent of the households in our sample do not have electricity service from the grid. The result is that the proximity of infrastructure services to households with and without electricity is on average quite similar. Though households with electrification may be slightly more likely to be located closer to major infrastructural facilities such as roads, schools, and banks, this is the case mainly in states such as Maharashtra and Andhra Pradesh. Punjab and Himachal Pradesh where almost all residents have access to household electrification reveal little relationship with access to other infrastructure. In the case of West Bengal and Rajasthan, the relationship is weak again because few households have electricity in the first place. Overall, the relationship between household electrification and access to infrastructure is not as strong as one would expect (Table 5.7).

5.30 Women who live in villages with better infrastructure conveniences tend to have an easier life than those from remote villages. While it is not necessarily the case that access to town or roads increases a woman's opportunity to earn an income in rural areas, it does tend to improve her access to fuel and conveniences such as piped water. However, just living in a village that has access to an electricity grid does not improve the lives of women as much as having electrification in the household. Similarly, since proximity to infrastructure does not really inform us about whether a particular infrastructure is used by the women in a household, our results are inconclusive on the benefits of access to infrastructure. If we had information on whether they actually used the banks or had children enrolled in school, our results on the effect of infrastructure and household electrification would have been stronger. In addition, our data do not allow one to analyze differences between villages with and without electrification, because there are only five villages in our data that do not have electricity. Therefore we are unable to draw conclusions on whether access to various other infrastructure facilities enhances the benefits of household electricity further.

Table 5.7 Proximity to Infrastructure and Electricity, Rural India 1996

Distances to nearest:	*Percentage of households with no electricity (%)*	*Percentage of households with electricity (%)*	*Total N*
Road			
Within village	33	67	2,412
1–3 kms	48	52	1,430
3–5 kms	56	54	539
>5 kms	32	68	466
Primary school			
Within village	40	60	4,233
1–2 kms	44	56	365
2–3 kms	25	75	224
>3 kms	0	100	25
Bank			
Within village	27	73	616
1–5 kms	32	68	1,592
5–10 kms	40	60	1,517
>10 kms	58	42	1,122
Total N	1,923	2,924	4,847

Source: ESMAP Energy Survey 1996

Reliability of Household Electrification

5.31 The reliability of electrification is a major concern in rural areas. The benefits of electricity cannot take place in an environment in which there are a high number of electricity service outages. In this context, the households in the survey were asked to evaluate the reliability of their electricity supply.

5.32 The study measured reliability by collecting data on the number of power outages experienced by households in a month. As can be seen from Table 5.8, only 4 percent of households reported zero outages. The majority of the households suffered more than 10 outages a month, with some reporting as many as 10 a day.

Table 5.8 Reliability of Household Electricity, Rural India 1996

Number of power outages per month	*Percentage of households*
None	4
1–10	40
11–30	24
31–60	10
61–90	11
91–300	11

Source: ESMAP Energy Survey 1996

5.33 Electricity breakdowns can extend for days at a time. Frequent power outages in a day are the norm for most villages. Most households also think that electricity is unreliable at present (Table 5.9, and as a result adll households keep kerosene as a backup system for lighting.

Table 5.9 Opinion on the Cost and Reliability of Household Electricity, Rural India 1996

Opinion	*Agree*	*Disagree*	*Don't know*
Thinks electricity is not reliable for lighting	45%	29%	26%
Willing to pay more for electricity if more reliable	43%	23%	35%
Thinks electricity is more expensive than kerosene for lighting	49%	35%	16%

Source: ESMAP Energy Survey 1996

5.34 However, more than 40 percent claim that they would be willing to pay more if reliability were improved. Thus, the benefits of electricity for rural households are probably somewhat understated because of the frequent power outages in rural areas.

Conclusion

5.35 Household electrification affects women's lives in rural India both directly and indirectly. About 60 percent of the women surveyed live in homes that have electricity. Their lives when compared to those who live in nonelectrified houses seem to be less burdensome and more balanced between work and leisure. While household income, education, caste, occupation, and village infrastructure all affect women's time use, household electrification seems to have a beneficial impact even after controlling for all such factors.

5.36 Women from houses with electricity spend less time collecting fuel, fetching water, and cooking. They spend more time reading, and watching TV. They also have more time to pursue other miscellaneous activities. Much of the direct effect of electrification on their time allocation seems to be driven by access to lights, but even more important, television. Television watching is the largest end use of electrification after lights and fans in rural India. Reading and watching TV are significant factors in raising awareness, broadening horizons, and educating rural women and thus should be seen as status-enhancing activities. With access to electrification, women seem to be able to adjust their responsibilities so as to spend some evening hours on housework and watching TV. Households with electrification are also likely to use better fuels, thus saving some time from cooking and collecting fuel.

5.37 However, the use of appliances that would directly help reduce the energy and effort of women is almost nonexistent in rural India. Since household decision making remains mainly the prerogative of men, the needs of the women remain largely ignored or unmet (IFAD 2000). Developing greater awareness among people of the potential uses of electrification for easing the lives of women, as well as developing markets for products targeted for women's use should be a priority. If more than 40 percent of electrified homes have been able to afford a television, an electrical appliance such as a mixer/grinder should be well within the means of many households.

6

Institutional Strategies on Domestic Energy Use and Policy Implications for Women's Lives

6.1 Women in rural India put in very long hours on arduous survival tasks and household chores. The energy and effort they spend often are not socially or economically recognized. Consequences on their health seem to be of little consideration. Time spent on economic pursuits is limited. Their lack of economic independence leaves them with little or no resources to opt for more efficient fuels or install more efficient technologies that can alleviate their hardship. When household money is spent on durable goods, preference seems to be given to those items that benefit the whole family such as owning fans or televisions. While biofuel dependence and water scarcity seem to be an important factor in explaining their difficult life, access to better fuels, technology, and electrification definitely seems to improve their level of well-being. This chapter examines some strategies that may help improve the energy situation of rural women.

Policies for Biofuels Management, Electrification, LPG, and Kerosene

6.2 Households that have access to electrification, LPG, or kerosene are much better off in terms of drudgery alleviation and improved respiratory health than those who do not use them for their daily lives. While the use of electricity seems to increase the time spent on earning an income and leisure pursuits, LPG and kerosene use reduces the time spent cooking and collecting fuels while protecting women from the polluting smoke of traditional chulhas. Even after controlling for women's household status factors, electrification and LPG have a positive effect on the balance of work and leisure. Not only the number of burdensome, unpaid and unrecognized tasks is reduced, but also the time thus saved is used for reading, earning an income, and enhanced leisure. Women's time spent earning an income becomes particularly important in light of the studies that have shown their income to be often important in maintaining family nutrition and access to health care.

6.3 In this section, we make some recommendations for the different sectors that have an impact on women's lives. In many cases these recommendations would be made to improve the sector environment in any case, but they are worth reviewing, even if they repeat or duplicate some of the other work being conducted by the Bank.

The Promotion of Improved Stoves to Improve Health and Reduce Drudgery

6.4 Biofuels management for domestic use in its present state entails considerable drudgery for women in rural India. These are the predominant fuels used in households owing to their relatively low cost and local availability. In fact they are thought of as "free" fuels as they are collected from nature. Most households do not perceive the time and labor involved as a great cost, as it is a task performed mainly by women and children.

6.5 The program on improved stoves in India has stressed energy efficiency more than the efficiency of women's time. This emphasis has overshadowed the other main justification for the program—namely, indoor air pollution—even though the stoves are called "smokeless" chulhas. Users clearly consider smoke removal and a cleaner kitchen among the main benefit of the stoves. These pollution removal aspects of improved stoves have not been given sufficient attention in stove design and dissemination strategies. There also needs to be more detailed work on the health benefits of removing smoke from kitchens and homes. Although the technical challenges may be significant, the development of stoves that have a long-term ability to vent smoke from living areas, in addition to being efficient and easy to use, is of paramount importance, especially for women's health (Lan and others 2002).

6.6 The most successful programs tend to work better for populations that expend cash income for stoves and can afford the expense (Barnes and others 1994). Still the issue of how to serve the poorest households remains and requires further investigation. The needs of the poorest households appear to be either underserved or involve simple stove adaptations designed for more affluent rural households. The increase in subsidies for the poor households has not led to increased participation in the program, indicating that new strategies need to be developed to target these users. The participation of the poor in the program is an area that could benefit from the collaboration of the technical back-up units and the nongovernmental organizations.

6.7 Evidence from the state of Maharashtra and international experience strongly support the goal of full commercialization of the buying and selling of stoves (Winrock International 2002). The main role of government should be to support the process of commercialization, which can be done through a variety of ways: designing incentives to private sector operators to produce, distribute, and sell improved stoves; setting technical standards; providing credit facilities for stove-makers; and offering promotional support.

6.8 The unfinished agenda for improving household energy services for the rural poor in India, with the respective improvement in health and quality of life, is enormous. Despite drawbacks, the improved stove programs had many achievements and positive elements. Additional and largely consistent lessons are also available from successful programs in other countries. This record and the recently completed review of successful stove programs in India (World Bank 2002b) should provide a strong basis for the development of the next generation of stoves and the next stages of implementing the stove programs at the state level.

Improved Wood Production and Women

6.9 In many parts of rural India woodfuels are becoming increasingly scarce, and people are taking longer amounts of time to collect them. As a consequence, households are increasingly turning to dung and crop residues as fuels. To alleviate these problems, there have been several programs during the last several decades to improve biomass availability in rural areas. The Ministry of Environment and Forests in conjunction with state forest departments has several programs to increase biomass production through afforestation. This is done through both natural regeneration and setting up plantations. Between 1980 and 1992 a major thrust of forestry projects involved social forestry. It is estimated that 17 million hectares were afforested. But there have been some problems with the programs as well. They often have involved a mix of trees that are used as pulpwood and structural timber for industries and the urban market, leaving only low-quality fuel for rural domestic use. Also, the state government sometimes usurps trees planted on private land by women as part of the program. In other cases, forest guards have claimed a share of the forest produce and physically punished rural collectors. Fruit trees planted by villagers have been declared government property. All this has led to a general disappointment with the social forestry program (Agarwal, 1986).

6.10 A more promising approach to afforestation was the Joint Forest Management Program initiated in 1988 that recognized the importance of involving the local communities in managing forests. Empowering the people who actually depended on the produce was seen as crucial to the sustainable management of resources. But unfortunately the analysis of rural women in this report indicates that they have experienced few of the benefits claimed by these programs.

6.11 For the forestry management program, it is mainly in West Bengal that the programs have been successful (Poffenberger and Singh 1996; Shailaja 2000). The forest departments often transfer power over the forests to local men, who in some cases have disallowed the collection of fuel by women (Narain 1994). Women's low status in society renders their participation minimal. Evaluation studies of forest committees reveal that where there is joint membership, women make up from approximately 2 to 7 percent of the membership of the committees. As members, women have sometimes been chosen by men to satisfy policy requirements and remain passive participants during the meetings (Narain 1994). In real terms there has been an increase in biomass production under these programs, but outside of the localized programs the benefits generally do not seem to have reached most women. Also, most people in rural areas do not live near forest reserves, so the benefits of such fuelwood promotion go to only a small proportion of the rural population.

LPG and Kerosene Distribution in Rural Areas

6.12 More rural people would use LPG if the fuel were readily available in their areas. The survey analyzed in this study indicates that LPG use is quite high in Himachal Pradesh, a state in which LPG restrictions have been reduced to encourage rural sales so that pressures on local forests would be alleviated. Although it is uncertain

whether the rate of deforestation has been affected, rural people in some states are using LPG for cooking. With some appropriate policy measures, the rate of LPG adoption could be increased in other states, and this would help improve the lives of rural women.

6.13 The structure of private entry for providing LPG for sale in rural areas is now in place. Under the current system, government retailers continue to provide subsidies for existing, mainly urban, consumers. The private sector is now allowed to import and sell LPG at market rates, which currently are above those of government retailers. However, private-sector sale of LPG is limited to about 1 percent of the total market. It is anticipated that the difference between private-sector and government-retailed LPG will gradually be phased out, and the market share of the private retailers will increase. However, given the political nature of this subsidy, this scenario cannot be guaranteed. In practice, government retailers have a significant advantage over private retailers (World Bank 2002a). Thus, LPG subsidies still go mostly to well-off urban consumers.

6.14 The experience with the Deepam scheme, a program to provide kerosene service to poor, rural women in the state of Andhara Pradesh, has confirmed the worldwide experience with the household use of LPG. The uptake of LPG is strongly income-elastic at low income levels, so that the poor will use LPG sparingly. As long as free or cheap biomass is available, households will continue to use traditional fuels rather than LPG in the short run. Further, the Government of India plans to reduce the LPG subsidy to 15 percent in the next few years. This will increase the end-user price of LPG and make it more difficult for low-income households to consume LPG. The private sector has been considering the introduction of small cylinders, but the connection fee waiver provided by the State Government of Andhara Pradesh to state-owned companies has shrunk the rural market for the private sector and made it difficult to launch a new cylinder size in the state in recent years.[7/]

6.15 A silver lining of the Deepam is that awareness of the benefits of LPG has grown in rural areas and there seems to be a willingness to increase its use if some viable alternative to the high cost of refills could be found. For those wishing to promote the use of LPG by the poor, an evaluation of the Deepam scheme offers a number of lessons (World Bank 2002b) which are outlined below.

- The relatively high operating cost of LPG service (that is, the cylinder refill cost) may make it difficult to develop an effective subsidy scheme for the poor that is fiscally sustainable and supports the establishment of commercially viable businesses.
- Rather than making the program universally available, consider concentrating on those areas where the availability of free or cheap biomass is diminishing.

7/ In July 2003, Hindustan Petro-Chemicals Ltd. inaugurated a 5 kg LPG cylinder in Chattisgarh targeting the rural and urban poor. The security deposit on the smaller cylinder is to be Rs. 350 and the cost of a refill is estimated at Rs. 90.

?? Bear in mind the importance of creating a sufficiently level playing field for all LPG distributors, including private companies, in the spirit of sector deregulation and its ultimate objective of providing better service at lowest cost.

?? Publicize the health benefits of reducing exposure to indoor air pollution to increase demand for cleaner cooking. Such public education campaigns should, however, be conducted in a broader context and emphasize a number of measures, including smokeless chulhas and separate kitchens.

?? Promote conditions that would allow the market to experiment with smaller cylinders.

6.16 Based on the above discussion, it is recommended that liberalization of LPG retailing and elimination of disincentives to expanding service in rural areas continue. One option would be to sell LPG in smaller bottles (World Bank 2002b), which rural people would be more likely to purchase, given that they only use small quantities to help meet their cooking needs. If small cylinders can be introduced, not only will each refill cost be less, enabling many households to refill more regularly, but the initial cylinder deposit fee (which essentially covers the cost of cylinder manufacture) will go down as well. Small cylinders may therefore yield double benefits: more regular consumption of LPG by the beneficiaries, especially in rural areas, and a lower subsidy bill for the government. Therefore market forces, and not government policy, should guide the sizes of cylinders to be made available on the market.

6.17 Turning to kerosene, we believe that the current policy to subsidize it for lighting in rural areas and for cooking in urban areas needs to be reassessed. The policy to subsidize lighting in rural areas is a remnant of the time when electricity was not available in those areas. In an ideal situation, the policy to subsidize kerosene for rural lighting could be changed to subsidize the access of poor households to electricity for basic lighting services that are reliable—since, as noted earlier, the availability of lighting has a significant impact on women's time use and the drudgery involved in cooking. This would free up kerosene for cooking in rural areas, and reduce the time, energy, and pollution involved in cooking. However, there are barriers to providing reliable electricity service, which are summarized in the next section.

Rural Electrification and Women's Lives

6.18 Rural electrification has a significant impact on women's time use and on reducing the drudgery in their lives. Thus a rural electrification program with an emphasis on providing reliable service to a wide variety of rural households could be justified based on its beneficial impact on women. However, the rural electrification program in India has stressed subsidies for agricultural production. While promoting agricultural production through irrigation by means of electric pumps is a legitimate goal, in practice the extensive agricultural subsidies have meant that the provision of electricity to rural households has been given lower priority. Consequently a high percentage of villages in India now have electricity, but the percentage of households within those

villages with electricity is lower than it should be. Therefore, from the point of view of reducing the drudgery of women, the rural electrification program should place greater emphasis on providing service to rural households.

6.19 For households with electricity, consumers are already purchasing lights, televisions, and fans, all of which have the potential in improving women's lives. Given the time necessary for meal preparation in rural India, it is unusual that there are not more appliances in households such as grinders for spices. Whether this is a matter of preference by rural women and their families, a lack of availability, or the poor reliability of electricity service is still a matter of question. Certainly the market for electricity appliances involving food preparation could be better developed in order to reduce the time women spend preparing food for their families.

6.20 Much has been written about the problems of rural electrification in India, covering agricultural subsidies, poor reliability, inadequate system design, theft of electricity, and many other concerns. The importance of the rural electrification program for women has not been alluded to for years, and this study provides a strong empirical base for showing the benefits of electricity for rural women. The benefits include the potential of an improved education, the reduction in food preparation time and other drudgery, and the improved access of women to mass communications such as television and print media. Overcoming the problems of providing reliable electricity to rural households that are typically willing to pay for electricity service should be a clear priority for the country. There are many ways to achieve these goals, but so far there has not been enough national recognition of the benefits of this program for women in rural households.

Conclusion

6.21 The long, unrecognized hours spent on arduous, unhealthy, and unpleasant tasks have sometimes been cited as a development outcome for rural energy projects. But the main motivation for rural energy programs justifiably has been generally improving rural quality of life, conserving fuel, and alleviating deforestation. This study shows that the impact of adopting modern energy services by rural women may be even more significant than was previously assumed by development researchers. As a consequence, in designing rural energy programs it is not unreasonable to pay more attention to the problems women have in obtaining a reliable and efficient energy supply.

6.22 Women in India typically spend much of their time on the hard work involved in caring for their families. They often work 12 to 14 hours a day, most of which is unpaid and recognized mainly within the family. In addition, some of those hours are spent in an extremely unhealthy environment. Respiratory illness and eye problems are common among women who cook on traditional chulhas (Smith 1998). Infant mortality may also be higher among children raised in such homes (Hughes and Dunleavy 2000; Claeson, Bos, and Padmanathan 1999; Mishra, Retherford and Smith 1997). This study supports the findings that women who use biofuels lead the most

burdensome lives. Of the three biofuels, firewood involves the most drudgery in terms of time and effort needed to collect it on a regular basis, but in terms of time spent cooking it is a better alternative than agricultural residues or dung. In any event, most women use a combination of these fuels to meet their energy needs.

6.23 The use of LPG or kerosene stoves relieves women of much of the most arduous tasks involved in cooking for their families and permits them to lead a relatively comfortable and healthy life. Household electrification also has positive consequences for women in terms of their general quality of life, including an increased likelihood that they will read, watch television, and earn income. Having lights at night increases their ability to read in the evening after dark. However, the advantages of electrification could be exploited even more, as there still is a puzzling underinvestment in appliances such as mixers, grinders, blenders, and others that could help women with their daily household work.

6.24 While the Government of India in association with many other nongovernmental private organizations has instituted various programs to address rural energy problems, the execution, pace, and rigor of implementation has been uneven. The results of this study indicate that such programs are essential for bringing about greater independence of women, principally through reducing the time spent on such tasks as fuelwood collection, food preparation, and cooking. In addition, the subordinate position of women in rural society needs to be recognized in the development and implementation of rural energy programs. Many recent studies indicate that the consultation with and participation of those benefiting from development programs lead to a greater likelihood of their success.

6.25 Kerosene, LPG, electricity, and improved stoves do appear to have a significant impact in terms of reducing arduous tasks by women in rural households. Besides improving the quality of life, in some cases electricity can be used for productive and income-producing activities inside of the home. Although not all households or all women in rural households will take advantage of the benefits made possible by the modern use of energy, the benefits for the majority of households are cumulative and worthwhile. In this context, energy policymakers need to pay more attention to the impact of modern rural energy services and how they affect the lives of women.

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