HOUSEHOLD ENERGY CONSUMPTION PATTERN IN RURAL KERALA

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CERTIFICATE

This is to certify that this thesis entitled " HOUSEHOLD ENERGY CONSUMPTION PATTERN IN RURAL KERALA" is a record of bonafide research work done by Sri. Chacko Jose P, under my supervision and guidance for the degree of Doctor of Philosophy, under the Faculty of Social Sciences of the Cochin University of Science and Technology.

This original work done by Sri. Chacko Jose P is the outcome of his own effort and has not formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title. This thesis is worth submitting for the degree of Doctor of Philosophy under the Faculty of Social Sciences.

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Supervising guide

DECLARATION

I declare that this thesis entitled "HOUSEHOLD ENERGY CONSUMPTION PATTERN IN RURAL KERALA" is the record of bonafide research work done by me under the supervision of Dr. Jose T Payyappilly, Director, School of Management Studies, Cochin University of Science and Technology. I further declare that this thesis had not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles of recognition.

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CONTENTS

	List of Tables	I-VIII
	List of figures	IX
CHAPTER I	INTRODUCTION	1-16
1.1	Energy and economic development	1
1.2	Rural energy Scenario	2
1.3	The household sector and rural energy scenario	3
1.4	Energy problem in the rural household sector	4
1.5	Government policies and rural energy problem	10
1.6	Relevance of the study	13
1.7	Scheme of the study	14
CHAPTER II	REVIEW OF HOUSEHOLD ENERGY STUDIES AND METHODILOGY OF THE PRESENT STUDY	17-64
2.1	Introduction	17
2.2	Review of Indian household energy studies	18
2.2(a)	A profile of household energy sector in India	19
2.2(b)	Rural household sector	20
2.2 (c)	Review of individual studies	28
2.3	Review of rural energy studies in Kerala	35
2.3(a)	profile of Kerala rural energy sector	35
2.3(b)	Review of individual studies	43
2.3 (c)	Emerging conclusion and significance of study	45
2.4	Objectives	53
2.5	Methodology	54
2.5(a)	Selection of sample village	54

2.6	Definitions	60
2.7	Limitations of the study	61
CHAPTER III	THE RURAL ENERGY SITUATION – A SYNOPTIC VIEW	65-87
3.1	Historical evaluation of energy	65
3.2	The energy crisis and developing countries	66
3.3	Coping with energy crisis in rural areas	70
3.3(a)	Energy options for rural development	70
3.3(b)	Conservation potential of rural energy sector	76
3.4	Cooking fuels and health problems	82
3.5	Gender issues related to rural energy	83
CHAPTER IV	RURAL ENERGY CONSUMPTION PATTERN IN KERALA	88-128
4.1	Profile of the sample village	88
4.2	Major socio-economic indicators of the sample population	90
4.3	Energy consumption pattern of the rural households –the aggregate Scenario	93
4.4	Household energy consumption pattern across geo-climatic regions	102
CHAPTER V	ENERGY CONSUMPTION PATTERN-INTER HOUSEHOLD ANALYSIS	129-239
5.1	Introduction	129
5.2	Energy consumption pattern across different income groups	129
5.3	Size of land holding and energy consumption	160
5.4	Household size and energy consumption	200
CHAPTER VI	ATTITUDE OF RURAL HOUSEHOLD TOWARDS ENERGY CONSUMPTION AND CONSERVATION	240-285
6.1	Attitude towards energy sources and devices	240
6.1(a)	Attitude towards the fuels in current use	240

6.1(b)	Difficulties faced with the current cooking fuel	245
6.1(c)	Energy transition at the household level	248
6.1(d)	Attitude towards energy devices and kitchen environment	257
6.1(e)	Attitude towards energy used for lighting	262
6.1(f)	Certain characteristics of fuel use and fuel procurement	263
6.2	Energy conservation a rural approach	267
6.2(a)	Approach to energy conservation practices	268
6.2(b)	Approach to improved energy technologies	274
CHAPTER VII	SUMMARY AND CONCLUSION	286-300
	Inferences	288
	Suggestions	296
	Scope for further studies	298
	Conclusion	299
	APPENDICES	
	BIBLIOGRAPHY	

LIST OF TABLES

Sl. No.	Table No.	Title	Page No.
1	1.1	Rural Energy Use Pattern in Developing Countries by end use	11
2	2.1	Fuel used by urban and rural households of different income categories (in per cent)	21
3	2.2	Distribution of households by fuel used for cooking (in per cent)	21
4	2.3	Use of bio fuels in rural households (in million tonne per year)	22
5	2.4	Share of different end use in non-commercial fuel consumption by rural households (in per cent)	22
6	2.5	Share of different end uses in non-commercial fuel consumption by Rural households (in per cent)	23
7	2.6	Annual consumption of bio fuels in rural households (in million tonnes)	25
8	2.7	Distribution of rural households by type of fuel for cooking (in per cent)	26
.9	2.8	Pattern of electrification in Indian villages across the states.	27
10	2.9	Fuel consumption share of different fuels and per capita consumption by households, all India and Kerala	37
11	2.10	Energy consumption by households and establishments in rural by fuel type NCAER 1985 (in tonnes)	40
12	2.11	Energy consumption by households and enterprises in rural Kerala by fuel type based on State Planning Board survey (1986)	41
13	2.12	Pattern of fuel consumption by percentage share of different energy end end use in fuel consumption and percentage share of different fuels in end use (rural households in Kerala) based on NCAER survey.	42
14	2.13	Pattern of fuel consumption by percentage share of different energy end end use in fuel consumption and percentage share of different fuels in end use (rural households in Kerala) based on NCAER survey	42
15	2.14	Energy content of different fuels (in kilo calories)	59
16	3.1	Urban and rural people committed to electricity in developing countries by region (1970 and 1990) (in percent)	71
17	3.2	Comparisons of lumens of Non-electric and electric lamps	73

18	3.3	Efficiency and fuel consumption of stove / fuel combinations (based on - water boiling and controlled cooking tests in Ungru, Karnataka and India.	79
19	4.1.	Distribution of the sample population	91
20	4.2.	Distribution of the sample population by household size (actual)	91
21	4.3.	Distribution of the households by educational status of members.	92
22	4.4.	Distribution of the households by occupational status of members.	94
23	4.5.	Distribution of the sample households by monthly income.	95
24	4.6.	Distribution of the sample population by size of holding.	96
25	4.7.	Energy consumption pattern of the sample households in 10^3 K.Cal for one month.	100
26	4.8.	Energy consumption pattern of the sample households in the study area in 10^3 K.Cal, for one month.	103
27	4.9.	Per household and per capita energy consumed by the sample household (in 10^3 K.Cal).	106
28.	4.10.	Energy consumption pattern by he proportion of different fuels used (in 10^3 K.Cal).	107
28	4.11	Energy consumption pattern by the mode of procurement of the fuel material (in 10^3 K.Cal).	109
30.	4.12.	Energy consumption pattern by the mode of procurement of the fuel material in per cent(in 10^3 K.Cal).	110
31.	4.13.	Per household and per capita energy consumption by mode of procurement of fuel material (in 10^3 K.Cal).	114-15
32.	4.14.	Energy consumption pattern by the proportion of fuels procured by different modes.	116
33.	4.15.	Energy consumption pattern by fuels used in various end uses in percent (in 10^3 K.Cal).	117

34.	4.16.	Energy consumption pattern by fuels used in various end uses (in 10^3 K.Cal).	118
35.	4.17.	Per household and per capita energy consumption by fuels used in various end use. (in 10^3 K.Cal).	123-24
36.	4.18.	Energy consumption pattern by the proportion of fuels used in various end use.	125
37	4.19	inter regional variations in energy consumption pattern – a comparison	127
38.	5.1.	Energy consumption pattern of sample households according to monthly income categories SA I (in 10^3 K.Cal).	131
39.	5.2.	Per household and per capita energy consumption by income categories SA I (in 10^3 K.Cal).	132
40.	5.3.	Energy consumption pattern by the proportion of fuels by different income categories SA I.	133
41.	5.4	Energy consumption pattern by the mode of procurement of fuel material by income categories in SA I (in 10^3 K.Cal).	136
42.	5.5	Energy consumption pattern by the end use of fuel income categories SA I (in 10^3 K.Cal).	137
43.	5.6.	Energy consumption pattern by the sample households according to income categories SA II (in 10^3 K.Cal).	139
44.	5.7	Per household and per capita energy consumption by income categories SA II (in 10^3 K.Cal).	140
45.	5.8	Energy consumption pattern by the proportion of fuels used by different income categories SA II.	141
46	5.9	Energy consumption pattern by the mode of procurement of fuel material by income categories SA II (in 10^3 K.Cal).	144
47.	5.10	Energy consumption pattern by the end use of fuel material by income categories SA II (in 10^3 K.Cal).	145

48.	5.11.	Energy consumption pattern by the Sample households according to income categories SA II (in 10^3 K.Cal).	147
49.	5.12.	Per household and per capita energy consumption by income categories SA II (in 10^3 K.Cal).	148
50.	5.13	Energy consumption pattern by the proportion of fuels used by different income categories SA III .	149
51.	5.14	Energy consumption pattern by the mode of procurement of fuel material by income categories SA III (in 10^3 K.Cal).	150
52.	5.15	Energy consumption pattern by the end use of fuel by income categories SA III (in 10^3 K.Cal).	151
53.	5.16.	Energy consumption pattern by the sample households according to income categories SA IV (in 10^3 K.Cal).	155
54.	5.17	Per household and per capita energy consumption pattern by income categories SA IV (in 10^3 K.Cal).	156
55.	5.18	Energy consumption pattern by the proportion of fuels used by different income categories SA IV.	157
56	5.19	Energy consumption pattern by the mode of procurement of fuel material by income categories SA IV (in 10^3 K.Cal).	158
57	5.20	Energy consumption pattern by the end use of fuel material by income categories SA IV (in 10^3 K.Cal).	159
58	5.21	Energy consumption pattern by the sample households by size of land holding SA I (in 10^3 K.Cal).	163
59	5.22	Per household and per capita energy consumption size of land holding (in 10^3 K.Cal).	164-65
60	5.23	Energy consumption pattern by the proportion of fuels used by size of land holding SA I.	166

61	5.24	Energy consumption pattern by mode of procurement of fuel material by size of land holding SA I (in 10^3 K.Cal).	167-68
62	5.25	Energy consumption pattern by the end use of fuel materials by size of land holding SA I (in 10^3 K.Cal).	169-70
63.	5.26	Energy consumption pattern by the sample households by size of land holding SA II (in 10^3 K.Cal).	173
64.	5.27.	Per household and per capita energy consumption by size of land holding SA II (in 10^3 K.Cal).	174-75
65.	5.28	Energy consumption pattern by the proportion of fuels used by size of land holding SA II.	176
66.	5.29	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA II (in 10^3 K.Cal).	177-78
67.	5.30.	Energy consumption pattern by the end use of fuel material by size of land holding SA II (in 10^3 K.Cal).	179-80
68.	5.31	Energy consumption pattern by the sample households by size of land holding SA II (in 10^3 K.Cal).	182
69.	5.32.	Energy consumption pattern by sample households by size of land holding SA III (in 10^3 K.Cal).	183-84
70.	5.33	Energy consumption pattern by the proportion of fuels used by size of land holding SA III.	185
71.	5.34.	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA III (in 10^3 K.Cal).	186-87
72.	5.35	Energy consumption pattern by the end use of fuel material by size of land holding SA III (in 10^3 K.Cal).	188-89
73.	5.36	Energy consumption pattern by the sample households by size of land holding SA IV (in 10^3 K.Cal).	192
74.	5.37	Energy consumption pattern by the sample households by size of land	

		holding SA IV (in 10^3 K.Cal).	193-94
75.	5.38	Energy consumption pattern by proportion of fuels used by different land holding categories SA IV (in 10^3 K.Cal).	195
76.	5.39	Energy consumption pattern by the proportion of fuel material by size of land holding SA IV (in 10^3 K.Cal).	196-97
77.	5.40	Energy consumption pattern by the end use of fuel material by size land holding SA IV (in 10^3 K.Cal).	198-99
78.	5.41	Energy consumption pattern by the sample households by household size SA I (quantity in 10^3 K.Cal).	202
79.	5.42.	Per household and per capita consumption by household size SA I (in 10^3 K.Cal).	203-204
80.	5.43.	Energy consumption pattern by the proportion of fuels used by sample households by household size SA I .	205
81.	5.44	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA I (in 10^3 K.Cal).	206-207
82.	5.45	Energy consumption pattern by the end use of fuel material by house hold size SA I (in 10^3 K.Cal).	208-209
83.	5.46.	Energy consumption pattern by the sample households by the household size SA II (in 10^3 K.Cal).	212
84.	5.47	Per household and per capita consumption by households size SA II (in 10^3 K.Cal).	213-14
85.	5.48.	Energy consumption pattern by the proportion of fuels used by the sample households by household size SA II.	215
86.	5.49.	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA II (in 10^3 K.Cal).	216-17
87.	5.50.	Energy consumption pattern by the end use if fuel material by household size SA II (in 10^3 K.Cal).	218-19

88.	5.51.	Energy consumption pattern by the sample households by household size SA II (in 10 ^{3} K.Cal).	221
89.	5.52.	Per household and per capita consumption by household size SA II (in 10 ^{3} K.Cal).	222-23
90.	5.53	Energy consumption pattern by the proportion of fuels used by the sample households by household size SA III.	224
91.	5.54	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA III (in 10 ^{3} K.Cal).	225-26
92.	5.55	Energy consumption pattern by the end use of fuel material by size of land holding size SA III (in 10 ^{3} K.Cal).	227-28
93.	5.56.	Energy consumption pattern by the sample households by house hold size SA IV (in 10 ^{3} K.Cal).	231
94.	5.57	Per household and per capita consumption by household size SA IV (in 10 ^{3} K.Cal).	232-33
95.	5.58.	Energy consumption pattern by the proportion of fuels used by sample households by house hold size. SA IV.	234
96.	5.59	Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA IV (in 10 ^{3} K.Cal).	235-36
97.	5.60	Energy consumption pattern by the end use of fuel material by household size SA IV (in 10 ^{3} K.Cal).	237-38
98	6.1.	Reason for using the cooking fuel in current use. (No of households).	242
99	6.2	Difficulties experienced with the present cooking fuel (No of households).	246
98.	6.3.	Time period since giving up old cooking fuel.	250
99.	6.4	Time period since giving up old cooking fuel	250
100	6.5	Households giving up or adopting a specific cooking fuel (No of households).	251

101.	6.6	Reason for giving up the old fuel (No of households).	254
102.	6.7	Reason for adopting the new fuel (No of households).	255
103	6.8	Households according to the position of kitchen (No of households).	259
104	6.9	Households according to air suction in the kitchen (No of households).	259
105.	6.10	Households by type of choolah used. (No of households)	261
106	6.11	Households by type of vessels used. (No of households)	261
107.	6.12	Households by fuels used for lightning (No of households).	264
108	6.13	Difficulty faced with present fuels used for lightning (No of households).	264
109	6.14	Households by certain characteristics of fuel used and fuel procurement (No of households).	265
110	6.15	Energy conservation practices adopted by the households (No of house holds).	270
111	6.16	Awareness and adoption of improved energy technologies by households (No of households).	275
112	6.17	Reason for adopting the improved energy technologies (No of households).	279
113	6.18	Reason for adopting the improved energy technologies (No of households).	280
114.	6.19	Proportion of the sample households mode of procurement of non commercial fuel.	283
115	6.20	Distribution of households by expenditure on fuels.	284

List of Figures

Sl. No.	Figure No.	Title	Page No.
1.	3.1	Fuel share of energy including biomass	67
2.	3.2	Energy efficiency and lighting	78

CHAPTER I

INTRODUCTION

1.1 Energy and economic development

Energy plays a crucial role in human existence. It is a basic requirement for subsistence in the form of cooking, heating and lighting. At the same time, it is a vital input in production processes such as agriculture, industry and transport.

Economic development has generally exhibited two features over the years. First, with development, world has consumed more and more quantities of energy and next, during this process has substituted one source of energy by another - generally non-commercial sources by commercial.

Countries in different stages of economic development also exhibit certain trends in their energy consumption pattern. For instance, the per capita energy intake is low in developing countries as compared to developed countries. The per capita energy consumption (in kg. of oil equivalent) is 369 for low-income economies, 1475 for middle income economies and 5066 for high-income economies[1]. Besides, developed countries, which accommodate only 24 per cent of world population, consume 66 per cent of world energy, whereas the developing countries with 76 per cent of the world population consume only 34 per cent energy[2].

Distinction between developed and developing countries is visible with respect to sources of energy as well. While the developing countries mostly depend on non-commercial fuels, developed countries depend mostly on commercial fuels. For instance, while oil is the most important single source of energy in developed countries (37 per cent), biomass fuels are the major single source (35 per cent) in developing countries[3].

1.2 Rural energy scenario

The world is still predominantly rural, with 55 per cent of the world population and 70 per cent of the population in low-income economies live in rural areas[4]. Besides, the rural sector accounts for almost 40 per cent of the total energy consumption of developing countries[5]. Energy greatly influences the quality of rural life. The availability of modern fuels can revolutionise the living conditions of the rural people. Energy opens up avenues for mechanisation of agriculture, modernisation of rural industries, reduction of rural unemployment and increased productivity of the whole rural community. Consequently, the importance of rural energy, not only for growth and development, but also to ensure minimum conditions for existence in large parts of the globe has been increasingly recognized in recent decades.

The energy demand in rural areas is primarily for end-user to meet basic needs. In the households they need it for cooking, lighting, heating and water pumping; in agriculture for water supply and transportation, and in rural industries for various operations and transportation. Several factors affect the rural energy demand, viz. level of development of the area, demography, resource endowments, agro-climatic patterns, forest and tree resources and access to these, irrigation, cropping patterns and yields, landownership pattern, possession of live stock, technological innovations and socio-economic factors. Tradition also affects rural energy demand.

The energy sources in rural areas are diverse. They include traditional sources like human, draught, wind, fuel wood, agricultural residue and animal dung; and commercial sources like coal, charcoal, kerosene, electricity and LPG. Non traditional sources are also used in rural areas. However, commercial sources do not account for more than 10 to 20 per cent of the total rural energy demand[6].

1.3 The Household sector and rural energy scenario

Energy consumption by the rural household in the developing countries has crucial impact on the global energy scene. This is because in developing countries, where majority of the population lives in rural areas, the most important single source of energy demand is attributable to the household and informal sectors. According to the Food and Agricultural Organization (FAO), the rural sector accounts for almost 40 per cent of the total energy consumption of the developing countries, most of which is used in the household sector[7].

Rural households demand energy for rather obvious end uses, of which cooking is the most important one. It is estimated that the energy use for cooking is as high as 95 to 98 per cent of total rural household energy use in some tropical developing countries. A variety of fuel materials like fuel wood, crop residues, dung, kerosene and LPG are used by the rural households to meet their cooking energy demand. Of these diverse sources, non-commercial fuels - especially fuel wood - are the most widely used. About 80 per cent of the wood harvested in developing countries is used for cooking, heating or small scale industries[9].

1.4 Energy problem in the rural household sector

Rural households in the developing countries are facing an energy crisis, which is directly and indirectly linked to the 'oil crisis' that resulted from the abrupt oil price hike by the OPEC in 1973-74 and 1979-80. The energy problem in the rural household sector is identified in terms of certain symptoms such as acute shortage of fuel material, rising fuel prices, increased fuel substitution (of superior fuels by inferior ones), longer fuel collection time and greater health hazards related to fuels or cooking practices.

Initially, the rural energy problem was described merely as a situation where biomass fuels were consumed at a rate faster than being produced. Hence the nature of the rural energy problem was viewed only as a problem of shortage of usable energy supplies or a problem of an imbalance between energy demand and supply or between energy production and consumption in the rural sector. However, on further examination it was also revealed that the rural energy problem is only a small subset of a large problem of rural under development. The rural energy problem was thus recognised only as a symptom of a much deeper disease of rural poverty. It is inextricably linked to a wider social, political and economic circles.

The predominance of the household sector in the rural energy scenario resulted in the household sector being worst hit most adversely by the rural energy problem. The availability of fuel to a household is determined by its access to local resources. This access, however, is constrained by many factors like distance between the resources and the point of use, pattern of land tenure and the biomass resource management system in an area, which include social structure, local resource management, tradition, customs and practices. The energy crisis increased the severity of these constraints, making it difficult for the rural households to acquire adequate fuel. For instance, landless families used to have traditional rights of access to fuel from the land of larger landowners in many communities. Such rights were eroded when biomass resources were commercialized due to the energy crisis[10].

The major dimensions of the rural household energy problem can be summarised as follows:

a). The most visible symptom of rural household energy crisis, perhaps, is increased fuel collection time. When fuel wood become scarce, fuel collectors were forced to devote more of their time and labour for searching for fuel. This increased the opportunity cost of labour spent for the purpose. Evidences from developing countries reveal that in the rural households, women walk up to 10km daily[11], spending 4-6 hours to collect fuel[12].

b). Fuel substitution by the households is another visible symptom of rural energy crisis. The commercialisation and reduced availability of fuel wood forced the rural households to shift to less-valued fuel sources like agricultural and animal residues. According to the World Bank, of the two billion people using traditional fuels in the developing countries, about a quarter to half use agricultural and animal wastes[13]. The use of these fuels has many implications varying from reduced fertility of soil to health hazards to the user. Apart from these, the low energy content of the agricultural and animal residues added to the low energy efficiency of the traditional three stone choola used by the rural households which ends up in increased demand for fuel.

c). Over dependence on biomass fuels have health implications. The health fuels have hazards relating to burning of biomass fuels which have important bearing for the household sector. Smoke depletes the kitchen environment and exposes the user to health problems. It has been noticed that the conventional biomass fuels emit more organic pollutants than fossil fuels. In clinical terms, a person spending three hours a day on cooking (using biomass fuels) is exposed to 700 micrograms of particulate matter per cubic meter, compared to the safety level of less than 75 micrograms. The benzo-a-pyrene inhaled by the user was equivalent to smoking 400 cigarettes a day. Studies have also shown that bronchitis and cow dung smoke is highly correlated[14]. Absence of proper house design and planning also contribute to the rural energy problem. The extremely poor ventilation of rural homes further deteriorates the kitchen environment.

d). The type of choola associated with non-commercial fuels and used by the rural households often results in much wastage of energy, which further aggravate rural energy problem. Choola is the major determinant of the amount of heat available for cooking. The rural households generally use the traditional three stone choola for cooking. The characteristics of efficient choolas like minimum heat loss after combustion and maximum delivery of heat energy to the cooking pot are extremely low in these choolas. The cooking efficiency of the choola determines not only fuel consumption but also the length of time spent in cooking. Besides factors like cooking practices, type of vessel and fuel-choola-vessel combination, followed by the rural households often result in much energy wastage.

e). Rural energy problems also affect adversely a household's ability to work and earn. Fuel scarcity forces the rural households to cook less. For instance, nutritional deficiencies as a result of shortages of cooking fuels have been noticed in rural areas of developing countries[15]. Under cooking of food may also occur when households face cooking fuel shortages. This has adverse health implications since certain foods can be toxic if under cooked. Another nutritional impact is the switching over to cereal staples, which require less cooking. Thus, dietary patterns and consequently nutrition status are considerably affected by the lack of access to adequate fuels and it has negative impact on the household's ability to work and earn. Ultimately a vicious circle results, where the law working capacity of the households pushes it to further poverty.

f). A substantial part of the rural population does not have electricity connection and rely on non-electric sources of lighting like candles and kerosene. These provide very low levels of illumination and are notoriously inefficient. This often causes health problems like eye diseases. Further, in rural households that are electrified, the over dependence on ordinary electric bulbs results in much wastage of energy.

g). The bleak rural energy scenario opens up endless possibilities for alternative sources of energy and energy conservation measures based on better energy management. But the fuel use in rural areas is related much to tradition and taboos, which prevent the popularisation of these measures. This further deepens the crisis.

h). The rural energy problem has a gender dimension also. The argument is, given the usual sexual division of labour, with women responsible for both collecting fuel and cooking, they are the worst affected and men who control resources, may have little interest in solving them.

i). The cost to environment of biofuel use in terms of increased deforestation, soil erosion and reduced soil fertility cannot be ignored since they contribute to a vicious circle of energy crisis.

Perhaps the most disturbing issue relating to rural energy problem is that, it affects the poor most adversely. This is because, though both the rich and poor use non-commercial fuels in rural areas, it is the poor who consume greater proportion of these fuels[16]. This is a natural corollary of the fact that the accessibility and availability of different fuel sources are greatly influenced by economic factors. (Table 1.1) Thus the rural energy problem cannot be separated from the inaccessibility and vulnerability of the poor throughout the developing world[17].

1.5 Government policies and rural energy problem

Solutions to the rural energy problems depend to a great extent on government policies. Governments and policy makers of the developing countries neglected initially rural energy issues. National energy policies and plans were overwhelmingly preoccupied with the production and use of modern energy forms. They rarely focussed on the rural sector and even if they did, it was only on an aggregate basis. This was due to the minor impact the rural sector has on the national energy scene because of their meager energy consumption, and also to the inherent difficulty of data collection and management.

Table 1.1
Rural Energy Use Pattern in Developing Countries by End Uses

	Household income		
End use	Low	Medium	High
Household			
Cooking	Wood residues & dung	wood residues,dung kerosene & biogas	Wood,kerosene Biogas,LPG,&dung
Lighting	Candles&kerosene (some times none)	Candles, kerosene & gasoline	kerosene,electricity & gasoline
Space heating	Wooe,residue Dung(often none)	Wood, residue dung	wood,residue, dung &coal
Other appliances	None	Electricity & Storage cells	Electricity &storage cells
Agriculture			
Tilling	Hand	Animal	Animal, gasoline Diesel(tillers & Tractors)
Irrigation	Hand	Animal	Diesel& electricity
Post harvest	Hand	Animal	Diesel&electricity
Industry			
Milling & mechanical	Hand	hand & animal	Hand,animal,diesel & electricity
Process heat	wood & residues	Coal, charcoal Wood residues	coal,charcoal,wood kerosene& residues

Source: Rural Energy and Development – "improving energy supplies for two billion people", World Bank, Washington, 1996, Table 2.2, P 25.

The dispersed and often non-monetized nature of energy consumption pattern in the rural areas also contributed to this neglect. Besides, authorities rarely had institutional and operational mechanisms in rural areas. This situation led to a vacuum of authority and lack of guidance for energy interventions in rural areas, resulting in the scarce allocation of energy resources and a low level of energy investment for rural development[18].

Many governments have taken the rural energy problem seriously, especially since 1980s, and have come out with remedial measures. These include dissemination of improved technology, better energy management techniques and scientific management of fuel resources. But unfortunately many of these solutions were often unsuitable to the rural setting and failed to meet the requirements of the rural people. For instance, the improved choola programmes have failed because they focussed mainly on improved thermal efficiency ignoring the user's needs and availability of fuels[19]. Similarly, schemes to plant trees for fuel have often failed because fuel was not the major concern of the target group, or, such schemes have actually increased hardship by reducing access to and supplies of other essential biomass resources, such as fodder and grazing land. Such failures occurred because energy problems were often tackled by energy experts who seek energy solutions alone.[20] Such narrow approaches is inadequate with the rural household energy problem, which is multidimensional.

1.6 Relevance of the study

The energy problem facing the rural areas is daunting not only because they retard development but they threaten the survival of many of the world's poor. The rural energy problems are multi-dimensional with social, economic, technological, environmental and ecological issues involved in it and they are intimately associated with the problems of poverty, equity and gender. Basically these problems reflect the biases found in virtually every society and it's planning system: the urban-rural or centre-periphery bias, the powerful-weak bias and the male-female bias.

Since the households dominate the rural energy sector and also since they are the finals resting place of any shock inflicted on the society, the 'incidence' of the rural energy problems is on the household sector. Most household energy problems are reflections of poverty and lack of investment in the poor. They persist not because they are insoluble but because they have not been addressed with sufficient seriousness.

Efforts to solve the rural energy problem by policy makers have often failed due to built in inconsistencies. Several attempts to introduce new energy technologies and better energy management practices have not been successful due to insufficient knowledge of local energy consumption pattern, practices and local needs.

Emerging conclusion is that, due to the great diversity of household energy use at the micro-level, understanding the pattern of energy use is essential for effective rural energy policies. Since household energy use pattern is highly region specific, micro-level surveys are a prerequisite for proper understanding and policy formulation.

The threat the rural energy problem poses to the household sector has now been recognized. Against this backdrop, the present study intends to critically analyse the micro-level issues that influence the rural household energy behavior, household perceptions regarding energy management techniques and approaches to new energy technologies within the socio-ecomic framework of Kerala, India.

1.7 Scheme of the study

The thesis has been divided into seven chapters. The first chapter gives a synoptic view of the rural energy problems and its implications to the household sector. The chapter also elucidates the relevance of rural energy studies. The second chapter reviews the existing literature on household energy consumption and high lights the relevance of the study. The chapter also lays down the objectives of the study and specifies the methodology. Chapter III examines the rural energy situation. The chapter provides the necessary background information regarding energy technologies and cooking practices. Chapter IV analyses the energy consumption pattern in the sample households. An analysis of the inter regional variations is also attempted in this chapter. Chapter V is devoted to analysing the inter household variations in the energy consumption pattern. Chapter VI examines the attitudes of the rural households to energy sources, uses, devices, cooking practices, conservation techniques and improved energy technologies. Chapter VII presents the conclusions and important findings of the study.

References

1.The World Bank, World Development Report 1997, Oxford University Press, New York, P.229.

2. David Hall, Biomass, World Bank Working - WPS 968, The World Bank, Washington, August 1992, P.25.

3. Ibid.

4. OP.Cit.Ref, P230.

5. Gustavo Best, ' The Role of Renewable Energy Technologies in Rural Development', in Bhagavan M.R.et.al (Ed), ' Energy for Rural Development', Zed Books, London, 1992, P.6.

6.OP.Cit, P IX.

7. OP.Cit, P.6.

8. World Bank, 'Energy in the Developing Countries', World Bank Washington, August 1980.

9. OP.Cit. Ref.5, P.16.

10.Jhon Soussan, 'Primary Resources and Energy in the third World', Routlidge, New York, 1988, P.27.

11.Ibid, P.65.

12.Padma Vasudevan, ' Women involvement as kitchen managers and stove users', in Report No. GCP/RAS/131/NET of Regional Wood Energy Development Programme in Asia, FAO, Bangkok, June 1991, p.203.

13.Sarala Gopalan, 'Domestic fuels and devices for cooking – practice, problems, policies and perceptiveness', Ph.D. Thesis, (unpublished), IIT, Delhi, 1989, P.27.

14.Srilatha Batliwala, 'Women and cooking energy', Economic and Political Weekly, Dec.24-31, P.2227.

15.Gerald Foley et.al, 'Energy in the transition from rural agriculture', in Miguel.S (et.al.) (Ed), Energy in the transition from subsistent, West view press, Colorado, 1981,P.2.

16.O.P.Cit. Ref. 9, P.59.

17.Marcela Serrato, 'Review', in OP. Cit. Ref 14, P.197.

18.OP.Cit, Ref.5, P.4

19.Douglas Barnes et.al, 'The designed diffusions of improved cooking stoves', The World Bank, Washington, Vol.8, No.2, 1993, PP 119-124.

20.Grald Leach, 'Household energy in south Asia', Elsevier Applied science, London, 1987, P.74.

CHAPTER II

REVIEW OF HOUSEHOLD ENERGY STUDIES AND METHODOLOGY OF THE PRESENT STUDY

2.1 Introduction

A well formulated research problem can be conceive and developed only after an extensive survey of the available literature in that area. Recognition of the fact that rural energy problems threaten the survival of the rural communities has resulted in much attention being placed on the rural energy problem. Consequently, a number of studies were taken up by researchers belonging to different disciplines on the rural energy problem, its causes and consequences. Many of these studies are multi disciplinary and multidimensional and the researchers have focussed on a host of issues like methodology of rural energy surveys, energy-economy nexus, appropriate energy technologies and their dissemination, government policies towards rural energy issues, energy modeling and primarily, the determinants of rural energy demand.

India, being predominantly rural, is seriously affected by the rural energy problems. Due to the vastness and magnitude of India's rural sector in terms of geographical area and population, the nature of the rural energy problem varies from region to region. Even within the same region, it would vary from one time period to another. Hence generalizations at the macro level is difficult. Consequently, considerable amount of literature exists on the rural energy use pattern in India.

A review of available literature on the rural household energy problem in India is presented in this chapter. Based on data available from various studies, an attempt is made to draw the features of India's rural energy scenario, with emphasis on the household sector. Such a review may be helpful in providing an insight into the various issues related to the problem.

2.2 Review of Indian household energy studies

This section attempts to provide a profile of household energy sector of India based on a review of available studies.

The literature available on household energy consumption in India can be divided into two. Firstly, there are policy oriented studies by different agencies like The Energy Survey of India Committee (ESI), Working Group on Energy Policy (WGEP), National Sample Survey (NSS), The Advisory Board on Energy (ABE), The National Council for Applied Economic Research (NCAER), Integrated Rural Energy Programme (IREP) and Tata Energy Research Institute (TERI)[1]. These studies mainly provide macro level picture and are intended for the purpose of creating a rural energy database, though some of them are supported by analysis. Secondly, there are studies by individual researchers, which are mostly micro level - region specific studies. These studies are helpful in understanding the causes of regional variations in rural energy consumption.

2.2(a) A profile of household energy sector in India

The household sector is the largest energy consumer in India, accounting for almost 50 per cent of the total consumption. The major end uses of energy in the household sector are for cooking, lighting, space heating and water heating. Energy sources include both commercial (coal, kerosene, electricity and LPG) and non-commercial (fuel wood, agricultural residues and animal waste). Commercial energy consumption is comparatively insignificant in rural areas, through it is on the increase. Total commercial energy consumption in the household sector is estimated to be 13 mote (million tones oil equivalent), which is 10 per cent of the total consumption (1991-92). Among the commercial fuels, petroleum products in the form of kerosene and LPG are the most important fuels, accounting for nearly two-thirds of the consumption of commercial fuels, the share of coal being one-fourth and of electricity one-tenth. Non commercial sources meet 76 per cent of total energy demand in this sector (1988-89). Among these, fuelwood meets 47 per cent of the fuel needs followed by animal dung (17 per cent) and crop residue (12 per cent).

As in most of the developing countries, in India also disparity exists between rural and urban households in fuels used. The rapid pace of urbanization and diverse urban growth patterns resulted in many basic structural changes in the economy that has important implications for energy use at the household level in urban areas. Rising per capita income associated with urbanization resulted in increased demand for commercial fuels in urban areas. The rural energy scene, on the other hand, is dominated by non-commercial fuel sources. However, it should be noted that in urban areas the poor still increasingly depend on non-commercial fuels. Table 2.1 provides a comparison of energy used in relation to their incomes in rural and urban household. It also provides information regarding disparity in energy use pattern between different income groups.

In the household sector, the most important energy end use is cooking, consuming a major chunk of the energy used. Therefore, a comparison of cooking fuels used by rural and urban households will provide further insight into the rural disparity. (Table 2.2)

2.2(b) Rural household sector

In India, as in other developing countries, the rural energy scenario is dominated by the household sector. The household sector

Table 2.1
Fuel used by urban and rural households of different income categories (in percent

	Annual household income (Rs)					
Fuel	*Upto 3,000*	*3,000 to 6,000*	*6,000 to 12,000*	*12,000 to 18,000*	*18,000 and above*	*Average*
Rural Commercial	4.2	4.6	7.6	7.6	10.1	5.1
Soft coke	1.3	1.6	4.7	4.9	7.3	2.1
Kerosene	2.7	2.6	2.3	1.8	1.8	2.6
Electricity	0.2	0.4	0.6	0.9	1.0	0.4
Non-commercial	95.8	95.4	92.4	92.4	89.9	94.9
Firewood	60.8	59.0	56.8	53.5	49.3	59.2
Vegetable wastes	16.1	14.6	15.6	18.2	16.6	15.6
Dung cake	18.9	21.8	20.0	20.7	24.0	20.1
Urban Commercial	37.3	56.8	71.9	76.5	82.7	58.3
Soft coke	14.9	23.6	31.1	20.0	19.8	23.2
Kerosene	19.4	23.8	19.6	17.7	14.8	21.1
Liquefied petroleum	-	5.2	15.9	34.0	41.3	9.8
Charcoal	2.2	2.5	2.7	1.3	1.5	2.3
Non-commercial	62.7	43.2	28.1	23.5	17.3	41.5
Firewood	54.9	37.3	22.8	16.7	13.9	35.5
Vegetable wastes	2.6	1.4	1.4	2.7	1.1	1.7
Dung cake	5.2	4.5	3.9	4.1	2.3	4.5

Note: The figures show the share (per cent) of each fuel in terms of useful energy.

Source: National Council for Applied Economic Research (NCAER). Domestic Fuel Survey with Special Reference to Kerosene, Volume I, New Delhi, 1985, P 296.

Table 2.2
Distribution of household by fuel used for cooking
Percentage of households using fuel

	Rural areas			*Urban areas*		
Fuel	1974	1979	1991	1974	1979	1991
Coal and soft coke	--	2.91	1.54	26.60	29.24	8.95
Kerosene	6.80	5.59	1.34	10.90	43.05	23.62
Firewood	64.20	34.80	71.69	47.00	49.70	32.74
Liquefied petroleum gas	0.80	0.10	1.22	4.00	9.07	26.93
Biogas	--	0.94	0.43	--	--	0.68

Source: TERI Energy Data, Directory and Year Book (TEDDY) 1996/97, Tata Energy Research Institute (TERI) New Delhi, page 294

Table 2.3

Use of bio fuels in rural households (in million tonner per year)

Source	*Firewood*	*Uints of Dung cakes*	*Agricultural residues*
National Council for Applied Econonomic Research	93.3	83.2	36.7
Tata Energy Research Institute: Rural Energy Database			
Low	181.3	40.1	31.6
Average	252.1	106.9	99.2
High	309.4	114.5	165.5
Planning Commission: Integrated Rural Energy Planning Programme Daily requirements (kilocalories per capita per day or megajoules per capita per day	169.0	54.2	62.8
Energy Survey of India (510 or 2.13)	151.3	41.5	47.8
Energy Demand Screening Group (520 or 2.18)	201.7	55.3	63.7
Advisory Board on Energy (620 or 2.60)	24.5	65.9	76.0

Source: Tata Energy Research Institute (TERI). 1992. Rural Energy Database, p.4.18. New Delhi: TERI. 66pp.

Table 2.4

Share of different end - uses in non-commercial fuel consumption bu rural household (in %)

Type of household and annual income (Rs)	*Cooking*	*Lighting*	*Water heating*	*Space heating*	*All uses*
Rural					
0 to 3,000	96.18	--	3.56	0.27	100.00
3,001 to 6,000	95.83	--	3.65	0.51	100.00
6,001 to 12,000	95.31	--	3.96	0.73	100.00
12,001 to 18,000	95.00	--	4.37	0.62	100.00
Over 18,000	95.29	--	4.09	0.62	100.00
All classes	**95.90**	**--**	**3.67**	**0.43**	**100.0**

Source:Complied from National Council for Applied Economic Research (NCAER). Domestic Fuel Survey with Special Reference to Kerosene, Volume II, New Delhi, 1985, P 124.

accounts for nearly 80 per cent of the total rural energy consumption. The most important source of energy in rural households is non-commercial sources, firewood being the most preferred fuel. (Table 2.3). This, however, poses a serious difficulty in quantifying the actual energy use, resulting in varying estimates by different agencies. This is also evident from Table 2.3.

Cooking is the most important rural energy end-use. Households depend heavily on non-commercial fuels for meeting this end use. However, the relative importance for different end-uses met with non-commercial fuels varies for different income categories. (Table 2.4) Similar is the case with commercial fuels, though their most important end use is lighting (Table 2.5).

Table 2.5
Share of different end-use in commercial fuel consumption by rural households (in per cent)

Type of household and Annual income (Rs)	Cooking	lighting	Water heating	Space heating	Others	All uses
Rural						
0 to 3000	32.86	66.26	0.41	0.43	0.05	99.95
3,001 to 6,000	39.25	58.51	0.51	1.53	0.23	99.80
6,001 to 12,000	47.82	46.79	0.72	4.11	0.51	99.44
12,001 to 18,000	48.16	43.87	1.23	5.83	0.92	99.08
Over 18,000	54.07	37.79	0.65	6.51	0.98	99.02
All classes	38.99	58.36	0.54	1.86	0.25	99.75

Source: Compiled from NCAER, op cit P 22-23

Due to the wide geographic area of the country, there are considerable variations in the type of fuel used and the end uses to which they are across regions. This is due to factors like local climate, cropping pattern, fuel accessibility and socio-cultural reasons. Tables 2.6 and 2.7 provide further evidence to the diversity in energy sources and uses in different parts of India.

After cooking, the most important end use in rural households is lighting. Commercial fuels, as evident from Tables 2.4 and 2.5, mostly meet lighting. Kerosene and electricity are the most important lighting energy sources. Though the demand for electricity for rural lighting needs is on the rise, its supply is highly inadequate in rural India. Even in states with 100 per cent rural electrification, there are a few households without electricity. In the rural areas, only 31.10 per cent households or 33.10 per cent of the population have access to electricity (Table 2.8).

According to 1991 census, only 42.37 per cent of the households in the country had electricity facility. These households provided shelter to 45.70 per cent of the population. Thus in 1991, 57 per cent of the households inhabiting 54 per cent of the population did not have facilities for electricity. Nearly 75 per cent of urban households and 70 per cent of the rural households were devoid of any electricity connection.

Table 2.6

Annual consumption of biofuels in rural households (in million tonnes)

State/Union Territory	*Firewood*			*Dung cakes*			*Agricultural residues*		
	Tata Energy Research Institute (average)	Planning Commission: (Integrated Rural Energy Planning Programme)	National Council for Applied Economic Research	Tata Energy Research Institute (average)	Planning Commission: (Integrated Rural Energy Planning Programme)	National Council for Applied Economic Research	Tata Energy Research Institute (average)	Planning Commission: (Integrated Rural Energy Planning Programme)	National Council for Applied Economic Research
Andhra Pradesh	23.2	10.8	9.7	9.5	2.5	2.3	18.6	3.6	1.8
Arunachal Pradesh	0.5	0.5	0.1	0.1	--	--	0.1	--	0.1
Assam	13.7	12.3	2.3	1.4	--	--	2.7	--	1.5
Bihar	34.1	26.9	8.9	8.2	9.9	19.9	7.8	13.0	6.0
Goa	--	--	0.1	--	--	0.7	--	--	--
Gujarat	8.6	9.1	4.0	2.3	2.2	2.5	3.0	3.0	0.2
Haryana	1.7	1.7	0.6	2.6	2.9	3.1	1.5	4.3	1.0
Himachal Pradesh	1.8	3.3	2.2	0.3	0.4	--	--	0.2	--
Karnataka	10.6	8.3	6.7	2.6	1.8	0.3	7.8	3.2	1.6
Kerala	7.4	10.0	3.2	1.2	--	--	1.0	1.6	1.8
Madhya Pradesh	32.6	13.1	8.7	6.2	1.8	9.6	5.7	1.5	2.3
Maharashtra	20.0	16.0	5.5	2.9	6.7	4.3	7.6	5.8	0.7
Manipur	0.9	0.8	0.4	0.1	--	--	0.2	--	0.1
Meghalaya	1.0	0.9	0.4	0.1	--	--	0.2	--	0.1
Mizoram	0.3	0.2	0.1	--	--	--	0.1	--	--
Nagaland	0.7	0.6	0.3	0.1	--	--	0.1	--	0.1
Orissa	26.0	11.2	4.6	4.3	0.6	3.3	7.6	0.4	0.8
Punjab	1.9	1.9	1.3	3.0	3.4	3.0	1.8	5.0	1.6
Rajasthan	9.8	4.3	7.1	7.8	2.1	4.8	2.8	0.8	0.5
Sikkim	0.3	0.2	--	--	--	--	0.1	--	--
Tamil Nadu	17.9	8.5	6.3	7.5	2.0	1.5	13.9	2.5	1.5
Tripura	1.6	1.4	0.7	0.2	--	--	0.3	--	0.2
Uttar Pradesh	16.6	21.9	15.6	37.2	17.2	23.5	5.6	17.3	7.0
West Bengal	20.3	4.4	4.5	9.0	--	4.9	10.5	--	7.7
Union Territories	0.4	0.4	0.2	0.4	0.3	0.2	0.3	0.4	0.1
All India	252.1	169.0	93.3	106.9	54.2	83.2	99.2	62.8	36.7

Source: TEDDY 1996 / 97, op cit, p.302

Table 2.7

Distribution of rural households by tyoe of fuel for cooking (in per cent)

	Cowdung cake	*Electri-city*	*Coal/ coke lignite*	*Char-coal*	*Cooking gas*	*Wood*	*Bio-gas*	*Kero-sene*	*Others*
Andhra Pradesh	3.37	0.07	0.06	0.30	2.07	91.56	0.49	0.87	1.20
Arunachal Pradesh	0.05	0.17	0.04	0.09	1.65	94.01	0.03	3.05	0.60
Assam	1.60	0.13	0.23	0.32	1.32	93.05	0.07	0.14	7.49
Bihar	39.49	0.09	4.52	0.60	0.18	47.39	0.07	0.14	7.49
Goa	0.47	0.22	0.05	0.48	16.58	75.78	0.58	5.58	0.33
Gujarat	14.35	0.09	0.11	0.42	3.38	75.98	0.97	3.77	0.91
Himachal Pradesh	37.78	0.14	0.15	0.43	1.85	63.02	0.24	1.28	1.07
Haryana	0.15	0.40	0.04	0.62	2.11	90.70	0.39	5.36	0.23
Karnataka	1.44	0.35	0.02	0.04	0.73	94.43	0.76	1.23	1.01
Kerala	0.06	0.10	0.01	0.01	1.56	96.78	0.19	0.57	0.68
Madhya Pradesh	14.56	0.12	0.60	0.17	0.47	82.92	0.14	0.51	0.50
Maharashtra	14.34	0.12	0.21	0.16	2.87	72.69	1.92	4.70	3.00
Manipur	0.27	0.21	0.05	0.18	2.21	92.19	0.17	1.03	3.65
Meghalaya	0.11	0.47	0.02	0.44	0.19	97.22	0.05	0.92	0.55
Mizoram	0.03	0.02	0.01	0.07	0.27	96.73	0.04	0.37	2.45
Nagaland	0.19	0.06	0.01	0.02	0.57	98.16	0.02	0.43	0.55
Orissa	15.21	0.28	0.64	0.22	0.42	77.13	0.23	0.29	5.56
Punjab	46.27	1.77	0.06	0.11	2.43	44.99	0.40	2.70	1.24
Rajasthan	9.07	0.04	0.07	0.42	0.51	88.00	0.08	0.97	0.81
Sikkim	0.01	0.37	0.24	0.16	1.16	81.72	0.12	15.81	0.41
Tamil Nadu	1.53	0.07	0.01	0.02	1.36	94.08	0.59	1.76	0.57
Tripura	0.51	0.01	0.01	1.33	0.64	96.16	0.01	0.27	1.06
Uttar Pradesh	43.62	0.18	0.26	0.31	0.63	52.63	0.16	0.68	1.15
West Bengal	24.68	0.09	10.94	1.96	0.57	41.54	0.18	0.32	19.87
Andaman Nicobars	0.05	0.07	0.05	0.01	0.66	88.74	0.04	9.47	0.84
Chandigarh	5.16	0.08	0.63	0.08	4.68	13.46	0.22	75.24	0.39
Dadar & Nagar Haveli	0.11	0.06	0.02	0.06	5.73	84.57	0.30	9.00	0.15
Daman & Diu	3.92	0.02	0.02	0.01	11.98	76.93	0.59	6.31	0.22
Delhi	24.08	0.13	0.53	1.00	17.95	16.00	0.44	39.43	0.41
Lakshadweep	0.00	0.08	0.00	0.00	0.05	98.34	0.00	0.76	0.55
Pondicherry	3.42	0.10	0.02	0.04	2.28	87.18	0.27	3.95	2.71
India excl. J&K	19.60	0.16	1.54	0.41	1.22	71.69	0.43	1.34	3.59

Source: Center for monitoring Indian Economy (CMIE), India's Energy sector, Mumbai, sep 1996, p 206

Table 2.8
Pattern of electrification in India villages across the states

Major states	*Villages with elec.*	*Households without elec.*	
		Total	*Rural*
Andhra Pradesh	100.0	53.7	62.5
Assam	97.0	81.3	87.6
Bihar	69.2	87.4	94.4
Gujarat	100.0	34.1	43.6
Haryana	100.0	29.7	36.8
Karnataka	100.0	47.5	58.3
Kerala	100.0	51.6	58.1
Madhya Pradesh	88.3	56.7	58.1
Maharashtra	100.0	30.6	41.6
Orissa	67.6	76.5	82.6
Punjab	100.0	17.7	23.0
Rajasthan	77.3	65.0	77.6
Tamil Nadu	99.9	45.3	55.5
Uttar Pradesh	73.4	78.1	89.0
West Bengal	72.5	67.1	82.3

Source : CMIE, ibid, p.11

2.2(c)Review of individual studies

The works by individual researches are mostly micro in nature and is helpful in providing region specific analysis of the energy use pattern. A review of such studies is perhaps more useful in understanding the energy use pattern of rural India, which is so diverse.

Makhijani and Poole[2] (1975) conducted a study on rural energy problem of developing countries based on empirical evidences from six villages selected from different regions of the world. This study which included one Indian village (the Mangoan village of Maharashtra) was perhaps the first attempt to study rural energy consumption in India.

Reddy and Subramanian[3] (1979) studied the rural energy use pattern of the Pura village in Karnataka. This study identified the fuel to end-use flow of that village, except agricultural residues and animal waste. The study observed that 91 per cent of the total energy use in the village is in the household sector and firewood is the major source of energy (89 per cent)

Revelle[4] (1980) made an attempt to provide a macro level analysis of rural energy use pattern in India. The study inferred that the rural people in India are tied to poverty and misery because they use too little energy and use it inefficiently. The study argues that the transformation of rural Indian society could be brought about by increasing the quantity and improving the technology of energy use.

Bowonder, et.al [5] (1985) have carried out a comprehensive study of eight rural communities in India. The study revealed that energy consumption varies widely among the rural communities depending on socio-economic and agro-climatic factors. The researchers observed that among the different factors influencing energy demand, irrigation is the most significant one. They also observed that energy used for cooking depends on the type of cereals used. An interesting outcome of the study was that, fuel wood is not used mainly by the low-income households but by the higher - income households. The study emphasized the need for location specific and household specific energy planning for rural communities.

Chopra[6] (1988) emphasized the need for proper planning to optimise the use of energy sources for speedy development of the rural areas where the majority of the population lives. The study highlights the need for linking the rural energy sector with the macro economic planning. The study also suggests that the Integrated Rural Energy Planning Programme should be intensified to tackle the rural energy crisis effectively.

Veena[7] (1990) made an enquiry of the nature and magnitude of the rural energy consumption pattern in Gujarat based on quantitative and qualitative data. The study makes a detailed analysis of the emerging gaps between demand and supply sources of energy and alternative sources of energy. The study has brought out valuable information regarding energy consumption across the sectors like domestic, agriculture, animal husbandry and transportation. The study has also outlined some policy oriented suggestions to minimise the constraints and problems involved in rural energy sector of Gujarat by 2000 AD

Rao[8] (1990) in a study relating to Karnataka examined various aspects of the rural energy problem. The study observed that in rural Karnataka, more than 95 per cent of the households depend on traditional sources of energy. The study noted that rural people spend about on average three hours daily for fuel collection.

Adams and Tymer[9] (1977) in their study undertook an evaluation of India's energy resources and policy from the rural perspective. The study examined the main non-commercial and commercial energy sources and solar energy with respect to supply, technology and government policy. The researches opined that India has reached the crossroads in her economic development and in her approach to energy use and policy in rural areas. The country, they argued, was on the threshold of shifting dramatically from traditional to modern energy sources and technologies. They argued that a reasonable long-sighted and coherent energy policy could make living in rural India a pleasant experience.

Batliwala[10] (1982) initiated the gender studies related to rural energy problem. The study attempted to understand the linkages between rural energy and nutrition. Contrary to the usual approaches to the problem, the researcher considered the possibility of reducing calorie expenditure, that is, of conserving the energy of the undernourished. The researcher is of the view that appropriate technology and alternative energy sources can generate positive impacts like reduction of fuel collection time, reduction in the energy expenditure of human beings and improved health for women and children.

Batliwala[11] (1983) in yet another study argued that women face the real human face of the rural energy crisis, but felt that it was inadequately studied. With women responsible for cooking and fuel collection, they are the most affected by the rural energy problem. The access of women to cooking energy resources is determined by their socio-economic status and their geographical location. As a consequence of this women are compelled to use inferior fuels. The use of inferior fuels along with inefficient choolas and extremely poor ventilation of rural homes, produce a deadly disease trap for women. It is also observed that scarcity of cooking fuel forces women to reduce the energy used for cooking, which results in nutrient losses.

Vasudevan[12] (1991) evaluating the improved cook stoves programme, argued that the focus has to be on the specific needs of the urban and the rural poor, although energy conservation in the domestic sector at all levels is equally important. The author feet that, recognizing the factors influencing the user's choices, like the per capita energy consumption, transitions to the usage of higher grade conventional energy sources etc, as related to women's status and living environment is an important prerequisite before attempting at any conserving. The study also gives information on factors like time distribution on domestic chores, cooking time, perception of improved cook stoves by the users and cooking practices.

Bhagavan and Giriappa[13] (1987) made an attempt to develop a new method of analysis of rural energy crisis in the Karnataka context. The researchers evaluated that in the context of rural India, a proper understanding of the production, consumption and reproduction of energy required a broader perspective including food, fodder and fertiliser. Using labour, land, physical and monetary assets, indebtedness and caste as the basic parameter of analysis, the study examines the energy situation evolving among different classes of people in rural areas. The surplus energy generated by the labour power of 'wage-labour class' is grossly under valued, under exchanged and under paid. Hence, the researchers infer that the wage-labour class is the most affected by the energy crisis.

Giriappa[14] (1986) has attempted to bring into light the various issues involved in the rural energy crisis. The author looked into the various aspects of the rural energy problem and suggests various solutions. Giriappa in yet another work[15] has examined the energy use in rural areas in the Karnataka context. The study makes a comprehensive analysis of the rural energy scene at the household and agricultural sectors. The study reveals the social implications of the rural energy crisis. It also explores the feasibility of energy management and non-conventional energy sources for rural development.

Somasekhara[16] (1985) made an analysis of the rural energy flows with a view to delineate village energy flows by different categories of users and endues. It also examined the possibilities of inter fuel substitution. Based on a survey of four villages in Karnataka, the study attempted to build village level energy transaction tables to address the problem of the inter-fuel substitution. The study revealed that since the bulk of rural energy is used up in the domestic sector and non-commercial fuels contribute the major amount, rural energy programmes should give high priority to domestic sector and non-commercial fuels. Energy conservation potential at the household level has been widely discussed in literature relating to improved cooking stove programmes[17]. However, there are only a few rural household energy studies that discuss the energy conservation potential of fuels, stove vessels and cooking methods. One of such studies is by Oberoi et.al[18] (1992) on the extent of use of fuel conservation method by rural families in Punjab. The study analyzed data on the type of choolas, vessels and cooking methods and observed that rural families have started adopting the fuel conservation methods. Yet another study in similar direction has also been done by Oberoi et.al.[19] (1992). This study examined the fuel consumption and thermal efficiency of choola with cooking vessels of three metals (Aluminum, Hindalium and Brass) and two different shapes of bottom (round and flat). The study observed that aluminum round bottom cooking vessels are the best to be used since they consume the minimum of fuel. Among the different cooking fuels, wood was found to be the most economical to be used because of its higher calorific value.

2.3 Review of rural energy studies in Kerala

Since the present study is proposed to be carried out in Kerala, it is only appropriate to review rural energy studies in Kerala. Only a few attempts have been made to analyse the rural energy scenario of Kerala.

2.3(a) Profile of Kerala rural energy sector

The economy of Kerala has many unique features. The uniqueness of the state's economy with respect to cropping pattern, social development, demography and human settlement pattern are so significant that they are capable of influencing the energy consumption pattern of the state. Kerala, naturally, is included in all India energy studies by various agencies. These are the major sources of macro level data on Kerala's energy sector. Besides, there are state level studies also, done by agencies like Kerala State Planning Board, State Committee on Science, Technology and Environment, Agency for Non-Conventional Energy and Rural Technology, Centre for Earth Science Studies, Kerala Sastra Sahitya Parishath and Energy Management Centre. Based on available information from such studies (and some individual studies) an attempt is made to draw an energy profile of rural Kerala.

A comparison of Kerala's energy sector with 'All India' will be useful to highlight the features of the state's energy sector. Such a comparison is provided in Table 2.9. As evident from Table 2.9, there are striking differences between Kerala and the rest of the country with regard to different energy consumption indicators. The disparity is not so visible for commercial energy sources, except the variations in urban kerosene consumption. In the case of non-commercial fuels, there are visible distinctions. For instance, dung cake, which is a significant source in 'All India', is insignificant in Kerala. Twigs and leaves, which form a major proportion of Kerala's fuel mix, is absent in at the national level. It may also be noted that vegetable waste is more significant in Kerala than in the rest of the country. Another apparent distinction is that, in Kerala, the urban-rural divide in the use of non-commercial fuels is not so pronounced as that of 'All India'. Yet another visible distinction is on the proportion of collected fuels. Not only the proportion of total collected fuel is high in Kerala, it is much higher for urban Kerala as compared to 'All India'.

Table 2-9 also provides information about per-cpaita energy consumption. It may be noted that per capita domestic energy consumption per annum is low in Kerala for rural urban and 'total'.

Table 2.9

Fuel Consumption Share Of Different Fuels & Per Capita Consumption By Households,All Inida & Kerala

Fuel Consumption	*Share of different fuels (%)*					
	All India			**Kerala**		
	Rural	*Urban*	*Total*	*Rural*	*Urban*	*Total*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. (a) Commercial Fuels						
i. Soft Cok	1.8	17.7	6.2	--	--	--
ii. Kerosene	7.1	21.2	11.0	7.2	6.2	7.0
iii. Electricity	1.8	9.3	3.9	3.5	9.3	4.9
iv. L. P. G.	0.1	8.5	2.4	0.2	6.6	1.8
v. Town gas	--	0.2	0.1	--	--	--
(b) Non-Commercial Fuels						
i. Fuelwood	51.5	34.8	46.9	17.3	56.2	27.2
ii. Twigs	--	--	--	41.9	7.1	33.1
iii. Vegetable waste	16.3	1.7	12.2	29.5	6.6	23.7
iv. Dung cake	21.1	4.0	16.3	--	0.5	0.2
v. Saw-dust	--	--	--	0.4	7.3	2.2
vi. Charcoal	0.1	2.6	0.8	--	--	--
vii. Gobar gas	0.1	neg.	0.1	neg.	--	neg.
(c) TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
2. Proportion of Commercial Fuels	10.8	56.9	23.7	10.9	22.1	13.7
3. Proportion of Non-commercial Fuels	89.2	43.1	76.3	89.1	77.9	86.3
4. Proportion of collected Fuels	79.6	7.2	59.4	86.1	19.9	71.0
5. Per Capita domestic energy consumption per annum (kgcr)	189.1	265.5	206.1	163.1	263.0	180.0

Source : Complied from NCAER Domestic Fuel Survey (1978-79)

Note : Adopted from Sarala Gopalan, 'Domestic fuels and demices for cooking - practices, problems, policies and perspectives, PhD Thesis (Unpublished), IIT, Delhi, 1989, P. 57.

neg : Negligible

The features of Kerala's rural energy sector, viz., dominance of non-fuel wood sources like twigs and vegetable wastes, insignificance of dung cake and low urban-rural divide in the share of non-commercial fuels may be 'attributed to rich endowment of the region with biomass. Of the total geographical area of the state, 58.29 per cent is under cultivation and 27.83 per cent is under forests. The agro-climatic conditions of the state (like average rainfall of 3100mm, average temperature of 90°F and large number of swift flowing rivers) are conducive for the thick growth of variety of vegetation. The vegetation in Kerala include a number of long standing fruit bearing tree crops like coconut, jack, mango etc which are commonly found in homesteads and plantation crops like rubber and cashew. Coconut trees that are widely found in both homesteads and agricultural lands of Kerala contribute considerable amount of fuel. It is estimated that coconut trees provide 42 per cent of the energy requirement of rural Kerala[21]. It may be interesting to observe that, of the supply of wood from different sources, homesteads in Kerala account for 74.40 to 83.60 per cent. Estates contributed 9.30 to 11.80 per cent, imports 2.40 per cent and forests (including plantations and illicit felling) accounted for only 4.70 to 11.40 per cent[22]. Like elsewhere, in rural Kerala also household sector dominate energy use pattern. Table 2.10 reveals that nearly three-quarters of the total energy (72.85%) generated from all fuels are consumed in the household sector. The share of household sector in non-commercial fuel consumption is higher than their share in commercial fuel consumption, though the trend reverses for commercial fuels.

A similar trend is recorded by studies of State Planning Board (Table 2.11). According to table 2.11, the total energy consumption in rural Kerala is 35557.84 10^9 kilocalories, of which 88.68 per cent are consumed by household sector. It may be noted that for both commercial and non-commercial fuels, the share of households is larger than that of enterprises (Table 2.12).

Table 2.12 provides information on the pattern of fuel consumption by percentage share of different end user. Cooking (87.71%) is the most important energy end use followed by lighting (9.27%). Water heating and space heating consumes only insignificant quantity of energy. It may be noted that, whereas 97.48% of non-commercial energy is used for cooking, only 7.44 per cent of commercial energy is used for cooking.

Table 2.13, using the State Planning Board Data, also provides a similar trend.

Table 2.10
Energy consumption by households and establishments in rural by fuel type – NCAER (1985), (in '000 tones)

Type of fuel	Households	Establishments	Total	% in total Households	Consumption Establishments
Fire wood	580	563	1143	50.74	49.26
Twigs	1401	---	1401	100.00	---
Wood shaving	---	---	---	---	---
Saw Dust	13	---	13	100.00	---
Charcoal	---	279	279	---	100.00
Crop wastes	986	--	986	100.00	---
Dung cake	1	22	23	4.35	95.65
Gober gas	1	---	1	100.00	---
Total non-commercial fuel	2982	863	3845	77.56	22.44
Coal / cake	---	---	---	---	---
Kerosene	242	98	340	71.78	28.22
Electricity	116	164	280	41.43	58.57
LPG	5	---	5	100.00	---
Town gas	---	---	---	---	---
HSD	---	123	123	---	100.00
Furnace oil	---	---	---	---	---
Total commercial fuels	364	384	748	48.66	51.34
Total all fuels	3346	1247	4593	72.85	27.15

Source: Compiled from Table 3.3 and 3.4, op cit Bahuleyan, PP94 - 96

Table 2.11
Energy consumption by households and enterprises in rural Kerala by fuel type -- based on State Planning Board Survey (1986)

(In 10^9 Kilo calories)

Type of Fuel	*House-holds*	*Enter-prises*	*Total*	*% in total consumption* House-holds	*% in total consumption* Enter-prises
Fuel wood	11169.03	3490.50	14659.62	76.19	23.81
Fuel from coconut and Palymrah trees	11664.91	46.03	11710.94	99.61	0.39
Twigs, leaves, shells and other vegetable wastes	7143.23	119.41	7262.64	98.36	1.64
Other non-commercial energy	26.11	--	26.11	100.00	--
All non-commercial enrgy	30003.28	3656.03	33659.31	89.14	10.86
Kerosene	887.27	12.77	900.04	98.58	1.42
Electricity	388.55	275.95	664.50	58.47	41.53
L.P.G.	37.21	--	37.21	100.00	--
Other Commercial energy	217.69	79.09	296.78	73.35	26.65
All commercial energy	1530.72	367.81	1898.53	80.63	19.37
All energy	31534.00	4023.84	35557.84	88.68	11.32

Source : Kerala State Planning Board, Rural Energy generation and use pattern - south Kerala, as quoted in ibid, p 99.

Table 2.12

Pattern of fuel consumption by percentage share of different energy end-uses in fuel consumption and by percentage share of different fuels in end-uses (rural households in Kerala) -- based on NCAER survey

Fuel	*Percentage share of end-uses* in fuel consumption*			
	Cooking	*Lighting*	*Water heating*	*Space heating*
Firewood solid	99.31	--	0.69	--
Twigs 99.43	--	0.57	--	
Saw dust	100.00	--	--	--
Crop wastes	93.60	--	6.40	--
Dung	100.00	--	--	--
Gobar gas	100.00	--	--	--
Total non-commercial fuels	97.48	--	2.52	--
Kerosene	8.68	91.32	--	--
Electricity	086	76.72	0.86	18.97
LPG	100.00	--	--	--
--				
Total commercial fuels	7.44	85.40	0.28	0.06
All fuels	87.71	9.27	2.27	0.66

* The category 'other uses' are excluded.

Source : NCAER, adopted from ibid p 112

Table 2.13

Pattern of fuel consumption by percentage share of different energy end-uses in fuel consumption and by percentage share of different fuels in end-uses (rural households in Kerala) -- based on NCAER survey

Fuel	*Percentage share of end-uses* in fuel consumption*				
	Cooking	*Lighting*	*Water heating*	*Space heating*	*Other domestic uses*
Fuelwood	89.90	--	3.12	1.00	1.87
Twigs, leaves, shells and other vegetable wastes	85.32	--	9.35	0.30	3.89
Fuel from coconut & Palmyrah trees	84.06	--	10.66	0.10	2.08
Kerosene	20.66	75.09	0.18	0.46	1.46
Electricity	2.59	86.42	0.52	0.28	4.50
LPG	100.00	--	--	--	--
Other fuels	9.88	--	0.73	0.10	3.97
All fuels	83.04	3.18	7.18	0.47	2.44

* Percentage figures do not add upto 100 since 'other uses' have been excluded.

Source: Kerals State Planning Board, adopted from ibid p 113.

2.3(b) Review of individual studies

The pioneering attempt to study rural energy situation of Kerala was initiated by Pillai. Pillai[20] (1982) analyzed the patterns of growth in the demand for and supply of electricity in Kerala along with an assessment of the import of rural electrification energy demand. The study observed that flour and saw mills together are the most important electricity consumers in rural areas. Pillai[21] (1983) in another attempt examined the household demand for fuelwood in rural Kerala. Using data collected from Thrissur district, the study projected the firewood demand by rural households in Kerala in 2001 AD

Thampi[22] (1983) conducted a study in three villages of Trivandrum district, with the objective of estimating the sources and quantity of energy used for a typical eco-system. The study also measured the dependence of the rural household energy on coconut trees. The methodology relied was the actual physical measurement. The study found that the behavior of households in an apparently homogenous eco-system is for from uniform in respect of the types, sources and consumption of energy. It was also revealed that the relative difficulty in procuring energy for domestic needs is seen increasing with decreasing fuel producing assets (land, trees etc) which is positively correlated to distribution of land holdings.

Krishnankutty[23] (1990) has examined different aspects of rural household energy problem in a study of demand and supply of wood in Kerala. The study estimated the per capita annual consumption of fuel wood by rural households as 0.178 tonnes and the total demand for fuel wood in the rural household sector of Kerala as 4.134 million tonnes. Of the total demand for wood in Kerala, the demand by the household sector accounted for 50 per cent. Of the household demand, wood as fuel accounted for 84.50%. Of the total wood demand in the state, fuel demand accounted for 83% and of this household sector accounted for the major share (51%).

Gopalan[24] (1989) initiated a wholestic approach of the rural energy problem incorporating energy sources, cooking devices, and cooking practices and household energy perceptions. The study makes a micro-level analysis of the impact of the eco-agricultural factors in household energy consumption across various land holding and income groups, with the objectives of anticipating the kinds of transition that could take place due to changes in socio-economic environment. The study was conducted in urban and rural areas of Trivandrum district and the methodology followed included primary survey, participative observation and laboratory experiments. Based on the observations made, the study suggested the formation of a national domestic cooking fuel policy.

Bahuleyan[25] (1992) has estimated the demand for energy in rural Kerala. The study was conducted in three villages selected on the basis of topography. Data were collected through personal interviews, making use of both accounting and recall methods. The study found out that non-commercial energy is the predominant energy source and cooking the predominant end-use in rural Kerala. The study identified the inter village variations in fuel availability and socio-economic conditions as the factors responsible for inter-village variations in energy demand.

2.3(c) Emerging conclusions and the significance of the study

The review of studies carried out, at the national level reveal that, just like in other developing countries, in India also, rural energy date base is considerably weak, especially at the household level. The studies done so far have found that the rural energy demand pattern is location specific and resultantly large inter-village differences occur. The rural household energy demand is observed to be a function of factors like level of development of an area, cropping pattern, household size, level of income, size of land holding, occupational and educational status, extent of fuel availability, type of fuel using devices, fuel efficiency, quantity of food cooked, number of cooking sessions, cooking practices, fuel mix, fuel preferences and so on. The extent to which these factors influence the rural household energy demand vary from region to region and period to period. Hence the diversity of India in geographical and cultural terms pose serious challenges to a correct understanding of the various aspects of rural energy situation. Only studies with respect to a large number of localities can help in evolving a suitable analytical framework for understanding the rural energy use pattern in India.

As mentioned earlier, the development pattern of Kerala economy has many unique features. The uniqueness of the state with respect to cropping patterns, human settlement patterns, occupational structure, land use pattern, demography and social sector development (especially the status of women) are powerful enough to influence the household energy demand of the state. For instance, the cropping pattern of the state with predominance of plantation crops and long standing fruit bearing crops provide abundant energy resources. Similarly the human settlement pattern with a variety of crops, especially coconut, cultivated in every homestead, ensures even distribution of these energy resources. Further, the wide spread education, especially in rural areas and among women, can considerably influence cooking practices.

Besides, the presence of a strong middle class with considerable purchasing power can be a major determinant in household energy consumption pattern of the state. However, the presence of such factors, it appears, is not reflected much in Kerala's energy sector. As revealed from Table 2.10, per capita energy consumption by households in Kerala is much lower than the national average. Not only the per capita energy consumption is low, the proportion of commercial fuels in total energy is also low. The proportion of collected fuels is also high in Kerala, indicating the low level of commercialisation of domestic fuels. If cooking fuels alone are taken, the predominance of non-commercial fuels become more explicit. However, recognizing that the LPG consumption by rural Kerala households alone is higher than that of India, one is left to doubt whether the lopsided growth pattern of the Kerala economy is exhibited by the energy sector also. Experiences all over the world show that energy transition moves from fuel wood to kerosene to LPG.

Electricity, on which a number of households depend for lighting, is in acute short supply in the state. There is a deficit of 14.3 per cent in electricity production in Kerala. The per capita power consumption in the state (235.72 kWh) is lower than the national average (318.84 kWh). However, in recent years there are attempts to generate additional power and it is expected that the problem of shortage of electricity in Kerala can be eliminated by early years of the next millenium.

Thus, the high level of development exhibited by Kerala in social sector contradicts with the performance of the (domestic) energy sector, especially when one correlates the low energy intake and the over dependence on non-commercial fuels. It is hence evident that there are certain factors, which delay energy transition in Kerala. Though this may be partially explained by the low per capita income of the state, there are more complex reasons relating to socio-cultural factors. Only in-depth micro level studies can shed light on their complexities.

Though urbanization is taking place at a fast rate in Kerala, the state is still predominantly rural. As per 1991 census, 73 per cent of Kerala's population lives in rural areas. Consequently, much of the domestic energy consumption takes place in rural households. This under lines the significance of rural household energy sector in Kerala.

Only a limited number of studies have been done so far on rural energy consumption pattern in Kerala. These studies have been highly useful in providing valuable insights into the complexities of the rural energy scene. However, the relationship between energy consumption and its determinants are still partially understood. This might be because these studies have often concentrated too much on the quantitative aspects and failed to take the integrated perspective. Rural energy demand certainly requires an integrated perspective. For instance, World Health Organization (WHO) takes energy end-use as a factor in health and housing[26]. WHO maintains that an important requirement for healthy housing is protection against air pollution indoors, caused by cooking and heating facilities and practices, associated mainly with the biomass fuels used with inefficient stoves and poor ventilation. A study conducted by Batliwala reveals that 'kacha' homes are suffer more indoor pollution 'pucca' homes, since the tached roofs improve ventilation[27]. Thus, house type, kitchen design, place of cooking etc are associated with household energy use. In fact, housing and household energy can be treated as two sides of the same coin[29]. This aspect of household energy use has not been adequately investigated in the Kerala context.

Rural energy problem has affected women the most. This is a fact that is rarely brought out by rural energy studies. The time spent by women and children for fuel collection has considerably increased due to the rural energy problem. This has far reaching consequences on the productivity and time management of women.

Besides, the conventional biomass fuels emit more organic pollutants than fossil fuels. These combined with the inefficiency of the choolas and the extremely poor ventilation of rural homes produce a deadly disease trap for women. Since problems related to fuel use and fuel collection are mostly associated with women, men are unlikely to give due attention to the same. In rural societies, where men control all the resources, this has serious implications. This gender dimension of the rural energy scene remains under researched in the rural energy studies of Kerala.

Household attributes such as type of stoves, fuel etc that are relevant in determining energy behavior are important in rural energy analysis also. These have also been underscored in rural energy studies in Kerala.

Two issues that deserve special attention in Kerala's energy sector at present are the possibilities of exploring suitable energy conservation techniques and also improved energy technologies. There are number cost effective measures to achieve energy conservation at the household level. For instance, energy saving can be achieved in rural households by improving the efficiency of cooking through the introduction of efficient fuels, stoves and also by following the energy saving tips of PCRA[29]. Similarly, Kerala has a fair chance of overcoming an acute energy crisis, if steps are taken to develop non-conventional and renewable sources of energy, especially biogas and solar energy. However, as evident from the experiences at other parts of the country, the successful dissemination of these technologies is highly dependent upon consumer's aspirations and attitudes. For instance, attempts to promote community biogas systems in Pura, Karnataka failed because they were directed at substituting biogas for wood as a cooking fuel. Due to the abundant wood resources in Pura, fuelwood collection was relatively easy, and therefore villagers had no incentive to maintain the biogas system[30]. Thus, to understand consumer attitudes, problem centered social scientific effort is critically necessary[31]. While technical research provides technologies for improved energy, only social-cultural research can explain how and why technical innovation are adopted[32]. Such endeavors, which are essential for understanding household perceptions regarding energy conservation, are preconditions for successful implementation of conservation programmes. Attempts like the above are lacking in the existing studies on household energy consumption pattern in Kerala.

After cooking, the most important energy consuming activity at the household level is lighting. Though Kerala has achieved 100 per cent rural electrification still 58.10 per cent of rural households are without electricity. These households depend on kerosene lamps and sometimes on candles. These provide very low levels of illumination, and are notoriously inefficient. This results in wastage of energy and health problems. In households with electricity, lighting energy has considerable conservation potential[33], particularly since 40 per cent of electricity consumed in the household sector is used for lighting[34]. For instance, rural households commonly depend on incandescent lamps for lighting. Considerable energy saving can be achieved if the incandescent lamps are replaced by Compact Fluorescent Lamps (CFLs) which consume only a fourth or even less electricity to produce the same amount of light as incandescent[35]. There are many other simpler methods of saving lighting energy like timely cleaning of lamps and bulbs. Information regarding lighting energy source equipments and practices are essential for the effective implementation of energy saving measures. However, such information is limited since the existing rural household energy studies in Kerala are preoccupied with cooking fuels and lighting fuels are side tracked.

To conclude, rural household energy consumption is a part of a major integrated system consisting of social and economic behavior of the community and resources available and accessible to the people. Hence there will be variations in energy use pattern from region to region and this calls for region specific studies. Kerala is a distinct region of India in respect of geo-climatic and socio-economic factors, which are capable of influencing rural energy demand. Rural household energy studies in Kerala, though are limited, throw light on various aspects of rural household energy consumption pattern. However, there are serious limitations to these studies as discussed above. These limitations have resulted in a lacuna of vital information necessary for formulating policies for tackling rural energy problem. This study is a humble attempt to bridge this gap.

2.4 Objectives

1 To examine the energy consumption pattern at the household level in rural Kerala

2 To assess the variations in rural household energy consumption pattern across geo-climatic and socio-economic clusters

3 To assess the attitudes of the rural households towards energy sources, uses and devices

4 To identify the factors influencing the adoption of energy conservation practices and shift to the improved energy technologies at the household level in rural areas

2.5 Methodology

In order to develop the database required for analysing the stated objectives, it was proposed to conduct a primary survey at household level in some sample villages representing different geographical regions in Kerala. The preparatory work for developing the methodology of the primary survey was based on review of rural energy studies and discussions with researchers and scholars who are familiar with rural energy studies. Discussions were also made with households of rural areas to understand the socio-cultural practices and to get an insight into their perceptions of domestic energy consumption. These discussions provided the back ground to develop the framework of the primary survey.

2.5 (a) Selection of sample villages

Four sample villages were identified for conducting the primary survey. The four villages are Pallippuram Panchayat in Ernakulam district, Mundathikode and Mattathur Panchayats in Thrissur district and Kottayi Panchayat in Palakkad district. These panchayats were selected based on the following arguments. Primarily, the selection was on the basis of geographic location in order to bring out the influence of natural endowments on fuel consumption pattern. Pallippuram is a coastal village, Mundathikode is a midland area and Mattathur is the periphery of reserve forest. Kottayi has been selected due to certain characteristics of Palakkad district. The cropping pattern of the district is dominated by Paddy and in fact, the district produces the highest quantity of paddy in the state. Palakkad district has also the highest gross and net area under irrigation in Kerala. In addition, the district has the lowest rural literacy rate in Kerala, especially for women and also has the third largest rural population among the districts. Besides, the district has less than (the state) average rain fall – in fact the second lowest among the districts, second lowest per capita income and second largest area in total operational holdings. The selection of Kottayi was thus an attempt to capture the energy consumption pattern of a rural area, which is a dry land region, has a distinct cropping pattern dominated by paddy and socio-economically less developed. However, it is admitted that the selection of the four villages was purposive as well. In all the sample panchayaths the researcher had personal contacts. This helped in building the rapport with the householders, which is essential for the success of a survey of this kind.

2.5 (b) Selection of sample households

As per the latest senses, the average village population in Kerala is between 15000 and 20,000. The sample villages, Pallipuram, Mundathicode, Mattathur and Kottayi; are also not an exception to this. Within this vast population, there are a number of socio-economic clusters. If an attempt is made to give a statistically rational representation to each of these clusters, it will lead to a very large sample size, which will be difficult to manage for an individual researcher. So it was decided to take a manageable and convenient sample size of 75 households from each village by random sampling.

The primary survey was conducted in the four sample villages during the period November 1997 to March 1998 using a pre-tasted schedule. The reference period of the survey was for one month.

The schedule was prepared after extensive literature review and interaction with experts and rural households. The first draft of the schedule was tested in a pilot survey and necessary corrections were made. Apart from collecting data required in the schedule, discussions with households and observation of cooking and other energy consuming practices were also used. Apart from information regarding energy use, the schedule also seeked information regarding other household details likes housing, socio-economic status of members, consumption pattern etc. These are essential for a comprehensive analysis of energy use pattern. A copy of the schedule is given in Annexure I. The data were collected by the researcher with the aid of local investigators. Care was taken to interview female members of the household since they are directly involved in energy use.

To get reliable estimates of energy consumed at the household level, the data collection has to be done with utmost care. Generally three methods are employed for energy related data collection, viz., the actual physical measurement method, accounting method and the memory recall method. In physical measurement method, energy materials are actually measured using weighing scales or similar techniques. In the accounting method, charts describing the concerned energy sources are supplied to the households and are requested to record the fuel consumption over a reference period. On the other hand, in the memory recall method, the informants are asked to recollect from memory the quantity of the fuel consumed over a period of time.

The present study has used a combination of the recall method and physical measurement method, with the former being the most important one and physical measurement method supplementing it. The physical measurement and accounting methods, though have many merits, could not be employed as a major measure in the present study due to the limitations faced by an individual researcher, both in terms of resources and time.

Each household was asked to recall the energy used in the past one month and the information was recorded in a chart prepared for the purpose. The households were given the choice of expressing the quantities in the local units familiar to them. Thus firewood, coconut residue and agricultural residue were recorded in terms of units like 'bundles', 'baskets' 'numbers' etc and saw dust in 'sacks' and 'tins'. Later the researcher converted these into kilograms by assigning weight to them on the basis of average weight of bundles, baskets etc arrived at by actual physical measurement. For biogas, the quantity of wet dung fed into the plant was recorded.

After the data collection, the quantities of fuel were converted into a uniform energy measure. Energy is measured in terms of different units like 'tons of coal replacement', 'fuel wood equivalent', 'joules' and 'kilo calories'. The present study has selected 'kilocalories' as the unit of measurement, primarily because of the convenience of conversion. Quantity of fuel used was converted to kilocalories with the aid of the conversion measures showed in Table2.14.

Table 2.14

Energy content of different fuels (in Kilo calories)

Fuel	Unit	Value
Fire wood	Kg	4408
Coconut residue	Kg	3500
Agriculture residue	Kg	3000
Saw dust	Kg	4200
Kerosene	Kg	9000
LPG	Kg	10800
Electricity	KWh	860
Petrol /Diesel	Lt.	10000
Cow dung (wet)	Kg	3290

Source: Compiled from the calculation of Advisory Board Energy, Working Group on Energy and Tata Energy Research Institute (TERI) as in

1). 'TERI Energy data, Directory and Year book 1996-97', TERI, New Delhi, p 459.
2). Giriappa.S, 'Energy use in rural areas', Oxford & IBH, New Delhi, 1991, p 117
3). Sarala Gopalan, 'Domestic fuel and devices for cooking – practices, problems, policies and perspective', Ph.D. thesis (unpublished) IIT, Delhi, P88.

There are variations in the energy content calculations by different agencies. For the purpose of the present study, the values were arrived at either by computing averages or by adopting the value that were applicable to the Kerala context. It may be noted that for biogas, energy content of wet dung has been considered rather than the gas, for the convenience of measurement.

After the completion of energy conversion and other data processing operations, detailed analysis was done to examine the objective of the study and draw reasonable conclusions.

2.6 Definitions

The working definitions and the key terms used in the present study are given here.

Biomass fuels: Combustible and / or fermentable material of vegetable origin. For example wood, charcoal, corncobs, cotton stalks, rice husk and animal dung.

Commercial and non-commercial fuels: Commercial fuels include commercially traded fuels like petroleum, coal, LPG and electricity. Non-commercial fuels include those fuels that ate not commercially traded, like fuel wood, agriculture residue, animal residue and other bio-fuels. However, strictly this definition is not correct since the so-called non-commercial fuels are often traded commercially. Even if some of these fuels may be commerçially traded, it is not a commercial activity of a substantiate nature with inputs of investment and management, especially in rural areas.

Calorific Value: The heat content of the fuel measured in calories. It is normally expressed in KiloCalories. The present study has used 10^3 KiloCalories (10^3 K.Cal) for the convenience of presentation.

Renewable energy: An energy from, the supply of which is partly or wholly regenerated in the course of the annual solar cycle, and fuels of vegetable origin are regarded as renewable, mineral fuels and nuclear power are not included.

Improved energy technologies: Those technologies, which improve the efficiency of energy use and hence reduce waste. Examples are smokeless choolah, pressure cooker, CFL etc.

Traditional and non-traditional fuels: Fuels that are in use for more than three hundred years are termed as traditional fuels. Those that are more recent than that are termed as non-traditional fuels.

Useful energy: The heat energy that is transmitted to the cooking pot in the fuel device system.

2.7 Limitations of the study

The present study has the following limitations. Firstly, the study has depended heavily on the recall method to collect data rather than on the physical measurement method. Second, energy consumption in rural areas are subject to seasonal variations. The present study has a reference period of only one-month and hence could not completely capture the seasonal variation. Third, most of the households used a mix of fuels in the two major end use of cooking and lighting. Similarly, the energy consumption by the rural households though is primarily meant for the domestic purposes, often overlap with other requirements like agriculture, live stock rearing etc. Hence though data were collected for domestic energy consumption, overlapping with non-domestic purposes may have occurred. Fourth, energy studies often associate energy consumption with education and occupation levels of the households. The present study has not considered these parameters. Fifth, the analytical frame work in chapter VI is based merely on the perceptions (attitudes) of the rural households, rather than on any complex measuring technique. This can give only a crude approximation.

References

1 See Annexure II for a brief review of these studies

2 Makhijini and Poole, Energy and agriculture: Energy and agriculture in the third world, Ballinger Publishing company, Cambridge, 1975.

3 Reddy, A.K.N. and Subramanian, D.K The design of rural energy centers, ASTRA. Indian Institute of Science, Banglore, 1979.

4 Revelle Roger, Energy use in rural India, in 'Energy in the developing world – The real energy crisis, Vaclaw Smill and William Knowland (Ed), Oxford University press London, 1980, pp.194 – 207.

5 Bowonder, B., Prakash Rao .N, Dasgupta. B, and Prasad. S.S.R,' Energy use in eight rural communities in India', World development, Great Britain Vol. 13, No.12,1985,pp.1263 –1286.

6 Chopra. S.K, Integrated approach vital, The Hindu survey of Indian Agriculture, The Hindu, Madras,1988, pp. 21 – 27.

7 Veena. D.R, Rural Energy – Consumption, Problems and prospects, Ashish, New Delhi, 1990.

8 Rao, Hemalatha, Rural Energy Crisis – A diagnostic Analysis, Ashish, New Delhi, 1990.

9 Adams John and Tyner Wallace, ' Energy in rural India: National policy from the village perspective', Indian Journal of Agriculture Economics, Indian Society of Agriculture Economics, Mumabi, Vol. XXII, Oct – Dec, 1977, PP 77 – 90.

10 Batliwala, Srilatha, Rural Energy Society and Under Nutrition: A New Perspective, Economic and political Weekly, Mumbai, Vol. XVII, No.9, Feb, 27, 1982. PP 329 – 333.

11 Batliwala Srilatha, ' Women and Cooking Energy', Economic and Political Weekly, Mumbai, Dec. 24 – 31, 1983, PP 2227 – 2230.

12 Vasudevan Padma , Women Involvement as Kitchen Managers and Stove Users', in Report No. GCPIRAS/131/NET of Regional Wood Energy Development program in Area, FAO, and June 1991.

13 Bhagavan. M.R and Giriappa. S, Class Character of Rural Energy Crisis – case of Karnataka, Economic and Political Weekly, Mumbai Vol. XXII, NO. 26, PP. 57 –A69.

14 Giriappa. S, Rural Energy Crisis, (Ed), Himalaya Publishing House, New Delhi, 1986.

15 Giriappa. S, ' Energy Use in Rural Areas – Process, Problem and prospects, Oxford & IBH, New Delhi, 1991.

16 Somasekhara . N, 'Rural Energy', Sterling Publishers, New Delhi, 1985.

17 Such studies are not reviewed here since it does not come under the direct preview of the present.study. However, some of them are included in the bibliography.

18 Oberoi. K, Kataria. P, Houspel . N and Gill. J, ' Study on the Extent of Use of Fuel Conservation method by the rural families', in Journal of Research , Punjab Agriculture University, 29(3): 414 – 15, Sep. 1992. PP. 414 – 415.

19 Oberai. K. et.al, ' Fuel Consumption and Thermal Efficiency of Chulah with Cooking Vessels of different metals and shapes', in OP.cit ref. 18, PP. 416 – 423.

20 Pillai, P.P, 'Dynamics of electricity supply and demand in Kerala: A macro economic study', Agricole publishing academy, New Delhi, 1982.

21 Pillai.P.P, 'Shortage of wood fuel for Kerala home fires', State and Society, Vol.4, No.4, Oct – Dec, 1983

22 Thambi Balachandran. K, 'Pattern of domestic energy consumption in rural Kerala – A study of selected village', M.Phil dissertation, Jawaharlal Nehru University, through C.D.S Trivadrum, 1983, P 123.

23 Krishnankutty. C.N, ' Demand and Supply of Wood in Kerala and their future trends', KFRI Research Report 67, Kerala Forest Research Institute, Peechi, 1990, P. 37.

24 Gopalan Sarala, ' Domestic fuel and devices for cooking – Practices, problems, policies and perceptiveness, Ph.D. Thesis, (unpublished), IIT, Delhi, 1989.

25 Bahuleyan.K.D, 'Demand for energy in the rural sector of Kerala', Ph.D. thesis (unpublished), University of Calicut, 1992.

26 Improving Environmental Health Condition in Low Income Settlements – A Community Based Approach, WHO Offset Publications, No.100, WHO, General 1987.

27 OP. Cit. Ref 11, P 2228.

28 Housing Energy and Indoor Environment, Memorandum 1993 M7, Lund university, Sweden 1993, P.9

39 PCRA – Petroleum Conservation Research Association. See chapter VI for these tips.

30 Rural Energy and Development Improving Energy Supplies for Two Billion people, World Bank, 1996, P.35.

31 Glenn Shippee, Energy Conservation and the role of the Social Sciences, Energy Policy, March 1981, P.34.

32 op.cit. Ref 28, P.24.

33 Energy Demand in Five Major Asian Development Countries – Structure and practices, World Bank Discussion Paper No.227, 1975.

34. 'India's Energy Sector', (center for monitoring Indian Economy, Mumbai, September 1996, P 11.

35. 'Energy End Uses – An Environmentally Sound Development Pathway',
Asian Development Bank, 1994, p.21.

CHAPTER III

THE RURAL ENERGY SITUATION– A SYNOPTIC VIEW

3.1 Historical evolution of energy

In the initial stages of development world did not require much energy. This was because world was predominantly agricultural and subsistence farmers depended mainly on traditional renewable energy sources. While wood served as fuel, wind and water provided power and these were supplemented by human and animal labour.

With the increase in population, agricultural production had to be increased, and more energy was needed to sustain the process. The increased energy demand from the urban sector added to this, which resulted in the commercialisation of traditional energy sources.

Industrial revolution drastically changed the world energy scenario. To meet the steep hike in energy demand that resulted from industrialisation, world was forced to look beyond the traditional energy sources. As a result mankind began to use fossil fuels, first in the form of coal, and then in the form of oil and other sub products.

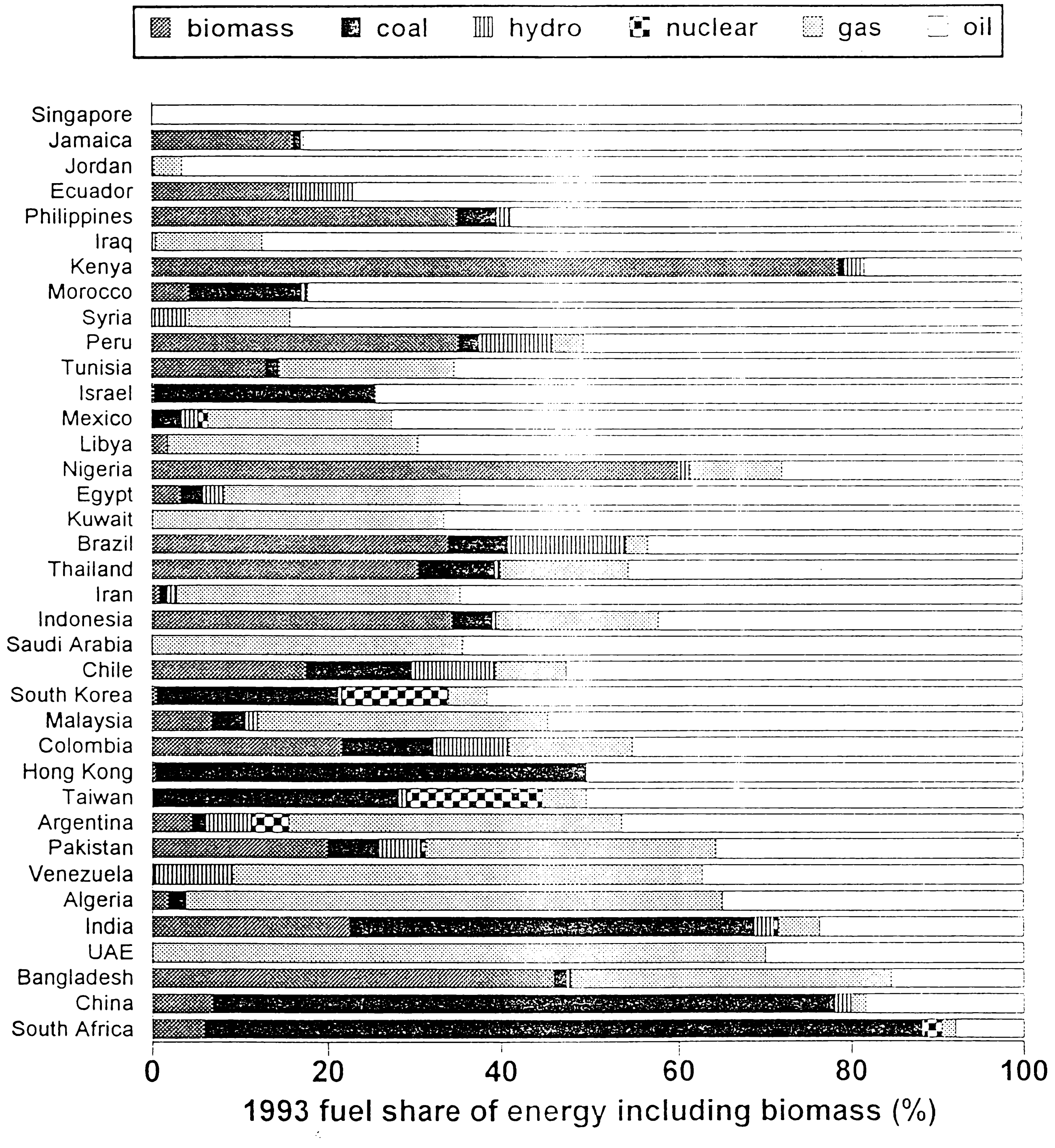
The fossil fuels, since their introduction, have served humanity to meet a number of end uses. But, in later years, development process has not only consumed resources at a rate which threatened the continuance of development process itself, but has also introduced new forms of technological and economic organisation, new social activities and new forms of international trade. This resulted in unexpected growth in energy demand, which rendered the known sources of energy inadequate. This led to the discovery of newer and non-conventional sources of energy like nuclear, solar, wind and geo thermal.

The present distribution of energy use among different sources is (for selected countries) presented in Fig 3.1. The figure reveals that while the developed nations consume substantial amounts of commercial energy, several of the developing countries still consume significant amounts of biomass fuels.

3.2 The energy crisis and developing countries

Although energy has always been a vital input in the process of economic development, its crucial role in sustaining economic growth, particularly in developing countries, was not recognized until the first oil price hike in the early 1970s. The 'oil crisis' or 'energy crisis' occurred when OPEC raised the oil prices twenty-fold[1].

Figure 3.1 fuel share of energy including biomas, 1993.



Source: World Bank discussion paper no.359 (1997) P 19.

The developed countries responded quickly to the energy crisis with conservation measures, technology changes and a shift to alternative sources of energy. However, adjustment to the crisis in the developing countries had been rather slow, mainly because the growth of these economies were closely tied to the use of commercial energy, especially imported oil. These countries neither had the option of reducing energy consumption (which will slow the rate of economic growth that is already low), nor revising course to quickly shift to alternative energy sources (which require much resources and technology).

The energy crisis, which hit the developing countries adversely, inflicted most of its impact on the rural areas. For majority of the developing countries, higher oil import costs that resulted from the oil crisis have been translated into higher prices for petroleum products like kerosene which were widely used in the rural areas. High prices of commercial fuels placed them out of reach of the poor and consequently they were forced to rely more heavily on their traditional sources of fuel. It was only then world was aware of a second energy crisis that was slowly creeping up in the rural areas of developing countries. This energy crisis, also known as 'the other energy crisis[2], was characterized by acute shortage of fuel wood and other traditional fuels in the rural areas of the developing countries. This opened up a new dimension to the energy crisis.

At this juncture it seems only appropriate to look into the causes (other than oil crisis) of rural energy crisis. The root cause of the rural energy problem lies in the increased pressure of population upon traditional energy sources, the need to develop new agricultural lands to meet food requirements and the resultant deforestation. The impact of oil crisis on the commercial fuels and the consequent commercialisation of traditional fuels should also be taken into account in this regard. Perhaps an equally important reason is the limited income and worsening poverty of the rural masses. Thus the rural energy crisis cannot be separated from the inaccessibility of the poor to common property resources and their vulnerability throughout the developing world.

The causes of the depletion of fuel wood are rooted in the subsistence nature of the rural fuel economy and are perhaps best explained by 'the tragedy of the commons[3]. By this argument, it is the nature of common resources to get depleted since there is no economic or social mechanism, which ensures their replacement. When wood is gathered as a free good from common land, no individual has the incentive or responsibility to replace the trees.

Once consumption exceeds the rate of natural replacement, depletion is inevitable.

3.3 Coping with energy crisis in rural areas

The previous section revealed that rural energy crisis resulted in scarcity and commercialisation of the most preferred rural fuels, technically ceasing them fueling the rural fires. The rural people reacted to this by shifting to inferior substitutes such as dung and agricultural residues. As discussed in the first chapter, the use of these fuels are undesirable due to their low energy content, alternative utilities and negative impact on the user's health. This necessitates the introduction of viable and safe alternative energy sources. Possibilities of energy conservation have also to be explored. This section first discusses possible alternative energy options and then potential areas of conservation.

3.3 (a) Energy options for rural development

Tackling the problems of rural energy is generally considered as a daunting task due to the complexities involved in it. However, there are a number of energy options that have either been successfully implemented or experimented, in different rural settings.

1. Electricity

Though widely used in urban areas, electricity is not a significant source of energy (particularly for domestic uses) in rural areas of developing countries. It may be observed from Table 3.1 that about 77 per cent of rural population in the developing countries live without electricity.

Table 3.1
Urban and Rural People committed to Electricity in Developing Countries, by Region, 1970 and 1990 (in per cent)

Region	Urban		Rural	
	1970	1990	1970	1990
North Africa and Middle East	65	81	14	35
Latin America and Caribbean	67	82	15	40
Sub – Saharan Africa	28	38	4	8
South Asia	39	53	12	25
East Asia and Pacific	51	82	25	45
All Developing Countries	52	76	18	33
Total served (in millions)	320	1,100	340	820

Source: "Rural Energy and Development – Improving Energy Supplies for two billion people, World Bank, 1996, Table 4.1, P.42.

Apart from helping to integrate the rural economies into modern national economies, rural electrification also promotes many structural changes in rural areas. The interest of world nations in rural electrification dates back to 1950s. Since, then rural electrification has been promoted as a major driving force for the development of the rural areas. In the 1960s and 70s, the rapid economic growth and improvements in the quality of rural life was made possible with increasing use of electricity for productive activities, modernization and other social changes. Domestic consumers also derive a significant improvement in their living conditions from rural electrification. Farmers and households have reported improved quality of lighting, greater security against crime and theft and protection from dangerous animals such as snakes[4]. Thus it is evident that rural areas often use electricity for purposes that are socially and economically valuable. As the World Bank observed, the rural areas do so often enough to justify investment in rural electrification from an economic perspective[5].

A shift from non-electric lighting sources to electric lighting sources provides the rural community with definite advantages. Table 3.2 presents a comparison of some non-electric and electric lamps, based on laboratory measurements. Lighting levels increase dramatically from candle to kerosene wick to kerosene mantle lamp, though with increased fuel consumption rates. However, a shift from kerosene to electric lighting results both in increased light output and reduced energy use rate. Energy saving potential of shifting from non-electric to electric lighting sources is discussed in 3.3(b).

Table 3.2

Comparison of Lumens of Non-Electric and Electric Lamps

Light source	Flux (Lumens)	Luminous efficiency (Lum/W)	Fuel Consumption (Kg/Klum-h)	Fuel.con Rate (Kg/h)
Candle	12	0.2	0.5	0.006
Kerosene wick	40	0.1	0.8	0.032
Kerosene Mantle	400	0.8	0.1	0.040
60W Incandescent	730	12.00	0.02	0.016
16W Compact Fluorescent	900	56.00	0.005	0.004

Source: Compiled from Table 2.5, "Energy End Use – An Environmentally sound development pathway", Asian Development bank, 1994, P.21

2. New and Renewable Energy Sources

Recent developments in renewable energy technologies have greatly added to the options available for improving rural energy supplies. The major technologies suited to rural areas are micro-hydro, biogas, wind generators, wind pumps, solar heaters for water heating, and sustainable ways to provide wood supplies. A more recent development has been the use of photovoltaic (PV) systems to provide electricity supplies for such small scale application as electric lights and domestic appliances. Apart from their environmental appeal, new and renewable energy technologies are attracting professional interest for several reasons, namely, the abundance of the solar resource, from which most forms of renewable energy are derived; technical progress and cost reductions; and the modularity of the technologies[6].

The concept of integrated rural energy systems has been proposed as a way of developing autonomous production of rural energy based on renewable sources. The merit of this concept is in developing indigenously produced, self-contained village energy systems operated with the aim of sustainability. This system encourages village participation in decision making process and stimulates development through increased use of locally produced energy[7].

New and renewable sources of energy are of great use at the household level. Simple technologies like improved cook stoves can have positive economic impact by reducing the energy use. There are other possible economic benefits such as improved family health, greater agricultural productivity, time saving and exposure to more advanced technology. While all these have important direct advantages for rural development, indirectly it may check migration of rural people to urban areas by providing better living conditions in the rural areas itself.

Of all the renewable energy sources, biomass (ligneous and herbaceous crops and agricultural and municipal wastes) is the largest, most diverse and most readily exploitable as far as the rural households are concerned. This necessitates promotion of more sustainable ways to supply biofuels. The possibilities for increasing biomass production through more sustainable ways such as agro-forestry, farm forestry and better forest management involving local participation are in active agenda of new and renewable energy programmes. Agro forestry and farm forestry entail planting of trees, shrubs and grasses on farmlands in alternating patterns with more traditional crops. This plays an important role in alleviating fuel wood shortages. Experiences also suggest that effective management (with the co-operation of local people) of existing forest resources reduce deforestation, at the same time provide enough fuel.

New and renewable energy technologies still account for less than two per cent of the primary energy supplies of developing countries, but in light of their promise, with good economic and environmental policies and with the development of the necessary support systems for installation and maintenance, their market shares should expand. However, the effective exploitation of the new renewable technologies requires a 'leveling of the playing field' - that is, eliminating tax, subsidy and import distortions that now discriminate against renewable in favour of fossil fuels. There should also be initiation of national surveys of wind and solar resources, promotion of credit schemes to help consumers meet the high first costs of such systems, developing private supply and service infrastructure and associated training and supporting of selected demonstration projects.

3.3(b) Conservation potential of rural energy sector

One of the characteristics of non-commercial fuels is their relatively low efficiency of use. The overall efficiency of conversion of wood, agricultural residue and dung is about five per cent as against the average efficiency of 20 per cent exhibited by commercial fuels[8]. Similarly the energy efficiency of lighting fuels used in rural areas is also relatively low. This provides ample scope for energy conservation in rural areas.

Conservation is possible either by improving the efficiency of the existing fuels and fuel using devices or by substituting inefficient fuels by efficient fuels.

1 Lighting fuels

Kerosene lamp and candles that are mostly used in rural areas for lighting are highly inefficient, when compared to electric sources. The most inefficient of the electric sources, the incandescent lamp, represents at a 50 to 100 – fold increases in energy efficiency relative to the kerosene wick lamp (See fig 3.2).

The fluorescent lamp, which is well suited to solar home systems, raises energy efficiency several hundred times. The quality of the light provided by electric incandescent or fluorescent bulbs is also vastly superior to that of kerosene.

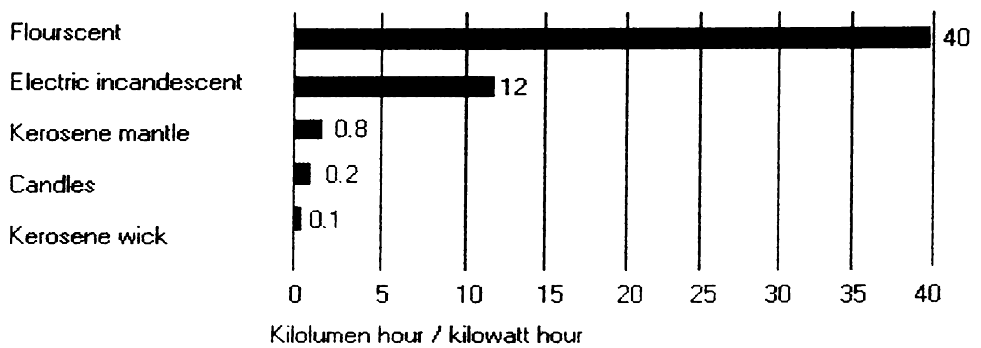
By an estimate of the Asian Development Bank,[9] a shift from kerosene to electric lightning results both in increased lightning output and reduced energy use rate. The light output increases from 40 to 730 lumens if kerosene wick lamp is replaced by a 60-watt incandescent bulb. An eight fold reduction in fuel use rate is seen if a kerosene lamp is replaced by a 16-watt compact fluorescent lamp (see table 3.2).

As kerosene and diesel are major fuel imports for many of the developing countries (and both are subsidized), significant fuel saving would result by electrifying all houses holds, even if the electricity was generated using diesel[10.] Electricity from sources other than the central grid like coal grids or renewable can also provide the necessary power.

2. Cooking Fuels

However, quickly modern energy spreads in developing countries, fuel wood, dung and agriculture residue will be used by tens of millions for decades to come. Given this and the fact that the enhancement of fuel supply through non-conventional sources has serious limitations, demand management is the remaining

Figure 3.2 Energy Efficiency and Lighting



Source : Rural Energy and Development - Improving Energy Supplies for Two Billion people, World Bank, 1996, P 43

Table 3.3
Efficiency and fuel consumption of stove/fuel combinations (based on water boiling and controlled cooking tests in Ungru, Karnataka, India)

Fuel	Stove	Efficiency[a] (WBT, %)	Specific fuel consumption[b] (Physical units/kgMj/kg)		Average cooking time (mins).
Biofuel stoves[c]					
Wood	3stone fire	15.6	217 g	3.34	101
	Traditional span	14.2	271 g	4.31	62
	ASTRA ole 3pan	33.2	141 g	2.24	62
	Swothee MS4	17.2	183 g	2.91	111
Charcoal	Traditional metal	32.2	95 g	2.38	N.A
Dung cake	Traditional 3-pan	11.1	304 g	4.00	N.A
Sawdust	IISc improved	30.4	253 g	4.02	N.A
Biogas	KVIC burner	45.1	0.05 m3	1.13	106
Other Stoves.					
Kerosene	Nutan	60.2	26.1 g	1.13	106
	Perfect	40.4	26.6 g	1.15	131
LPG	Superflame	60.4	20.1 g	0.91	76
Electricity	Hotplate	71.3	0.17 kWh	0.64	99

Notes: a The efficiency is the average of three water boiling tests, except for three stone fire and the ASTRA stove (two test each) **b** Specific fuel consumption is based on kg of cooked food, averaged over three meals in each case. The typical meal 1,102 g rice (+12,121 g water); 883 9 a millet, + 1,554 g water); 256 g cowpeas (legume, +2,463 g water); and 150 g vegetables mixed with cowpeas. **c** The stoves are described in the foot notes to table 9.11
Source: 'Energy End Use – An environmentally sound development pathway', Asian Development Bank, P.152.

alternative. On the demand side an effective strategy is the introduction of the improved choolah.

The fuel use in rural areas in developing countries for cooking is higher than that of many U.S households, since the energy is used inefficiently[11]. The wood fuel, for example, is burned either in open fire or in inefficient mud stoves. Only a small fraction of the heat of combustion actually serves the purpose as most of the heat escapes the cooking pot. Studies have shown that fire wood is the costliest fuel, if we take into account the efficiency of use and it is a paradox that the costly fuel is used by more the poor. The cost of producing one more unit of energy is higher than the cost of saving one unit and in this context, the fuel-efficient choolah has an important role[12]. Besides, improved choolahs help to reduce / delay de-forestation. Since choolah can be built much faster than biomass can be 'produced' through afforestation, improved stoves can delay deforestation and 'buy time' for other means to halt or slow down deforestation[13]. World Bank estimates that relatively simple and inexpensive improved stoves can reduce by as much as 30 per cent the amount of fuel needed for cooking, thus cutting the time needed to gather wood[14]. Moreover, because the improved choolah give off less smoke, they make the domestic environment less damaging to householders' health.

Table 3.3 provides a comparison of efficiency and fuel consumption of different stove-fuel combinations. It may be noted that in wood fueled choolas, 3-stone fire and traditional 3-pan choolas (which are usually used by rural households) are less efficient than Astra ole 3-pan or swosthee MS4 (which are improved choolahs). The relative efficiency of modern fuels like kerosene, LPG and electricity are also revealed in Table 3.3.

As revealed in table 3.3, considerable economies in fuel use can be achieved also by shifting to modern fuels from traditional fuels. This energy saving is due to the high efficiency of the modern fuels and their stoves.

3 Cooking Practices

Cooking practices of the households are equally important in energy use. They form an essential determinant in energy conservation apart from the nature of the fuel and stove. Cooking practices are related to the staple food, food preparation methods, vessels used, and awareness of the cook, culture and tradition. Crude estimates of energy saving associated with some cooking practices are discussed here[15].

It is evident that there is built-in economy in cooking larger quantities of food. Households can save energy if they reduce cooking sessions. Variations in variety of food materials profoundly influence the time taken for cooking (processing) and also fuel use. For instance, parboiled rice takes more time to cook than raw rice. Similarly a great deal of energy is wasted when excess water is used for cooking. Experiments have shown that double the quantity of water use for cooking rice lead to an increase of 65 per cent in fuel consumption. Similar instances are many in cooking practices and the responses of the cooks to these behaviors have been identified and analysed in chapter VI.

It is widely believe and commonly observed that fuel saving possibility are not practiced by the rural households. This hypothesis is examined and tested in a subsequent chapter. Hence, theoretically there is huge potential for energy saving at the rural households level. But whether these possibilities are acceptable to the rural masses depends on a number of complex issues.

3.4 Cooking Fuels and the Health problems

The environmental consequences of cooking system choice range from air pollution in the kitchen to outdoor air pollution, acid rain and global climate changes. Air pollutants from cooking fuels include particulates, carbon monoxide, nitrogen oxide, sulphur oxide and a variety of hydrocarbons. The quantity of each pollutant released by a cooking fuel is its emission factor (grams of pollutant per kg of fuel burnt), and depends on fuel type, and cook stove design and operation. The emission results in a concentration (mg/m3) of the pollutant in the air that depends on the kitchen size, ventilation and the emission factor. A person's exposure to the pollutant depends on the time spent in the kitchen during cooking.

The low energy efficiency of fuel and choolas used in the rural households results in long hours being spent by the cook in the kitchen. The poor ventilation of the rural kitchen adds to the health implications. Asian Development Bank (ADB) notes that concentration of total suspended particulate, benzopyrine, and other pollutants in rural kitchens of developing countries often exceed by large margins the ambient air quality standards of these pollutants in all countries. ADB further notes that series of epidemiological studies conducted in Napal demonstrated statistically significant relationships between domestic smoke exposure and chronic bronchitis and acute respiratory infection.[16]

3.5 Gender issues related to rural energy

Rural energy is essentially associated with gender issues due to the traditional division of labor in rural areas. In the rural households, cooking and fuel collection are the sole responsibility of women and children. Consequently rural energy problems have direct impact on women. This section briefly mentions the influence of rural energy problems on women and the related gender issues.

Observations and field studies in different parts of India and other developing countries corroborate the fact that a major part of the women's work is related to fuel collection and cooking. For instance, rural households surveys in India reveal that women spend 4 to 6 hours daily for fuel collection and cooking[17].

Long hours spent in kitchen for cooking with traditional fuels, exposes the user to smoke and related health problems. Smoke however has implications other than health related. Smoke depletes the kitchen environment, which keeps other family members away from the kitchen. Since women spend most of their time in kitchen, it reduces the interaction between family members. Smoke also causes soot on the walls, roofing, kitchen utensils etc, increasing the time and effort spent in cleaning the utensils.

Cooking energy also determines a woman's nutritional level and that of her family. Scarcity of cooking fuels often forces woman to reduce the energy use for cooking which may result in fewer meals being prepared. Given the rural tradition that woman eat only after meeting the food requirements of other family members, they are the final sufferers.

Fuel scarcity also place increased pressure on woman. When firewood is scarce, woman either have to walk long distance to collect fuel, or substitute fuel wood with less efficient fuels. Both of these have negative health implications.

Studies reveal that woman's start cooking at one age as early as 13 years[18], and fuel collection even earlier. The gender divisions of labour, thus not only influence the life of adult woman, but also are responsible for prorogating female illiteracy.

Hence a woman in poverty has low access to cooking fuel, spends the longest time obtaining it and puts it to use in stoves that are not only fuel inefficient, but also exposes the user to serious diseases.

The gender dimensions of the rural energy problem stems from the fact that men, who control resources, are not directly affected by these problems and hence they are unlikely to take initiative in solving them. Men control both income (with which fuel has to be purchased) and land resources (from where fuel can be collected.); thus controlling the accessibility of woman to desired fuels. Studies reveal that one major criterion for fuel substitution is the degree to which access to sufficient resources for the household is dependent on a woman's subordination to a male[19].

The practice in the rural households is that husbands give their wives cash allowance with which woman is expected to purchase sufficient food and fuel. It may not be necessary that husband will raise this allowance when fuel prices is at a rise. Similarly it is also important as to who makes household decisions on items such as cooking fuels and stoves. As in most cases, if such decisions are solely that of the husband's, woman's requirement of efficient stoves (for e.g: smokeless choolah) and better vessels (for e.g. replacing mud with aluminum) are unlikely to be met. Similarly, kitchen design done without consulting women are likely to result in poorly ventilated kitchen and inconvenient cooking places.

Thus, if woman must negotiate for money to buy food and fuel, then rising fuel and stove price represent increased demand on male controlled income, which are unlikely to be met[20]

References

1 Giriappa .S (Ed), " Rural Energy Crisis", Himalaya Publishing House, New Delhi, 1986, P.124.

2 It was with this publication [Eric Eckholm, 'The other Energy crisis: Fire wood], Energy in the developing world – the real energy crisis, Oxford University Press, London, 1980,that the world became aware of the rural energy crisis.

3 Hardin .G, ' The tragedy of the commons', Science, Vol. 162, December 1968, PP 1243 –1248.

4 Mohan Mun Asinghe , "Rural electrification for development", west view press London,1987, P.10.

5 "Rural energy and development – Improving Energy supplies for two Billion

people", World Bank, 1996, PP 43 – 44.

6 Ibid. P 58.

7 Shearer.W, ' Integrated rural energy system', Vol. II, No.1, United Nations University, Tokyo, 1984, P.2.

8 OP.Cit.Ref.4, P.21.

9 'Energy End Use – An environmentally sound development pathway', Asian Development Bank, 1994, P.20.

10 Ibid.

11 Sudhakaran.M.N, Diffusion of improved chulahs – a study with reference to Kerala', M.Phil Thesis (unpublished) JNU, 1991.

12 Reddy.A.K.N, ' India: The emerging challenges – energy for development", paper presented at the National Seminar at ISEC in Oct 5 – 7, 1988.

13 op.cit Ref 9, P.160.

14 op.cit Ref 5, P.7

15 Adapted from Srala Gopalan, 'Domestic Fuels and device for cooking – practices, problems, policies and perceptiveness', Ph.D. thesis (unpublished) IIT, Delhi, 1989, PP 119 –121, 214.

16 op.cit. Ref 9, PP 161 – 166.

17 Padma Vasudevan, ' Women involvement as kitchen managers and stove users', in Report No.GCP/RAS/131/NET of Regional Wood Energy Development Program in Asia , FAD, June 1991, P.203.

18 Saritha Batliwala, ' Women and Cooking energy', Economic and Political Weekly, Dec 24 – 31, 1982, P 2227.

19 Jhon.R.Campbell, 'Urban household perceptions and energy use', Lund University, Sweden, Memorandum, 1992 M.6, 1002 P.16.

20 Ibid. P 35.

CHAPTER IV

RURAL ENERGY CONSUMPTION PATTERN IN KERALA

In rural areas that are diverse in natural endowment and social structure, knowledge of the energy consumption pattern and its behavior across geo-climatic and socio-economic clusters is a pre requisite for sound policy formulation. This chapter and the succeeding chapters serve this purpose. In the present chapter, an attempt is made to understand the nature of rural household energy consumption at the aggregate level and also to examine the inter regional variations.

4.1 Profile of the sample Villages

Household energy consumption is a part of an integrated system, where social and economic behavior of the community and the accessibility to natural resources play a crucial role. The energy consumption pattern varies from region to region depending on the composition of this system. To conceive these variations, the present study selected four villages belonging to eco-agiculturaly and geo-climatically different regions in Kerala. The villages are Pallipuram (Study area I) in Ernakulam district, Mundathicode (Study area II) and Mattathur (Study area III) in Trichur district and Kottayi (Study area IV) in Palakkad district.

4.1 (a) Pallipuram

Pallipuram panchayath is a coastal village situated in Ernakulam district. The panchayat is bordered by the Arabian Sea on the west and the Periyar River (the widest river in Kerala) on the north. The cropping pattern of the panchayath consists of coconut, paddy and arecanut. The occupational pattern of the village is composed of fishing, fish processing and sale, agriculture, toddy tapping, coir weaving and handloom.

4.1 (b) Mundathicode

Mundathicode panchayath is a typical midland area situated in Trichur district. Major crops in the panchayath are coconut, arecanut, paddy and plantain. The occupational structure of the panchayath consists of agriculture, mining, cottage industries and construction works.

4.1 (c) Mattathur

Mattathur panchayath of Trichur district is situated in the vicinity of reserve forest. In fact, 42.53 per cent of the total area of the panchayath is forestland. The panchayath is bordered on the north by reserve forest and on the south by "Kodassery" hill (the tallest hill in the Trichur district), which is a part of the Annamalai mountain range of the Western Ghats. The cropping pattern of the panchayath consists of rubber, cashew, tapioca, coconut, arecanut, paddy, plantain and spices.

4.1 (d) Kottayi

Kottai panchayath belongs to the Palakkad district, which is known as 'Kerala's rice bowl'. This typical agricultural village is surrounded on the north and east by Bharathapuzha (Kerala's longest river). The cropping pattern of the panchayath is dominated by paddy, followed by vegetables, sweet potato, tapioca, coconut, ginger, plantain and rubber. Major sources of employment in the panchayath include agriculture, small scale and cottage industries.

4.2 Major Socio-economic indicators of the sample population

The key socio-economic characteristics of the sample households is discussed here. Table 4.1 shows the distribution of the sample population spread across the four sample villages. The table reveals that the sex ratio is in favor of women in all the study areas, with a slight variation in study area SA IV. The table also provides information on the average household size, which varies from 4.97 in SA II to 5.40 in SA I.

The distribution of the sample population by household sizes is given in Table 4.2.It can be seen that the dominant household sizes in the study area are either 4 or 5.Table 4.3 shows the distribution of the households according to the educational status of members.

Table 4.1
Distribution of the sample population

Study Area	No. of HH	Population details Male	Female	Children under 14	Total	Ratio of female to male	Average HH size
I (Pallipuram)	75	159	162	84	405	1.02	5.40
II (Mundathikode)	75	147	152	74	373	1.03	4.97
III (Mattathur)	75	159	168	69	396	1.05	5.28
IV (Kottayi)	75	156	154	72	382	0.99	5.09
ALL	300	621	636	299	1556	1.02	5.19

Source: Primary survey
Note: HH = Household

Table 4.2
Distribution of sample population by household size (actual)

Household Size	No of households in study areas I	Percentage	II	Percentage	III	Percentage	IV	Percentage	All	Percentage
2	0	0.00	8	10.66	3	4.00	5	6.66	21	7.00
3	11	14.66	9	12.00	8	10.66	9	12.00	37	12.33
4	20	26.66	15	20.00	18	24.00	15	20.00	68	22.66
5	18	24.00	19	25.33	17	22.66	19	25.33	73	24.33
6	8	10.66	8	10.66	11	14.66	12	16.00	39	13.00
7	5	6.66	8	10.66	9	12.00	9	12.00	30	10.00
8	5	6.66	3	4.00	4	5.33	2	2.66	12	4.00
9	4	5.33	3	4.00	3	4.00	2	2.66	10	3.33
10 & above	4	5.33	2	2.66	2	2.66	2	2.66	10	3.33

Source: Primary survey

Table 4.3
Distribution of households by educational status of members

Educational status	Study areas I	II	III	IV
Primary	42 (10.88)	28 (7.71)	39 (10.18)	47 (12.81)
Secondary	107 (27.72)	67 (18.46)	79 (20.63)	111 (30.25)
High school	134 (34.72)	118 (32.51)	130 (33.94)	116 (31.61)
SSLC/PDC	65 (16.84)	91 (25.07)	86 (22.45)	57 (15.53)
Degree/Diploma	24 (6.22)	41 (11.29)	34 (8.88)	19 (5.18)
PG/Professional degree	5 (1.30)	14 (3.86)	9 (2.35)	6 (1.63)

Note: 1) Figures in brackets show percentages to total 2) Children under 6 and illiterate are excluded 3) SA = Study area.

It may be interesting to note that in all the study areas maximum number of people are under the 'high school' category, though in SA I and SA IV 'secondary' category is also equally important.

The occupational status of the members of the sample household is presented in Table 4.4. The most important occupational group is 'other casual labours' (mainly in the construction sector) in SA I and SA II and agricultural labourers in SA II and SA IV. Fishing and related activities are the other important avenues of employment in SA I.

The distribution of the sample households by monthly income is presented in Table 4.5. In study areas I and IV, the maximum number of households are in income category 1000-2000 and in study area II and III it is in the income category 2000-3000.

A description of the sample population by size of holding is given in Table 4.6. It may be noted that in all the study areas the prominent land holding category is 1-2 acres, with the exception of study area IV where it is less than 1 acre.

4.3 Energy consumption pattern of the rural household- the aggregate scenario

Table 4.7 presents the energy consumption pattern of the sample households for a period of one month, at an aggregate level.

Table 4.4
Distribution of households by occupational status of members

Occupation	Study areas I	II	III	IV
Farmers	12 (7.14)	23 (13.07)	18 (11.04)	31 (20.53)
Agricultural labors	33 (19.84)	41 (23.30)	56 (34.36)	72 (47.68)
Other casual labors	51 (30.36)	43 (24.43)	32 (19.36)	16 (10.60)
Traders	18 (10.71)	23 (13.07)	13 (7.98)	10 (6.62)
Cottage industries	9 (5.36)	17 (9.66)	14 (8.59)	6 (3.97)
Service sector	14 (8.33)	21 (11.93)	16 (9.82)	9 (5.96)
Others	31* (18.45)	8 (4.55)	14 (8.59)	7 (4.64)
All	168 (100.00)	176 (100.00)	163 (100.00)	151 (100.00)

*23 persons (13.69 percent) in this category in SA I are engaged in fishing and related jobs
Note: Figures in brackets show percentage

Table 4.5
Distribution of the sample households by monthly income

Monthly income (In Rs.)	No of house holds in study areas SA I	SA II	SA III	SA IV	ALL
Less than 1000	14 (18.67)	8 (10.66)	12 (16.00)	17 (22.66)	51 (17.00)
1000-2000	26 (34.67)	23 (30.67)	19 (25.33)	27 (36.00)	95 (31.67)
2000-3000	22 (29.33)	30 (40.00)	25 (33.33)	15 (20.00)	92 (30.66)
3000-4000	6 (8.00)	7 (9.33)	9 (12.00)	8 (10.67)	30 (10.00)
4000-5000	5 (6.67)	4 (5.33)	6 (8.00)	4 (5.33)	19 (6.33)
5000 and above	2 (2.67)	3 (4.00)	4 (5.33)	4 (5.33)	13 (4.33)
ALL	75 (100.00)	75 (100.00)	75 (100.00)	75 (100.00)	300 (100.00)

Note : Figures in brackets show percentages to total
Source : Primary Survey

Table 4.6
Distribution of sample population by size of holding

Land holding size (in acres)	No of households in the study area I	Percentage	II	Percentage	III	Percentage	IV	Percentage	All	percentage
Less than 1	28	37.33	15	20.00	18	24.00	21	28.00	82	27.33
1-2	18	24.00	21	28.00	17	22.66	13	17.33	69	23.00
2-3	8	10.66	13	17.33	10	13.33	11	14.66	42	14.00
3-4	6	8.00	9	12.00	5	6.66	8	10.66	28	9.33
4-5	3	4.00	4	5.33	2	2.66	3	4.00	12	4.00
5-6	4	5.33	3	4.00	2	2.66	2	2.66	12	4.00
6-7	2	2.66	3	4.00	3	4.00	3	4.00	11	3.66
7-8	1	1.33	2	2.66	3	4.00	2	2.66	8	2.66
8-9	2	2.66	1	1.33	2	2.66	2	2.66	7	2.33
9-10	-	0.00	-	0.00	3	4.00	2	2.66	5	1.67
10-11	-	0.00	1	1.33	2	2.66	-	0.00	3	1.00
11-12	-	0.00	-	0.00	1	1.33	1	1.33	2	0.66
12-13	1	1.33	-	0.00	-	0.00	1	1.33	2	0.66
13-14	-	0.00	-	0.00	1	1.33	1	1.33	2	0.66
14-15	-	0.00	-	0.00	1	1.33	1	1.33	2	0.66
15 & above	1	1.33	1	1.33	4	5.33	3	4.00	9	3.00
Rented	1	1.33	2	2.66	1	1.33	-	0.00	4	1.33
All	75	100.00	75	100.00	75	100.00	75	100.00	300	100.00

Source : Primary survey

It can be observed from Table 4.7 that the aggregate energy consumption of the sample households amount to 299680.58 10^{3} K.Cal, of which 260631.86 10^{3} K.Cal (86.97 per cent) is contributed by non-commercial fuels and 39048.72 10^{3} K.Cal (10.03 per cent) commercial fuels. Evidently, non-commercial fuels dominate energy sources used in rural areas.

Among the non-commercial fuels, firewood (121748.96 10^{3} K.Cal) is the most important source of energy (46.71 per cent) and in fact, it is the single largest source of energy in the rural areas (40.63 per cent). Coconut residue, consisting of coconut leaf, spathe, shell and husk, contributes 92452.50 10^{3} K.Cal of energy, which accounts to 35.47 per cent of the non-commercial sources and 30.85 per cent of all the fuels. It is interesting to note that, these two fuels taken together contribute 71.48 per cent of all the energy requirements of the rural households. Sawdust (4.77 per cent of the non-commercial sources), bio gas[1] (3.36 per cent) and 'others' (9.17 per cent) are the other non-commercial sources. 'Others', include fuels like twigs, leaves, areacnut residue, tapioca residue, rubber seed and other agricultural residues. It is interesting to note that 'others' consisting of these miscellaneous fuels, though is contributing only 7.98 per cent, is the third single largest source of energy.

As evident from Table 4.7, commercial energy sources have only a limited influence over the rural household energy scenario. Kerosene amounting to 14904.00 10^{3} K.Cal (38.17 per cent) and electricity amounting to 13084.04 10^{3} K.Cal (13.50 per cent) are the most important commercial fuels in rural areas. However, the share of these fuels in aggregate is only 4.97 per cent for kerosene and 4.37 per cent for electricity. Other commercial sources are LPG (10.01 per cent) and 'others' (18.31 per cent). 'Others' include petrol and diesel used by the households for domestic transportation. Table 4.7 also presents information on the mode of procurement of the fuel material. It is interesting to note that the share of the fuels purchased (49.64 per cent) and collected (50.36 per cent) are almost equal for the sample households. This perhaps is due to the increased commercialization of the rural fuel transactions. However, when the non-commercial fuels alone are considered, the proportion of collected fuels (57.91 per cent) is greater than the purchased fuels (42.09 per cent). Firewood (53.82 per cent) is the mostly purchased fuel and coconut residue (72.91 per cent) and 'others' (72.08 per cent) are the mostly collected fuels.

Table 4.7 further reveals information on the major energy end uses in rural households. The major end uses are cooking, lighting, water heating and domestic transportation. Lighting also includes energy demanded for fans, radios and other household appliances [2]. In the present study, these end uses have been clubbed to two, viz., cooking and 'lighting and others'. 'Lighting and others' include the energy used for water heating for domestic purposes (in non-commercial category) and for lighting and household transportation (in commercial category). It can be observed from Table 4.7 that the amount of energy used for cooking is as high as 252010.68 10^3 K.Cal (84.09 per cent) of the total energy use. The dominance of cooking as an end use is more prominent in the case of non-commercial fuels (64.43 per cent). However, this trend is reversed when only the commercial fuels are considered. For the commercial fuels, as much as 63.39 per cent is used for 'lighting and others'. Hence it is inferred that cooking fuels in the rural households is still dominated by non-commercial fuels.

Among the cooking fuels, firewood (45.64 per cent) is the most important source of energy. Interestingly, LPG meets only 1.55 per cent of the cooking energy demand. This reveals that LPG, which is the favorite cooking fuel of the urban dwellers, is yet to become popular in rural areas. It may be noted that none of the sample households used electricity for cooking.

Table 4.7

Energy consumption pattern of the sample households in 10^3 Kcal for one month.

Fuel Type	Total quantity	Per H.H Qty	Per Capita Qty	Mode of procurement: Quantity purchased	Mode of procurement: Quantity collected	End use: Quantity used for Cooking	End use: Quantity used for Lightning &Others
Fire Wood	121748.96 A (46.71) (40.63) B	442.72	85.08	65524.92 C (53.82) (44.05) D	56224.04 (46.18) (37.25)	114938.60 (94.41) (45.64)	6810.36 (5.59) (14.29)
Coconut Residue	92452.50 (35.47) (30.85)	343.69	67.48	25042.50 (27.09) (16.83)	67410.00 (72.91) (44.67)	81130.00 (87.75) (32.19)	11322.50 (12.25) (23.75)
Saw Dust	12453.00 (4.77) (4.16)	249.06	41.65	12453.00 (100.00) (8.37)	0.00 (0.00) (0.00)	12306.00 (98.82) (4.88)	147.00 (1.18) (0.31)
Bio Gas	10067.40 (3.36) (3.36)	2516.85	402.70	0.00 (0.00) (0.00)	10067.40 (100.00) (6.67)	10067.40 (100.00) (3.99)	0.00 (0.00) (0.00)
Others	23910.00 (9.17) (7.98)	181.14	35.24	6690.00 (27.98) (4.50)	17220.00 (72.08) (11.41)	200555.00 (83.88) (7.96)	3855.00 (16.12) (8.09)
All Non Comm	260631.86 (100.00) (86.97)	874.60	171.92	109710.42 (42.09) (73.75)	150921.44 (57.91) (100.00)	238497.00 (91.51) (94.64)	22134.86 (8.49) (46.43)
Kerosene	14904.00 (38.17) (4.97)	79.28	15.66	14904.00 (100.00) (10.02)	0.00 (0.00) (0.00)	9603.00 (64.43) (3.81)	5301.00 (35.57) (11.12)
LPG	3910.68 (10.01) (1.30)	122.21	21.85	3910.68 (100.00) (2.63)	0.00 (0.00) (0.00)	3910.68 (100.00) (1.55)	0.00 (0.00) (0.00)
Electricity	13084.04 (33.50) (4.37)	46.90	9.07	13084.04 (100.00) (8.80)	0.00 (0.00) (0.00)	0.00 (0.00) (0.00)	13084.04 (100.00) (27.45)
Others	7150.00 (18.31) (2.36)	193.24	35.22	7150.00 (100.00) (4.81)	0.00 (0.00) (0.00)	0.00 (0.00) (0.00)	7150.00 (100.00) (15.00)
All Commercial	39048.72 (100.00) (13.03)	130.16	25.61	39048.72 (100.00) (26.25)	0.00 (0.00) (2.41)	13513.68 (34.61) (5.36)	25535.04 (63.39) (53.57)
All	299680.58 -- (100.00)	998.94	192.61	148759.14 (49.64) (100.00)	150921.44 (50.36) (100.00)	252010.68 (84.09) (100.00)	47669.90 (15.91) (100.00)

Note: Figures in brackets shows percentages, A = Percentage of the total commercial / Non-commercial as applicable, B = Percentage of that fuel to the total quantity of all fuels. C = Collected / purchased or cooking / lightning as a percentage of total, D = Collected / purchased or cooking / lightning as a percentage of the respective total.

Source: Primary survey (Compiled from Tables 4.8, 4.9, 4.11 and 4.14).

Out of the fuels used for 'lighting and others', the most important non-commercial source is coconut residue (23.75 per cent) and commercial source is electricity (27.45 per cent).

When the fuels are considered individually, a major share of all fuels, except kerosene (share in cooking 64.43 per cent) and electricity (share in cooking 0.00 per cent) are used for cooking. For instance, 94.41 per cent of firewood, 87.75 per cent of coconut residue and 83.88 per cent of 'others' is used for cooking (Table 4.7).

From the forgoing trends the following inferences may be drawn regarding the pattern of energy consumption at the household level in rural Kerala. The household energy scene is dominated by non-commercial sources of energy, which contributes 86.97 per cent of the total energy demand. These non-commercial sources are mostly used for cooking (91.51 per cent). The most important use of commercial fuels is for lightning. 63.39 per cent of all the commercial fuels are used for this purpose. Firewood is the most important fuel in the rural areas. It provides nearly half of the energy requirements (40.63 per cent) of the rural households. Reasonably high per household and per capita figures for firewood provides further evidence for this. Among the commercial sources, kerosene is the single largest source of energy contributing 38.17

per cent. The dominant mode of procurement in the rural areas is fuel collection where 50.36 per cent of all the energy and 57.91 per cent of all the non-commercial fuels are collected. Coconut residue and 'others' are the mostly collected fuels. Cooking is the most important end use in rural areas, consuming about 84 per cent of the energy. Firewood is the most important cooking fuel. The use of LPG is limited to 1.55 per cent of the households and none of the households use electricity for cooking. For the end use of 'lighting and others', commercial sources are mostly used. Kerosene is the most important fuel in this category.

4.4 Household energy consumption pattern across geo-climatic regions

In this section, a break-up of the aggregate scenario presented previously is given, so as to examine the inter village variations in energy consumption (Table 4.8).

(a) Total quantity

In SA I (Pallipuram) the total energy use is 71495.42 10^3 K.Cal, of which 61943.78 10^3 K.Cal (86.64 Per cent) is contributed by the non-commercial sources and 9551.64 10^3 K.Cal (13.36 Per cent) by the commercial sources. Coconut residue contributing 32357.50 103 K.Cal of energy (45.26 per cent) and consumed by 93.33 per cent of the households, is the single largest source of

Table 4.8

Energy consumption pattern of the sample households in the study areas in 10^3 K.Cal, for one month

Study areas	SA I		SA II		SA III		SA IV		ALL	
Fuel type	No	Qty	No	Qty	No	Qty	No	Qty	No	Qty
1.Fire wood	69 (92.00)*	22194.28 (31.04)	68 (90.67)	30833.96 (41.71)	71 (94.67)	42801.68 (52.09)	67 (89.33)	25919.04 (35.95)	275 (91.67)	121748.96 (40.63)
2.Coconut Residue	70 (93.33)	32357.50 (45.26)	68 (90.67)	20212.50 (27.34)	64 (85.33)	18375.00 (22.36)	67 (89.33)	21507.50 (29.83)	269 (89.67)	92452.50 (30.85)
3.Saw Dust	17 (22.67)	4452.00 (6.23)	17 (22.67)	3948.00 (5.34)	5 (6.67)	1197.00 (1.46)	11 (14.67)	2856.00 (3.96)	50 (16.67)	12453.00 (4.16)
4.Biogas	0 (0.00)	0.00 (0.00)	1 (1.33)	2961.00 (4.01)	1 (1.33)	1974.00 (2.40)	2 (2.67)	5132.40 (7.12)	4 (1.33)	10067.40 (3.36)
5.Others	17 (22.67)	2940.00 (4.11)	32 (42.67)	5385.00 (7.28)	35 (46.67)	7395.00 (9.00)	48 (64.00)	8190.00 (11.36)	132 (44.00)	23910.00 (7.98)
6.All Non Commercial	73 (97.33)	61943.78 (86.64)	75 (100.00)	63340.46 (85.68)	75 (100.00)	71742.68 (87.31)	75 (100.00)	63604.94 (88.23)	298 (99.33)	260631.86 (86.97)
7.Kerosene	47 (62.67)	4419.00 (6.18)	50 (66.67)	3942.00 (5.33)	46 (61.33)	3879.00 (4.72)	45 (60.00)	2664.00 (3.70)	188 (62.67)	14904.00 (4.97)
8.LPG	7 (9.33)	1035.18 (1.45)	8 (10.67)	958.50 (1.30)	10 (13.33)	1111.86 (1.35)	7 (9.33)	805.14 (1.12)	32 (10.67)	3910.68 (1.30)
9.Electricity	70 (93.33)	2847.46 (3.98)	71 (94.67)	3485.58 (4.71)	69 (92.00)	3285.20 (4.00)	69 (92.00)	3465.80 (4.81)	279 (93.00)	13084.04 (4.37)
10.Others	8 (10.67)	1250.00 (1.75)	12 (16.00)	2200.00 (2.98)	10 (13.33)	2150.00 (2.62)	7 (9.33)	1550.00 (2.15)	37 (12.33)	7150.00 (2.36)
11.All Commercial	75 (100.00)	9551.64 (13.36)	75 (100.00)	10586.08 (14.32)	75 (100.00)	10426.06 (12.69)	75 (100.00)	8484.94 (11.77)	300 (100.00)	39048.72 (13.03)
12 All	75 (100.00)	71495.42 (100.00)	75 (100.00)	73926.54 (100.00)	75 (100.00)	82168.74 (100.00)	75 (100.00)	72089.88 (100.00)	300 (100.00)	299680.58 (100.00)

Source: Primary survey.

Note: 1) Figures in bracket show percent to total, 2) *Percent to total number of households (75) energy in the study area. Firewood (22194.28 10^3 K.Cal, 31.04 per cent) and kerosene (4419. 10^3 K.Cal, 6.18 per cent) are the other important energy sources.

In SA II (Mundathicode), the aggregate energy use is 73926.54 10^3 K.Cal, of which 63340.46 10^3 K.Cal (85.68 per cent) is contributed by non-commercial sources and 10586.08 10^3 K.Cal (14.32 per cent) by commercial sources. Firewood contributing 30833.96 10^3 K.Cal (41.71 per cent) is the most important single source of energy in SA II. Coconut residue (21212.50 10^3 K.Cal, 27.34 per cent) 'others' (5385 10^3 K.Cal, 7.28 per cent), sawdust (3948 10^3 K.Cal, 5.34 per cent) and kerosene (3942 10^3 K.Cal, 5.33 per cent) are the other important sources.

In SA III (Mattathur), the total energy consumption is equal to 82168.74 10^3 K.Cal and is composed of 71742.68 10^3 K.Cal (87.31 per cent) of non-commercial sources and 10426.06 10^3 K.Cal (12.69 per cent) of commercial sources. It may be noted that firewood, the single largest source of energy meets more than fifty per cent (52.09 per cent) of the energy needs of the study area. Coconut residue is also used in sizable quantity (22.36 per cent)

In SA IV (Kottayi), the aggregate energy use is 72089.88 10^3 K.Cal, of which 63604.94 10^3 K.Cal, (88.23 per cent) is non-commercial sources and 8484.94 10^3 K.Cal (11.77 per cent) is commercial sources. Firewood contributing 35.95 per cent continuos to be the single largest source, but is closely followed by coconut residue which contributes 29.83 per cent. 'Others' (11.36 per cent) and bio gas (7.12 per cent) are the other important fuels.

Table 4.9 presents information on energy consumption in terms of per cpaita and per household figures. The major trends are the following. It may be observed from Table 4.9 that the general trend is in agreement with what was presented in Table 4.8. For instance, the highest per household and per capita energy consumption is in SA III and the lowest in SA I. Similar trend is exhibited when the non-commercial fuels alone are considered. However, when the commercial fuels are considered separately, the highest per capita consumption is in SA II and lowest is in SA IV. The probable reasons for these trends may be the development profile of these villages.

Table 4.10 shows the energy consumption pattern by the proportion of different fuels used. The 4.10 also confirms the general trends revealed in Table 4.8. Table 4.10 provides additional information on the proportion of the individual fuels across the study areas. From Table 4.10, it may be noted that the proportion of non-commercial fuels is the highest in SA III and the lowest in SA I. Among the non-commercial fuels, for firewood, the highest

Table 4.9

Per household and per capita energy consumed by the sample house holds (in 10^3 K.cal)

Study areas	SA I		SA II		SA III		SA IV		ALL	
Energy Type	Per HH	Per Capita	Per HH	Per Capita	Per HH	Per Capita	Per HH	Per Capita	Per HH	Per Capita
Firewood	321.66	58.87	453.44	88.86	602.84	112.64	386.85	73.65	442.72	85.08
Coconut Residue	462.25	84.71	297.24	60.34	287.11	53.42	321.01	63.26	343.69	67.48
Saw Dust	261.88	40.11	232.24	39.09	239.40	41.28	259.64	44.63	249.06	41.65
Bio Gas	0.00	0.00	2961.00	592.20	1974.00	329.00	2566.20	366.60	2516.85	402.70
Others	172.94	30.95	168.28	31.68	211.29	40.63	170.63	33.98	181.14	35.42
Non Commercial	848.54	156.42	844.51	169.81	956.57	181.17	848.07	166.51	874.60	171.92
Kerosene	94.02	16.80	78.84	16.99	84.33	16.30	59.02	11.58	79.28	15.66
LPG	147.88	31.37	119.18	23.38	111.19	17.93	115.02	18.72	122.21	21.85
Electricity	40.68	7.61	49.09	9.66	47.61	8.83	50.23	9.60	46.90	9.07
Others	156.25	29.07	183.33	34.92	215.00	38.39	221.43	37.80	193.24	35.22
All Commercial	127.36	23.58	141.15	28.38	139.01	26.33	113.13	22.21	130.16	25.61
All	953.27	176.53	985.69	198.19	1095.58	207.50	961.20	188.72	998.94	192.61

Source : Primary survey

Note : 1) Per HH = Per household

2) Only user households are considered in calculating per household and per capita

Table 4.10

Energy consumption pattern by the proportion of different fuels used (in 10^3 K.Cal)

Fuel type	Study area SA I		SA II		SA III		SA IV		ALL	
	No	Qty	No	Qty	No	Qty	No	Qty	No	Qty
1.Fire wood	25.09	18.23	24.73	25.33	25.82	35.16	24.36	21.29	100.00	100.00
2.Coconut Residue	26.02	35.00	25.28	21.86	23.79	19.88	24.91	23.26	100.00	100.00
3.Saw Dust	34.00	34.75	34.00	31.70	10.00	9.61	22.00	22.93	100.00	100.00
4.Biogas	0.00	0.00	25.00	29.41	25.00	19.61	50.00	50.98	100.00	100.00
5.Others	12.88	12.30	24.24	22.52	26.52	30.93	36.36	34.25	100.00	100.00
6.All Non Commercial	24.50	23.77	25.17	24.30	25.17	27.53	24.17	24.40	100.00	100.00
7.Kerosene	25.00	29.65	26.60	26.45	24.47	26.03	23.94	17.87	100.00	100.00
8.LPG	21.88	26.47	25.00	24.51	31.25	28.43	21.88	20.59	100.00	100.00
9.Electricity	25.09	21.76	25.45	26.64	24.73	25.11	24.73	26.49	100.00	100.00
10.Others	21.62	17.48	32.43	30.77	27.03	30.07	18.92	21.68	100.00	100.00
11.All Commercial	25.00	24.46	25.00	27.11	25.00	26.70	25.00	21.73	100.00	100.00
All	25.00	23.86	25.00	24.67	25.00	27.42	25.00	24.06	100.00	100.00

Source: Based on Table 4.8

Note: Qty = Quantity.

proportion is in SA III and the lowest in SA I. For coconut residue and sawdust, the highest share is in SA I and the lowest in SA III. For 'others the highest proportion is in SA IV and the lowest in SA I. When all the commercial fuels are considered, the proportion is the highest in SA II and the lowest in SA IV. Among the commercial fuels, for kerosene the highest proportion is in SA I and the lowest in SA IV. Interestingly, the highest proportion of LPG consumption is in SA III, where the proportion of all non-commercial fuels is also the highest. Two causes may be identified for this phenomenon. First, as evident from Table 4.6, study area III has the highest proportion of larger size of holdings. This implies that the availability of 'home produced' non-commercial fuels will be higher and consequently their consumption. Secondly, in SA III has a relatively higher proportion of higher income groups. Naturally, higher affordability of expensive commercial fuels like LPG (see Table 4.5). For electricity, the highest share is in SA II and the lowest is in SA I.

(b) Mode of procurement

Mode of procurement of energy material can vary across the regions. Energy consumption pattern of the sample households by the mode of procurement of the fuel material in each of the study areas is presented in Table 4.11 and 4.12.

Table 4.11

Energy Consumption pattern by the mode of procurement of the fuel material (in 10^3 K.Cal).

Study areas	SA I		SA II		SA III		SA IV		ALL	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	14083.56 (63.46)	8110.72 (36.54)	19417.20 (62.97)	11416.72 (37.03)	18712.00 (43.72)	24089.70 (56.28)	13312.16 (51.36)	12606.90 (48.64)	65524.92 (53.82)	56224.04 (46.18)
Coconut Residue	13335.00 (41.21)	19022.50 (58.79)	4182.50 (20.69)	16030.00 (79.31)	1785.00 (9.71)	16590.00 (90.29)	5740.00 (26.69)	15767.50 (73.31)	25042.50 (27.09)	67410.00 (72.91)
Saw Dust	4452.00 (100.00)	0.00 (0.00)	3948.00 (100.00)	0.00 (0.00)	1197.00 (100.00)	0.00 (0.00)	2856.00 (100.00)	0.00 (0.00)	12453.00 (100.00)	0.00. (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)	5132.40 (100.00)	0.00 (0.00)	10067.40 (100.00)
Others	1890.00 (64.29)	1050.00 (35.71)	2520.00 (46.80)	2865.00 (53.20)	930.00 (12.58)	6465.00 (87.42)	1350.00 (16.48)	6840.00 (83.52)	6690.00 (27.98)	17220.00 (72.08)
All Non Comm	33760.60 (54.50)	28183.22 (45.50)	30067.70 (47.47)	33272.72 (52.53)	22623.96 (31.53)	49118.72 (68.47)	23258.16 (36.57)	40346.80 (63.43)	109710.42, (42.09)	150921.44 (57.91)
All Commercial	9551.64 (100.00)	0.00 (0.00)	10586.08 (100.00)	0.00 (0.00)	10426.10 (100.00)	0.00 (0.00)	8484.94 (100.00)	0.00 (0.00)	39048.72 (100.00)	0.00 (0.00)
All	43312.20 (60.58)	28183.22 (39.42)	40653.80 (54.99)	33272.72 (45.01)	33050.00 (40.22)	49118.70 (59.78)	31743.10 (44.03)	40348.80 (55.97)	148759.14 (49.64)	150921.44 (50.36)

Note: Figures in bracket show percentages to total

Table 4.12

Energy Consumption pattern by the mode of procurement of the fuel material-according to share in each mode (in 10^3KCal)

Study areas	SA I		SA II		SA III		SA IV		ALL	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	purchased	Collected
Fire Wood	14083.56	8110.72	19417.20	11416.72	18712.00	24089.70	13312.16	12606.90	65524.92	56224.04
	(32.52)	(28.78)	(47.76)	(34.31)	(56.62)	(49.04)	(41.94)	(31.25)	(44.05)	(37.25)
Coconut Residue	13335.00	19022.50	4182.50	16030.00	1785.00	16590.00	5740.00	15767.50	25042.50	67410.00
	(30.79)	(67.50)	(10.29)	(48.18)	(5.40)	(33.78)	(18.08)	(39.08)	(16.83)	(44.67)
Saw Dust	4452.00	0.00	3948.00	0.00	1197.00	0.00	2856.00	0.00	12453.00	0.00.
	(10.28)	(0.00)	(9.71)	(0.00)	(3.62)	(0.00)	(9.00)	(0.00)	(8.37)	(0.00)
Bio Gas	0.00	0.00	0.00	2961.00	0.00	1974.00	0.00	5132.40	0.00	10067.40
	(0.00)	(0.00)	(0.00)	(8.90)	(0.00)	(4.02)	(0.00)	(12.72)	(0.00)	(6.67)
Others	1890.00	1050.00	2520.00	2865.00	930.00	6465.00	1350.00	6840.00	6690.00	17220.00
	(4.36)	(3.73)	(6.20)	(8.61)	(2.81)	(13.16)	(4.25)	(16.95)	(4.50)	(11.41)
All Non Comm	33760.60	28183.22	30067.70	33272.72	22623.96	49118.72	23258.16	40346.80	109710.42,	150921.44
	(77.95)	(100.00)	(73.96)	(100.00)	(68.45)	(100.00)	(73.27)	(100.00)	(73.75)	(100.00)
All Commercial	9551.64	0.00	10586.08	0.00	10426.10	0.00	8484.94	0.00	39048.72	3631.86
	(22.05)	(0.00)	(26.04)	(0.00)	(31.55)	(7.39)	(26.73)	(0.00)	(26.25)	(2.41)
All	43312.20	28183.22	40653.80	33272.72	33050.00	49118.70	31743.10	40348.80	148759.14	150921.44
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Figures in bracket show percentages to total

It can be observed from Table 4.11 that in SA I most of the fuel materials are purchased (60.58 per cent). The same trend is exhibited when only the non-commercial sources are considered. Of the non-commercial fuels, 54.50 per cent is purchased while only 45.50 per cent is collected. Among the purchased fuels, firewood (32.52 per cent) and among the collected fuels, coconut residues (67.50 per cent) are first in the order (Table 4.12). When the fuels are considered individually, firewood (63.46 per cent) and 'others' (64.29 per cent) are mostly purchased, while coconut residue (58.79 per cent) is mostly collected (Table 4.11).

In study area II, most of the fuels are procured by purchase mode (54.99 per cent) when all the energy sources are taken in to account (see Table 4.11). However, this trend is reversed when only the non-commercial fuels are considered. It can be seen from Table 4.11 that 52.53 per cent of all the non- commercial sources is collected. Among the purchased fuels, more than half is composed of firewood (47.76 per cent), and among the collected fuels the same is applicable to coconut residue (56.62 per cent, Table 4.12). When the fuels are considered individually, firewood (62.97 per cent) has the greatest purchased proportion while coconut residue (79.31 per cent) and 'others' (53.20 per cent) have greater collected proportion. (Table 4.11).

In study area III, 59.78 per cent of the fuels is procured by collection and the same trend is exhibited when non-commercial fuels alone (68.47 per cent) are considered (Table 4.11). Interestingly, among the purchased and collected fuels, firewood stands first with 56.62 per cent and 49.04 per cent respectively. (Table 4.12). When the fuels are considered individually (Table 4.11) the share of purchased fuels is high for firewood (51.36 per cent) while the collected share is high for coconut residue (73.31 per cent) and 'others' (83.52 per cent)

In study area IV, the predominant mode of procurement is fuel collection with a share of 55.97 per cent. When the non-commercial alone are considered (64.43 per cent), the same trend prevails. Among the purchased fuels, firewood (41.94 per cent) is the most purchased one and coconut residue (39.08 per cent) is the most collected fuel. When the fuels are considered individually, firewood (51.36 per cent) has the greatest share of purchased fuels, while coconut residue (73.31 per cent) and 'others' (83.52 per cent) have a greater collected share (Table 4.12).

Table 4.13 presents the information on energy consumption by the mode of procurement in terms of per household and per capita figures. The key trends revealed from Table 4.13 are the following. When all the fuels are taken together, the highest per capita consumption is in SA II for the purchased fuels and in SA III for collected fuels. The lowest per capita consumption for the purchased fuels is in SA IV (and SA III) and for the collected fuels is in SA I.

Table 4.14 presents the proportion of fuels procured by the different modes. Table 4.14 helps to compare the trends across the study areas. The major trends revealed in the table are the following. For 'all fuels', the proportion of purchased fuels is the largest in SA I and the lowest in SA III. For this category, the proportion of collected fuels is the highest in SA III and the lowest is in SA I. For firewood, the highest proportion of purchased fuel is in SA II and the lowest in SA IV. The highest proportion of collected firewood is in SA III and for the coconut residue, it is interesting to note that purchased and collected proportions are the highest in SA I. It may also be noted that the collected proportion of 'others' and biogas is the highest in SA IV.

(c) End-uses

End uses to which energy is put are often dependent on the availability and accessibility of the fuel material. Energy consumption pattern of the sample households based on the share in the various end uses is presented in Tables 4.15 and 4.16.

Table 4.13

Per house hold and Per capita energy consumption by mode of procurement of fuel material (in 10^3 kcal)

Study area	SA I				SA II				SA III			
Mode	Purchased		Collected		Purchased		Collected		Purchased		Collected	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per capita
Fire Wood	260.81	45.87	219.21	36.70	346.74	62.84	207.58	38.96	317.15	55.20	349.13	64.76
Coconut Residue	277.81	52.50	279.74	51.41	174.27	29.45	250.47	50.09	105.00	16.08	259.22	48.23
Saw Dust	261.88	40.41	0.00	0.00	232.24	39.09	0.00	0.00	239.40	41.28	0.00	0.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	2961.00	592.20	0.00	0.00	1974.00	329.00
Others	171.82	30.00	116.67	21.88	102.32	20.18	93.00	13.48	93.00	13.48	190.15	36.53
All Non Comm	519.39	95.10	402.62	74.17	492.91	92.52	468.63	93.99	377.07	65.96	663.77	125.62
All Commercial	127.36	23.58	0.00	0.00	141.15	28.38	0.00	0.00	139.01	26.33	0.00	0.00
All	577.50	106.94	402.62	74.17	542.05	108.99	468.63	93.99	440.67	83.46	663.77	125.62

(Continued..........)

…………Table 4.13

Study areas	SA IV				ALL			
Mode	Purchased		Collected		Purchased		Collected	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	261.02	47.04	206.67	38.20	297.84	53.45	253.26	46.74
Coconut Residue	133.49	25.63	235.34	46.38	189.72	34.59	256.31	49.93
Saw Dust	259.64	44.63	0.00	0.00	249.06	41.65	0.00	0.00
Bio Gas	0.00	0.00	2566.20	366.60	0.00	0.00	2516.85	402.70
Others	96.43	15.52	152.00	30.54	115.34	19.01	148.45	29.49
All Non Comm	375.13	71.56	545.23	106.74	442.38	82.86	522.22	102.04
All Commercial	113.13	22.21	0.00	0.00	130.16	25.61	0.00	0.00
All	423.24	83.10	545.23	106.74	495.86	97.55	522.22	102.04.

Table 4.14
Energy Consumption pattern by the proportion of fuels procured by different modes

Study areas	SA I		SA II		SA III		SA IV		ALL	
Mode Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	purchased	Collected
Fire Wood	21.49	14.43	29.63	20.31	28.56	42.85	20.32	22.42	100.00	100.00
Coconut Residue	53.25	28.22	16.70	23.78	7.13	24.61	22.92	23.39	100.00	100.00
Saw Dust	35.75	0.00	31.70	0.00	9.61	0.00	22.93	0.00	100.00	0.00
Bio Gas	0.00	0.00	0.00	29.41	0.00	19.61	0.00	50.98	0.00	100.00
Others	28.25	6.10	37.67	16.64	13.90	37.54	20.18	39.72	100.00	100.00
All Non Comm	30.77	18.67	27.41	22.05	20.62	32.55	21.20	26.73	100.00	100.00
All Commercial	24.46	0.00	27.11	0.00	26.70	0.00	21.73	0.00	100.00	0.00
All	29.12	18.67	27.33	22.05	22.22	32.55	21.34	26.73	100.00	100.00

Table 4.15

Energy consumption pattern by fuels used in various end uses (in 10^3 K.Cal)

Study areas / End Use / Energy Type	SA I Cooking	SA I Light & Others	SA II Cooking	SA II Light & Others	SA III Cooking	SA III Light & Others	SA IV Cooking	SA IV Light & Others	ALL Cooking	ALL Light & Others
Fire wood	20100.48 (90.57)	2093.80 (9.43)	29577.68 (95.93)	1256.28 (4.07)	40707.88 (95.11)	2093.80 (4.89)	24552.66 (94.73)	1366.48 (5.27)	114938.60 (94.41)	6810.36 (5.59)
Coconut Residue	30170.00 (93.24)	2187.50 (6.76)	16887.50 (83.55)	3325.00 (16.45)	15190.00 (82.67)	3185.00 (17.33)	18882.50 (87.79)	2625.50 (12.21)	81130.00 (87.75)	11322.50 (12.25)
Saw Dust	4452.00 (100.00)	0.00 (0.00)	3801.00 (96.28)	147.00 (3.72)	1197.00 (100.00)	0.00 (0.00)	2856.00 (100.00)	0.00 (0.00)	12306.00 (98.82)	147.00 (1.18)
Bio Gas	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)	5132.40 (100.00)	0.00 (0.00)	10067.40 (100.00)	0.00 (0.00)
Others	2580.00 (87.76)	360.00 (12.24)	4470.00 (83.01)	915.00 (16.99)	5745.00 (77.69)	1650.00 (22.31)	7260.00 (88.64)	930.00 (11.36)	20055.00 (83.88)	3855.00 (16.12)
All Non Comm	57302.48 (92.51)	4641.30 (7.49)	57697.18 (91.09)	5643.28 (8.91)	64813.88 (90.34)	6928.80 (9.66)	58683.46 (92.26)	4921.48 (7.74)	238497.00 (91.51)	22134.86 (8.49)
Kerosene	3033.00 (68.64)	1386.00 (31.36)	2610.00 (66.21)	1332.00 (33.79)	2520.00 (64.97)	1395.00 (35.03)	1440.00 (54.05)	1224.00 (45.95)	9603.00 (64.43)	5301.00 (35.57)
LPG	1035.18 (100.00)	0.00 (0.00)	958.50 (100.00)	0.00 (0.00)	1111.86 (100.00)	0.00 (0.00)	805.14 (100.00)	0.00 (0.00)	3910.68 (100.00)	0.00 (0.00)
Electricity	0.00 (0.00)	2847.46 (100.00)	0.00 (0.00)	3485.58 (100.00)	0.00 (0.00)	3285.20 (100.00)	0.00 (0.00)	3465.80 (100.00)	0.00 (0.00)	13084.04 (100.00)
Others	0.00 (0.00)	1250.00 (100.00)	0.00 (0.00)	2200.00 (100.00)	0.00 (0.00)	2150.00 (100.00)	0.00 (0.00)	1550.00 (100.00)	0.00 (0.00)	7150.00 (100.00)
All Commercial	4068.18 (42.59)	5483.46 (57.41)	3568.50 (33.71)	7017.58 (66.29)	3631.86 (34.83)	6794.20 (65.17)	2245.14 (26.46)	6239.80 (73.54)	13513.68 (34.61)	25535.04 (65.39)
All	61370.66 (85.84)	10124.76 (14.16)	61265.68 (82.87)	12660.86 (17.13)	68445.74 (83.30)	13723.00 (16.70)	60928.60 (84.52)	11161.28 (15.84)	252010.68 (84.09)	47669.90 (15.91)

Note: Figures in brackets show percentages to total

Table 4.16

Energy Consumption pattern by fuels used in various end uses – according to share in each end use (in 10^3 kcal)

Study areas / End use / EnergyType	SA I Cooking	SA I Light &oth	SA II Cooking	SA II Light&oth	SA III Cooking	SA III Ligth&oth	SA IV Cooking	SA IV Ligth&oth	ALL Cooking	ALL Ligth&oth
Fire Wood	20100.48 (32.75)	2093.80 (20.68)	29577.68 (48.28)	1256.28 (9..92)	40707.88 (59.47)	2093.80 (15.26)	24552.56 (40.30)	1366.48 (12.24)	114938.60 (45.61)	6810.36 (14.29)
Coconut Residue	30170.00 (49.16)	2187.50 (21.61)	16887.50 (27.56)	3325.00 (26.26)	15190.00 (22.19)	3185.00 (23.21)	18882.50 (30.99)	2625.00 (23.52)	81130.00 (32.19)	11322.50 (23.75)
Saw Dust	4452.00 (7.25)	0.00 (0.00)	3801.00 (6.20)	147.00 (1.16)	1197.00 (1.75)	0.00 (0.00)	2856.00 (4.69)	0.00 (0.00)	12306.00 (4.88)	147.00 (0.31)
Bio Gas	0.00 (0.00)	0.00 (0.00)	2961.00 (4.83)	0.00 (0.00)	1974.00 (2.88)	0.00 (0.00)	5 132.40 (8.42)	0.00 (0.00)	10067.40 (3.99)	0.00 (0.00)
Others	2580.00 (4.20)	360.00 (3.56)	4470.00 (7.30)	915.00 (7.23)	5745.00 (8.39)	1650.00 (12.02)	7260.00 (11.92)	930.00 (8.33)	200555.00 (7.96)	3855.00 (8.09)
All Non Comm	57302.48 (93.37)	4641.30 (45.84)	57697.18 (94.18)	5643.28 (44.57)	64813.88 (94.69)	6928.80 (50.49)	5 8683.46 (96.32)	4921.48 (44.09)	238497.00 (94.64)	22134.86 (46.43)
Kerosene	3033.00 (4.94)	1386.00 (13.69)	2610.00 (4.26)	1332.00 (10.52)	5220.00 (3.68)	1359.00 (9.90)	1440.00 (2.36)	1224.00 (10.97)	9603.00 (3.81)	5301.00 (11.12)
LPG	1035.18 (1.69)	0.00 (0.00)	958.50 (1.56)	0.00 (0.00)	1111.86 (1.62)	0.00 (0.00)	805.14 (1.32)	0.00 (0.00)	3910.68 (1.55)	0.00 (0.00)
Electricity	0.00 (0.00)	2847.46 (28.12)	0.00 (0.00)	485.58 (27.53)	0.00 (0.00)	3285.20 (23.94)	0.00 (0.00)	3465.80 (31.05)	0.00 (0.00)	13084.04 (27.45)
Others	0.00 (0.00)	1250.00 (12.35)	0.00 (0.00)	2200.00 (17.38)	0.00 (0.00)	2150.00 (15.67)	0.00 (0.00)	1550.00 (13.89)	0.00 (0.00)	7150.00 (15.00)
All Commercial	4068.18 (6.63)	5483.46 (54.16)	3568.50 (5.82)	7017.58 (55.43)	3631.86 (5.31)	6794.20 (49.51)	2245.14 (3.68)	6239.80 (55.91)	13513.68 (5.36)	25535.04 (53.57)
All	61370.66 (100.00)	10124.76 (100.00)	61265.68 (100.00)	12660.86 (100.00)	68445.74 (100.00)	13723.00 (100.00)	60928.60 (100.00)	11161.28 (100.00)	252010.68 (100.00)	47669.90 (100.00)

Note:1) Figures in brackets show percentage to total 2) Light & oth = Lighting and others

It can be seen from Table 4.15 that in SA I, most of the fuel material (85.84 per cent) is used for cooking. The same trend is exhibited by 'all non-commercial' sources also. For instance, the share of all commercial fuels in cooking is 92.51 per cent. However, a major portion of the commercial fuels (57.41 per cent) is used for 'lighting and others'. It can be further observed from Table 4.15 that the greater share of all the fuels except electricity is used for cooking in SA I. From Table 4.16 it may be observed that among the fuels used for cooking, coconut residue is the most important source (49.16 per cent). Similarly, in the fuels used for 'lighting and others', coconut residue (21.61 per cent) is the major fuel among non-commercial sources and electricity (28.12 per cent) is the major fuel among the commercial sources.

In SA II, a large proportion (82.87 per cent) of the fuel materials is used for cooking. The same trend is reflected t when the non-commercial fuels alone are considered. However, there is a reverse in this trend when the commercial fuels alone are considered. It may be observed from Table 4.15, that 66.29 per cent of 'all commercial' sources is used for 'lighting and others'. It can be further observed from Table 4.15 that a major share of all the fuels except electricity (and kerosene to an extend) is used for cooking in SA II. From Table 4.16 it can be noted that of the fuels used for cooking, firewood is the major cooking fuel (48.28 per cent). Among the fuels used for 'lighting and others', coconut residue (26.26 per cent) is the major fuel among the non-commercial sources and electricity (27.53 per cent) is the major fuel among commercial sources.

Table 4.15 further reveals that, in SA III more than eighty per cent of the energy (83.30 per cent) is used for cooking. The same trend is applicable to 'all non-commercial' sources also. The share of all non-commercials fuels taken together, in cooking is 90.34 per cent. However, for commercial fuels this trend is reversed and 65.17 per cent of the energy is used for 'lighting and others'. It my also be noted from Table 4.15 that cooking is the dominant end use in SA III where major share of all the fuels except electricity is used for this purpose. Table 4.16 reveals that among the fuels used for cooking, firewood is the most important fuel consuming more than half of the 'cooking energy' (59.47 per cent). Similarly, in the fuels used for 'lighting and others', coconut residue (23.21 per cent) is the mostly used fuel among the non-commercial sources and electricity (23.94 per cent) is the major fuel among commercial sources.

In SA IV, a large proportion of the fuel materials (84.52 per cent) is used for cooking. The same trend is exhibited by 'all non-commercial' sources also, for which the share in cooking is 92.51 per cent. For the commercial fuels, however, a major portion (73.54 per cent) is used for 'lighting and others'. Table 4.15 further reveals that a major proportion of all the fuels except electricity is used for cooking. Still, it is worth mentioning that nearly half of the kerosene (45.95 per cent) is used for 'lighting and others'. When the cooking fuels are examined in isolation, it may be noted that in SA IV, firewood (40.30 per cent) is the major contributor in that particular end use (Table 4.16). When the fuels used for 'lighting and others' are considered, electricity (31.05 per cent) is the major fuel among the commercial sources and coconut residue (23.52 per cent) is the major fuel among non-commercial sources.

Table 4.17 shows the energy consumption pattern by the end use in terms of per household and per capita figures. It is interesting to note that for cooking and 'lighting and others'; per capita figure is the highest in SA II and the lowest in SA I. When the non-commercial fuels are alone considered, the highest figure for cooking is in SA III and for lighting is in SA I. For the same category of fuels, the lowest consumption for cooking is in SA I and for lighting is in SA II. When the commercial fuel alone are considered, the highest per capita consumption for cooking is in SA I and the lowest is in SA IV. For lighting, the highest figures are in SA II and the lowest in SA I.

Table 4.18 facilitates a comparison of energy consumption pattern by end use across the study areas by providing information on the proportion of fuels used in various end uses. It may be noted from the table that for 'all fuels', the proportion of energy used for cooking is almost equal for all the study areas, with a slight exception in SA III. For lighting fuels, however, there are notable variations. For instance, the highest proportion of energy for 'lighting and others', is consumed in SA III and the lowest in SA I. When the non-commercial fuels are considered separately, the highest share for cooking and lighting is in SA III on the other hand, when the commercial fuels are alone considered, the highest share for cooking is in SA I and for lighting is in SA II.

A comparison of the performance of individual fuels across the regions may be interesting. For firewood, the maximum share for cooking is used in SA III and for 'lighting and others' in SA I and SA III. The minimum share of firewood for cooking is in SA I and for 'lighting and others' in SA II. For coconut residue, the highest share for cooking is in SA I and 'lighting and others', is in SA II. However, it may be noted that the share of coconut residue for

Table 4.17

Per house hold and Per Capita energy consumption by fuels used in various end use (in 10^3 kcal)

Study area	SA I				SA II				SA III			
End use	Cooking		Light & Others		Cooking		Light & Others		Cooking		Light & Others	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per capita
Fire Wood	291.31	53.32	123.16	20.33	441.16	86.74	114.27	16.32	537.35	107.13	139.59	21.59
Coconut Residue	457.12	85.47	115.13	20.07	281.46	56.86	127.88	20.65	266.49	49.64	122.50	19.07
Saw Dust	261.88	40.11	0.00	0.00	223.59	37.63	73.50	14.70	122.50	19.07	0.00	0.00
Bio Gas	0.00	0.00	0.00	0.00	2961.00	592.20	0.00	0.00	1974.00	329.00	0.00	0.00
Others	161.25	28.99	90.00	16.39	159.64	29.60	76.25	14.25	174.09	33.02	82.50	13.52
All Non Comm	784.97	144.70	154.71	27.97	824.25	163.91	134.36	22.48	875.86	165.34	164.97	27.27
Kerosene	189.56	34.86	38.50	6.90	200.77	39.55	30.27	6.50	157.50	25.71	36.73	7.63
LPG	147.88	31.37	0.00	0.00	119.81	23.38	0.00	0.00	111.19	17.93	0.00	0.00
Electricity	0.00	0.00	40.68	7.61	0.00	0.00	49.09	9.66	0.00	0.00	47.61	8.83
Others	0.00	0.00	156.25	29.07	0.00	0.00	183.33	34.92	0.00	0.00	215.00	38.39
All Commercial	254.26	46.76	73.11	13.54	223.03	41.49	93.57	18.81	215.00	38.39	90.59	17.16
All	818.28	151.53	135.00	25.17	816.88	164.25	168.81	33.94	912.61	172.84	182.97	34.65

Continued............

............Table 4.17

Study area	SA IV				ALL			
End use	Cooking		Light & Others		Cooking		Light & Others	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	366.46	69.75	113.87	15.18	419.48	80.66	123.82	18.56
Coconut Residue	281.23	55.54	105.00	16.83	324.52	64.13	117.94	19.09
Saw Dust	259.64	44.63	0.00	0.00	246.12	41.16	73.50	14.70
Bio Gas	2566.20	366.60	0.00	0.00	2516.85	402.70	0.00	0.00
Others	154.47	31.03	77.50	10.69	161.73	31.58	80.13	13.11
All Non Comm	784.25	153.62	140.61	22.89	816.77	159.66	148.56	25.07
Kerosene	160.00	26.67	29.14	5.69	177.83	31.49	33.34	6.73
LPG	115.02	18.72	0.00	0.00	122.21	21.85	0.00	0.00
Electricity	0.00	0.00	50.23	9.60	0.00	0.00	46.90	9.07
Others	0.00	0.00	221.43	37.80	0.00	0.00	193.24	35.22
All Commercial	221.43	37.80	83.20	16.33	190.33	32.56	85.12	16.74
All	812.38	159.50	148.82	29.22	85.12	16.74	158.90	31.26

Table 4.18

Energy consumption pattern by the proportion of fuels used in various end uses

Study areas	SA I		SA II		SA III		SA IV		ALL	
End Use / Energy Type	Cooking	Light & Oth	Cooking	Light & Oth	Cooking	Light & Oth	Cooking	Light & Oth	Cooking	Light & Oth
Fire wood	17.49	30.74	25.73	18.45	35.42	30.74	21.36	20.06	100.00	100.00
Coconut Residue	37.19	19.32	20.82	29.37	18.72	28.13	23.27	23.18	100.00	100.00
Saw Dust	36.18	0.00	30.89	0.00	9.73	0.00	23.21	0.00	100.00	100.00
Bio Gas	0.00	0.00	29.41	0.00	19.61	0.00	50.98	0.00	100.00	100.00
Others	12.86	9.34	22.29	23.74	28.65	42.80	36.20	24.12	100.00	100.00
All Non Comm	24.03	20.97	24.19	25.49	27.18	31.30	24.61	22.23	100.00	100.00
Kerosene	31.58	26.15	27.18	25.13	26.24	25.64	15.00	23.09	100.00	100.00
LPG	26.47	0.00	24.51	0.00	28.43	0.00	20.59	0.00	100.00	100.00
Electricity	0.00	21.76	0.00	26.64	0.00	25.11	0.00	26.49	0.00	100.00
Others	0.00	17.48	0.00	30.77	0.00	30.07	0.00	21.68	0.00	100.00
All Commercial	30.10	21.47	26.41	27.48	26.88	26.61	16.61	24.44	100.00	100.00
All	24.35	21.24	24.31	26.56	27.16	28.79	24.18	23.41	100.00	100.00

Note : Light & Oth = Lighting and others 'lighting and others' is the lowest in SA I, where it is found in abundance. The highest consumption of 'others' for cooking is in SA IV and for 'lighting and others' is in SA III. The lowest consumption of others for both cooking and 'lighting and others' is in SA I. Among the commercial fuels, the higher proportion of kerosene for cooking and lighting is in SA I. This might be due to the topography of the region where the supply of non-commercial fuels is comparatively low. For LPG, the highest proportion is in SA III and the lowest in SA IV. For electricity, the highest share is in SA II and the lowest share is in SA I.

In this chapter, we have examined the energy consumption pattern and inter regional variations in Kerala, based on the sample drawn from the four study areas. From the forgoing discussions, the following conclusion may be drawn (see table 4.19).

(a) The energy consumption is the highest is in SA III and the lowest is in SA I.

(b) The share of commercial fuels is the highest in SA II and the lowest in SA IV.

(c) For non-commercial fuels, the share is the highest in SA IV and the lowest in SA II.

(d) The most important single source of energy is firewood in all the study areas except SA I where it is coconut residue.

Table 4.19
Inter regional variations in energy consumption pattern – a comparison

Single largest source and share	SA I		SA II		SA III		SA IV	
Total energy (Qty)	71495.42		73926.54		82168.74		72089.88	
Share of commercial	13.36		14.32		12.69		11.77	
Share of non-commercial	86.64		85.68		87.31		88.23	
Largest commercial	Kerosene		Kerosene		Kerosene		Kerosene	
Lowest commercial	LPG		LPG		LPG		LPG	
Largest non-commercial	Coconut residue		Fire wood		Fire wood		Fire wood	
Lowest non-commercial	Saw dust		saw dust		Saw dust		Saw dust	
Single largest source and share	Coconut residue (45.26 %)		Fire wood (41.71 %)		Fire wood (52.09 %)		Fire wood (35.95) Coconut residue (29.85 %)	
Purchased share (%)	60.58		54.99		40.22		44.03	
Collected share (%)	39.42		45.01		59.78		55.97	
Mostly purchased	Fire wood		Fire wood		Fire wood		Fire wood	
Least purchased	Others		Others		Others		Others	
Mostly collected	Coconut residue		Coconut residue		Coconut residue		Coconut residue	
Least collected	Others		Others		others		others	
Cooking %	85.84		82.87		83.30		84.52	
Lighting %	14.16		17.13		16.70		15.84	
Cook → Commercial %	42.59		33.71		34.83		26.46	
Cook → Non-commercial %	92.51		91.09		90.34		92.26	
	Non-Com	Comm	Non-com	Comm	Non-com	Comm	Non-com	Comm
Cook → Maximum used fuel	CR	KER	FW	KER	FW	LPG	Others	LPG
Cook → Minimum used fuel	Others	LPG	Others	LPG	SD	KER	FW	KER
Light → Commercial %	57.41		66.29		65.17		73.54	
Light → Non-commercial %	7.49		8.91		9.66		7.74	
	Non-com	Comm	Non-com	Comm	Non-com	Comm	Non-com	Comm
Light → Maximum used fuel	CR	ELE	CR	Others	Others	KER	Others	ELE
Light → Minimum used fuel	Others	Others	FW	KER	CR	LPG	FW	Others

Note: SA = Study area, Non-Com = Non-commercial, Comm = Commercial KER = Kerosene, FW = Fire wood, CR = Coconut residue, ELE = Electricity , Cook = Cooking, Light = Lighting and Others

(e) Kerosene is the most important and LPG is the least important commercial fuel in all the study areas.

(f) With the exception of biogas, sawdust is the least consumed non-commercial source in all the study areas.

(g) The share of fuels procured by purchase is greater in study areas I and II while the share procured by collection is the highest in study areas III and IV. Firewood is the mostly purchased fuel in all the study areas. Coconut residue is the most collected fuel in all the study areas except III where it is firewood.

(h) In all the study areas, the most important energy end use is cooking.

Notes

1. Though biogas is used by only 1.33 per cent of the sample households, it has been shown separately in the analysis since the study has a focus on improved energy technologies.
2. Many households used candles, batteries etc for lighting, especially to meet the power failure due to load shedding. The energy consumption for these have been excluded in the present analysis due to the difficulty of measurement and also due to the negligible amount involved.

CHAPTER V

ENERGY CONSUMPTION PATTERN – INTER HOUSEHOLD ANALYSIS

5.1 Introduction

In the earlier chapter we have examined the energy consumption pattern at the macro level and the extent of variations among sample villages. The socio-economic profile of an area including educational status, occupation, income, household size, gender etc has considerable influence on the level of living of households. Hence, in this chapter an attempt is made to associate the socio-economic clusters and energy consumption pattern. The chosen parameters include income, household size and size of land holding. Certain major indicates like education and occupation is not included in the present analysis since it was felt 'apriori' that these parameters do not have a significant association with the energy consumption pattern. For instance, the presence of a highly educated member in the household need not necessarily influence the energy consumption pattern or cooking practices of the household.

5.2 Energy consumption pattern across different income groups

Income of a household is a decisive factor in the household's ability to acquire fuel material and energy using equipments. More significantly, the purchasing power of a household is the key determinant of its capacity to acquire more efficient energy sources and better technologies.

The present analysis examines the energy consumption pattern of the sample households spread across six income categories (see Table 4.5). Each of the study areas are analysed individually.

Information on the energy consumption pattern of the sample household according to income categories for SA I is presented in Tables 5.1 (aggregate), 5.2 (per household and per capita) and 5.3 (by proportion). It may be noted from Tables 5.1 and 5.2 that, of the six income categories the highest energy consumption takes place in the category'1000-2000' and the lowest in category '5000 and above'. However this trend is not exhibited by the per capita figures presented in the Table 5.2. According to Table 5.2, per capita energy consumption is the highest in '5000 and above' category and the lowest in '3000-4000' category. Table 5.3 further reveals that when the non-commercial fuels alone are considered, '1000-2000' category consumes the maximum and '5000 and above' the minimum of these energy sources. In terms of per capita, it is the highest in '2000-3000' category and the lowest in '3000-4000' category (Table 5.2). When the commercial fuels alone are taken in to account, the maximum consumption is in '3000-4000' category and the minimum in 'less than 1000' category. In terms of per capita, the highest

Table 5.1

Energy consumption pattern of the sample house holds according to monthly income categories **SA I** (quantity in 10^3 K.Cal)

Income Categories (in Rs) Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	1939.52 (22.13)	7956.44 (30.53)	7956.44 (32.15)	771.40 (19.13)	2622.76 (47.77)	947.72 (39.49)	22194.28 (31.04)
Coconut Residue	4445.00 (50.71)	14717.50 (56.47)	11830.00 (47.81)	665.00 (16.49)	595.00 (10.84)	105.00 (4.38)	32357.50 (45.26)
Saw Dust	126.00 (1.44)	1008.00 (3.87)	3318.00 (13.41)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4452.00 (6.23)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	1650.00 (18.82)	1170.00 (4.49)	0.00 (0.00)	120.00 (2.98)	0.00 (0.00)	0.00 (0.00)	2940.00 (4.11)
All Non Commercial	8160.52 (93.10)	24851.94 (95.36)	23104.44 (93.37)	1556.40 (38.59)	3217.76 (58.61)	1052.72 (43.87)	61943.78 (86.64)
Kerosene	432.00 (4.93)	756.00 (2.90)	486.00 (1.96)	1377.00 (34.15)	1053.00 (19.18)	315.00 (13.13)	4419.00 (6.18)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	345.06 (8.56)	383.40 (6.98)	306.72 (12.78)	1035.18 (1.45)
Electricity	172.86 (1.97)	454.08 (1.74)	1055.22 (4.26)	404.20 (10.02)	485.90 (8.85)	275.20 (11.47)	2847.46 (3.96)
Others	0.00 (0.00)	0.00 (0.00)	100.00 (0.40)	350.00 (8.68)	350.00 (6.38)	450.00 (18.75)	1250.00 (1.75)
All Commercial	604.86 (6.90)	1210.08 (4.64)	1641.22 (6.63)	2476.26 (61.41)	2272.30 (41.39)	1346.92 (56.13)	9551.64 (13.36)
All	8765.38 (100.00)	26062.02 (100.00)	24745.66 (100.00)	4032.66 (100.00)	5490.06 (100.00)	2399.64 (100.00)	71495.42 (100.00)

Note: Figures in brackets show percentage to total.

Table 5.2

Per household and Per capita energy consumption by income categories **SA I** (in 10^3K.Cal)

Inc Categ	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above		All	
Engy Type	Per H.H	Per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita
FW	149.19	38.79	306.02	60.28	378.88	68.00	257.13	48.12	655.69	100.88	473.86	86.16	321.66	63.05
CR	317.50	85.48	566.06	111.50	537.73	98.58	166.25	33.25	198.33	28.33	105.00	17.50	462.25	92.19
SW	126.00	63.00	336.00	31.50	255.23	46.73	0.00	0.00	0.00	0.00	0.00	0.00	261.88	42.40
BG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTH	165.00	41.25	195.00	32.50	0.00	0.00	120.00	20.00	0.00	0.00	0.00	0.00	172.94	35.85
ANC	582.89	156.93	955.84	188.27	1050.20	192.54	389.10	77.82	643.55	107.26	526.36	95.70	848.50	169.71
KER	61.71	16.00	42.00	7.49	54.00	9.00	229.50	47.48	210.60	35.10	157.50	28.64	94.02	17.54
LPG	0.00	0.00	0.00	0.00	0.00	0.00	115.02	0.00	191.70	0.00	153.36	0.00	148.88	31.77
ELE	15.71	4.22	18.92	3.88	47.96	8.79	67.37	13.94	191.70	0.00	137.60	25.05	40.68	8.18
OTH	0.00	0.00	0.00	0.00	100.00	20.00	116.67	23.33	175.00	29.17	225.00	40.91	156.25	29.07
ALC	43.20	11.63	46.54	9.17	74.60	13.68	412.71	85.39	454.46	75.74	673.46	122.45	127.36	25.54
ALL	626.10	168.57	1002.39	197.44	1124.80	206.21	672.11	139.06	1098.01	183.00	1199.82	218.15	953.27	176.53

Note : Per H.H = per house hold . FW = Fire Wood. CR = Coconut Residue. BG= Bio Gas ANC = All Non Commercial.
KER = Kerosene. OTH= Others . ELE= Elcetricity. ALC= All Commercial

Table 5.3
Energy consumption pattern by the proportion of fuels used by different income categories **SA I**

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	8.72	35.76	35.76	3.47	11.79	4.26	100.00
Coconut Residue	13.71	45.41	36.50	2.05	1.84	0.32	100.00
Saw Dust	2.82	22.56	74.26	0.00	0.00	0.00	100.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	55.99	39.70	0.00	4.07	0.00	0.00	100.00
All Non Commercial	13.16	40.08	37.26	2.51	5.19	1.70	100.00
Kerosene	9.69	16.95	10.90	30.88	23.62	7.06	100.00
LPG	0.00	0.00	0.00	33.11	36.79	29.43	100.00
Electricity	5.95	15.62	36.31	13.91	16.72	9.47	100.00
Others	0.00	0.00	7.95	27.82	27.82	35.77	100.00
All Commercial	6.29	12.59	17.07	25.76	23.64	14.01	100.00
All	12.25	36.42	34.58	5.64	7.67	3.35	100.00

figure is in ' 5000 and above' and the lowest in '1000-2000' (Table 5.1 and 5.3)

When the income categories are considered individually (Table 5.1) in the first three income categories, coconut residue is the most important source of energy. Note that, none of these households use LPG and their use of other commercial sources are also limited. In the 3000-4000 category, kerosene is the most important fuel. This explains the high consumption figure for 'all commercial' for this category. In the last two categories, firewood is the major fuel. It may also be noted that the share of commercial fuels is higher for the last three categories than the first three. When the major fuels are considered individually (Table 5.3), the consumption of firewood is maximum in the 1000-2000 and 2000-3000 category. For coconut residue, it is the maximum in 1000-2000 and the minimum in the '5000 and above'. For sawdust the highest consumption is in '2000-3000' and the lowest is in ' less than 1000'. It may also be noted that, none of the households in the 3000 to 5000 income group consume sawdust. It is interesting to observe that the proportion of the non-commercial fuels taken together first increases, reaches maximum and then diminish as we move up the income ladder. For all commercial fuels, it increases continuously with income, but decrease for the '5000 and above' category.

Table 5.4 presents information on the energy consumption pattern by the mode of procurement of fuel materials by income categories. It can be seen from the table that, in all the income categories, the purchased share is greater than the collected share for both all fuels and all non-commercial fuels. When the fuels and income categories are considered individually, the following trends are revealed. In all the income categories, the purchased share of fuel wood is greater than the collected share. On the other hand, for coconut residue and others, the collected share is more in all the income categories.

Table 5.5 shows the energy consumption pattern by the end use of fuel materials according to income categories. It can be seen from the table that, though in all the income categories (except 5000 and above) the share of fuels used for cooking is greater than that used for 'lighting and others', the share of latter increases as the income increases. When the fuels and the income categories are considered individually, in all the income categories major portion of the firewood is used for 'cooking', though its share decreases for higher income groups. A similar trend is exhibited by coconut residue, except for '5000 and above' category. When all the non-commercial fuels are taken together, the share of 'lighting and others' increases up to 3000-4000 category and then slightly

Table 5.4

Energy consumption pattern by the mode of procurement of fuel material by income categories **SA I** (in 10^3K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
Mode / Energy Type	Purchased	collected	purchased	collected	purchased	Collected	purchased	collected	purchased	collected	purchased	Collected
Fire Wood	1278.32 (65.91)	661.20 (34.09)	5377.76 (67.59)	2578.68 (32.41)	5829.60 (66.48)	2666.84 (33.52)	0.00 (0.00)	771.40 (100.00)	1829.32 (69.75)	793.32 (30.25)	308.56 (32.56)	639.16 (67.44)
Coconut Residue	2047.50 (40.06)	2397.50 (53.94)	6440.00 (43.76)	8277.50 (56.24)	4847.50 (40.98)	6982.50 (59.02)	0.00 (0.00)	665.00 (100.00)	0.00 (0.00)	595.00 (100.00)	0.00 (0.00)	105.00 (100.00)
Saw Dust	126.00 (100.00)	0.00 (0.00)	1008.00 (100.00)	0.00 (0.00)	3318.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	960.00 (58.18)	690.00 (41.82)	930.00 (79.49)	240.00 (20.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	120.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	4411.82 (54.06)	3748.70 (45.94)	13755.76 (55.35)	11906.18 (44.65)	13455.10 (58.24)	9649.34 (41.76)	0.00 (0.00)	1556.40 (100.00)	1829.32 (56.85)	1388.44 (43.15)	308.56 (29.31)	744.16 (70.69)
All Comm	604.86 (100.00)	0.00 (0.00)	1210.08 (100.00)	0.00 (0.00)	1641.22 (100.00)	0.00 (0.00)	2476.26 (100.00)	0.00 (0.00)	2272.30 (100.00)	0.00 (0.00)	1346.92 (100.00)	0.00 (0.00)
All	5016.68 (57.23)	3748.70 (42.77)	14965.84 (57.42)	11096.18 (42.58)	15906.32 (61.10)	9649.34 (38.99)	2476.26 (61.41)	1556.40 (38.59)	4101.62 (74.71)	1388.44 (25.29)	1655.48 (68.99)	744.16 (31.01)

Note: Figures in brackets show percentages to total.

Table 5.5

Energy consumption pattern by the end use of fuel material by income categories **SA I** (in 10^3K.Cal)

Income Category	Less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
End uses	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Energy Type												
Fire Wood	1939.52 (100.00)	0.00 (0.00)	7515.64 (94.46)	440.80 (5.54)	7471.58 (93.91)	484.88 (6.09)	595.08 (77.41)	176.32 (22.86)	1917.48 (73.11)	705.28 (26.89)	661.20 (66.77)	286.52 (30.23)
Coconut Residue	4445.00 (100.00)	0.00 (0.00)	14717.50 (100.00)	0.00 (0.00)	10570.00 (89.35)	1260.00 (10.65)	332.50 (50.00)	332.50 (50.00)	105.00 (17.65)	490.00 (82.35)	0.00 (0.00)	105.00 (100.00)
Saw Dust	126.00 (100.00)	0.00 (0.00)	1008.00 (100.00)	0.00 (0.00)	3318.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	1530.00 (92.73)	120.00 (7.27)	1050.00 (89.74)	120.00 (10.26)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	120.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	8040.52 (98.53)	120.00 (1.47)	24291.14 (97.74)	560.80 (2.26)	21359.56 (92.45)	1744.88 (7.55)	927.58 (59.60)	628.82 (40.40)	2022.48 (62.85)	1195.28 (37.15)	661.20 (62.81)	391.52 (37.19)
Kerosene	0.00 (0.00)	432.00 (100.00)	0.00 (0.00)	756.00 (100.00)	360.00 (74.07)	126.00 (25.93)	1323.00 (96.08)	54.00 (3.92)	1035.00 (98.29)	18.00 (1.71)	315.00 (100.00)	0.00 (0.00)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	345.06 (100.00)	0.00 (0.00)	383.40 (100.00)	0.00 (0.00)	306.72 (100.00)
Electricity	0.00 (0.00)	172.86 (100.00)	0.00 (0.00)	454.08 (100.00)	0.00 (0.00)	1055.22 (100.00)	0.00 (0.00)	404.20 (100.00)	0.00 (0.00)	485.90 (100.00)	0.00 (0.00)	275.20 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	100.00 (100.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	450.00 (100.00)
All Comm	0.00 (0.00)	604.86 (100.00)	0.00 (0.00)	1210.08 (100.00)	360.00 (21.93)	1281.22 (78.07)	1323.00 (53.43)	1153.26 (46.57)	1035.00 (4555)	1237.30 (54.45)	315.00 (23.29)	1031.92 (76.61)
All	8040.52 (91.73)	724.86 (8.27)	24291.14 (93.21)	1770.88 (6.79)	21719.56 (87.77)	3026.10 (12.23)	2250.58 (55.81)	1782.08 (44.19)	3057.48 (55.69)	2432.58 (44.31)	976.20 (40.68)	1423.44 (59.32)

Note: Figures in brackets show percentages to total decrease. It is interesting to note that, none of the households in the first two income categories use commercial fuels for cooking. Their consumption of. commercial fuels is limited to kerosene and electricity used for lightning.

Details of energy consumption of the sample households according to income categories for SA II is presented in Tables 5.6 (aggregate), 5.7 (per household and per capita) and 5.8 (proportion). The energy consumption is the highest in the income category 2000-3000 and the lowest in '5000 and above' (Table 5.6 and 5.8). In terms of per capita, (Table 5.7) the same trend is maintained for the highest consumption but the lowest per capita consumption is in the 'less than 1000' income category. The dominance of the '2000-3000' category is due to the fact that 40, per cent of the households in this SAII are concentrated in the '2000-3000'-income group (Table 4.5). It can be read from Table 5.6 that when the non-commercial fuels alone are considered, the highest energy consumption is in the '1000-2000' category. The high share of firewood (47.75 per cent) and coconut residue (36.61 per cent) used in this category explains this supremacy. It may be noted that, the share of non-commercial fuels is around 90 per cent for the first three income groups, but is around 50 per cent for the last three income groups. On the other hand, when ' all commercial' fuels are

Table 5.6

Energy consumption pattern by the sample house holds according to income categories **SA I** (quantity in 10^3 K.Cal)

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	1300.36 (36.66)	9587.40 (47.75)	16133.20 (42.44)	1124.04 (19.65)	1234.04 (33.31)	1454.64 (50.77)	30833.96 (41.71)
Coconut Residue	1190.00 (33.54)	7350.00 (36.61)	9222.50 (24.26)	1365.00 (23.86)	945.00 (25.51)	140.00 (4.89)	20212.50 (27.34)
Saw Dust	210.00 (5.92)	357.00 (1.78)	3381.00 (8.89)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3948.00 (5.34)
Bio Gas	0.00 (0.00)	0.00 (0.00)	2961.00 (7.79)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (4.01)
Others	300.00 (8.64)	1659.00 (8.44)	3210.00 (8.45)	180.00 (3.15)	0.00 (0.00)	0.00 (0.00)	5385.00 (7.28)
All Non Comm	3000.36 (84.58)	18989.40 (94.58)	34907.78 (91.84)	2669.04 (46.65)	2179.24 (58.82)	1594.64 (55.65)	63340.46 (85.68)
Kerosene	486.00 (15.19)	396.00 (1.97)	10260.00 (2.70)	1386.00 (24.22)	378.00 (10.20)	288.00 (10.05)	3942.00 (5.33)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	287.55 (5.03)	223.65 (6.04)	447.30 (15.61)	958.50 (1.30)
Electricity	79.12 (2.23)	691.44 (3.44)	1476.62 (3.88)	528.90 (9.24)	374.10 (10.10)	335.40 (11.71)	3485.58 (4.71)
Others	0.00 (0.00)	0.00 (0.00)	600.00 (1.58)	850.00 (14.86)	550.00 (14.84)	200.00 (6.98)	2200.00 (2.98)
All Commercial	547.12 (15.42)	1087.44 (5.42)	3102.62 (8.16)	3052.45 (53.35)	1525.75 (41.18)	1270.70 (44.35)	10586.08 (14.32)
All	3547.48 (100.00)	20076.84 (100.00)	38010.40 (100.00)	5721.49 (100.00)	3704.99 (100.00)	2865.34 (100.00)	73926.54 (100.00)

Note: Figures in brackets show percentage.

Table 5.7

Per household and Per capita energy consumption by income categories **SA II** (in 10^3K.Cal)

Inc Categ	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above		All	
Engy Type	Per H.H	Per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita
FW	185.77	68.44	416.84	93.08	556.32	95.46	281.01	51.09	617.12	94.94	484.88	62.27	453.44	88.86
CR	148.75	59.51	319.57	71.36	354.71	58.74	227.50	47.07	236.25	45.00	140.00	28.00	297.24	60.34
SW	210.00	52.50	178.50	32.45	241.47	39.32	0.00	0.00	0.00	0.00	0.00	0.00	232.24	39.09
BG	0.00	0.00	0.00	0.00	2961.00	592.20	0.00	0.00	0.00	0.00	0.00	0.00	2961.00	592.20
OTH	75.66	27.27	169.50	32.60	200.63	32.76	90.00	20.00	0.00	0.00	0.00	0.00	168.28	36.68
ANC	375.05	150.18	825.63	184.36	1163.59	200.62	381.29	78.50	544.81	103.77	531.55	75.94	844.54	169.81
KER	117.00	39.38	26.40	6.49	46.64	8.84	231.00	47.79	189.00	47.25	288.00	48.00	78.84	16.99
LPG	0.00	0.00	0.00	0.00	0.00	0.00	95.85	23.69	111.83	27.69	149.10	21.30	119.81	23.38
ELE	15.82	7.91	31.43	6.85	49.22	8.49	75.56	15.56	111.83	27.96	111.80	15.79	49.09	9.66
OTH	0.00	0.00	0.00	0.00	150.00	28.57	212.50	40.48	183.33	34.38	200.00	40.00	183.33	34.92
ALC	68.39	27.36	47.28	10.56	103.42	17.83	436.06	89.78	381.44	72.65	423.57	60.51	141.15	23.38
ALL	443.44	117.38	872.91	194.92	1267.11	218.45	817.36	168.36	926.25	176.43	955.11	136.44	985.69	198.19

Note : Per H.H = per house hold . FW = Fire Wood. CR = Coconut Residue. BG= Bio Gas ANC = All Non Commercial.
KER = Kerosene. OTH= Others . ELE= Elcetricity. ALC= All Commercial

Table 5.8

Energy consumption pattern by the proportion of fuels used by different income categories **SA II**

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire.Wood	4.22	31.09	52.32	3.65	4.00	4.72	100.00
Coconut Residue	5.89	36.36	45.63	6.75	4.68	0.69	100.00
Saw Dust	5.32	9.04	85.64	0.00	0.00	0.00	100.00
Bio Gas	0.00	0.00	100.00	0.00	0.00	0.00	100.00
Others	5.57	31.48	59.61	3.34	0.00	0.00	100.00
All Non Comm	4.74	29.98	55.11	4.21	3.44	2.52	100.00
Kerosene	11.87	10.05	26.03	35.16	9.59	7.31	100.00
LPG	0.00	0.00	0.00	30.00	23.33	46.67	100.00
Electricity	2.27	19.84	42.36	15.17	10.73	9.62	100.00
Others	0.00	0.00	27.27	38.64	25.00	9.09	100.00
All Commercial	5.17	10.27	29.31	28.83	14.41	12.00	100.00
All	4.80	27.16	51.42	7.74	5.01	3.88	100.00

taken together, for the first three income categories, the share of these fuels are around 10 per cent where as for the last three categories, the share is around 50 per cent.

When the income categories are considered individually (Table 5.6) firewood is the single most important fuel in all the income categories except 3000-4000 (kerosene). When the major fuels are considered individually (Table 5.8) for firewood, the consumption is the highest in 2000-3000 group and the lowest in the 3000-4000 group. For coconut residue, it is the highest in the 2000-3000 category and the lowest in '5000 and above'. For sawdust it is the highest in 2000-3000.Also note that, none of the households in the last three income categories use sawdust. For 'others' the highest consumption is in '2000-3000' category and the lowest in '3000-4000'. None of the households in the last two categories rise 'others'. For 'all non commercial', the consumption increases from 'less than 1000' to 2000-3000 and then drops considerably. The maximum use of kerosene is in '3000-4000' and the minimum is in 4000-5000. It is seen that none of the households in the first three income categories use LPG. For electricity and 'all commercial' the highest consumption is in the 2000-3000 category and the lowest is in 'less than 1000'.

Table 5.9 presents information on the energy consumption pattern by the mode of procurement of energy sources across the income categories. It can be seen from the table that except in the first income category, in all the categories, the purchased portion of the fuel is greater than the collected portion. For instance, in the 'less than 1000' category. 71.97 per cent of the fuel material is collected. However, when non-commercial fuels alone are considered, the dominance of the purchased fuels is reduced to two income categories, viz., 1000-2000 and 2000-3000. A fuel wise analysis of the Table 5.9 reveals that, this dominance of the collected share is mainly due to the high share of collected coconut residue. To illustrate, in the last three income categories, none of the households purchase coconut residue. Among the non-commercial fuels, firewood is the most purchased fuel.

Table 5.10 shows the energy consumption pattern by the end use of fuel material by the income categories in SA II. It can be seen from the table that, in all the categories, (except the slight variation in 4000-5000 category) the share of fuels used for cooking is greater than that of used for 'lighting and others'. No clear pattern is visible in the behavior of energy consumption and income. This trend is more or less the same for all commercial

Table 5.9

Energy consumption pattern by the mode of procurement of fuel material by income categories **SA II** (in 10^3 K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	132.24 (10.17)	1168.12 (89.83)	7207.08 (75.17)	2380.32 (24.83)	10535.12 (65.30)	5598.16 (34.70)	595.08 (52.94)	528.96 (47.06)	506.92 (41.07)	727.32 (58.39)	440.80 (30.30)	1013.84 (69.70)
Coconut Residue	105.00 (8.82)	1085.00 (91.18)	1785.00 (24.29)	5565.00 (75.71)	2292.50 (24.86)	6930.00 (75.14)	0.00 (0.00)	1365.00 (100.00)	0.00 (0.00)	945.00 (100.00)	0.00 (0.00)	140.00 (100.00)
Saw Dust	210.00 (100.00)	0.00 (0.00)	357.00 (100.00)	0.00 (0.00)	3381.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	0.00 (0.00)	300.00 (100.00)	750.00 (44.25)	945.00 (55.75)	1680.00 (52.34)	1530.00 (94.44)	90.00 (50.00)	90.00 (50.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	447.24 (14.91)	2553.12 (85.09)	10099.08 (53.18)	8890.32 (46.28)	17888.62 (51.25)	17019.16 (48.75)	685.08 (25.67)	1983.96 (74.33)	506.92 (23.26)	1672.32 (76.74)	440.80 (27.64)	1153.84 (72.36)
All Comm	547.12 (100.00)	0.00 (0.00)	1087.44 (100.00)	0.00 (0.00)	3102.62 (100.00)	0.00 (0.00)	3052.45 (100.00)	0.00 (0.00)	1525.75 (100.00)	0.00 (0.00)	1270.70 (100.00)	0.00 (0.00)
All	994.36 (28.03)	2553.12 (71.97)	11186.52 (55.72)	8890.32 (44.28)	20991.24 (55.22)	17019.16 (44.78)	3737.53 (65.32)	1983.96 (34.68)	2032.67 (54.86)	1672.32 (45.14)	1711.50 (59.73)	1153.84 (40.27)

Note: Figures in brackets show percentages to total.

Table 5.10

Energy consumption pattern by the end use of fuel material by income categories **SA II** (in 10^3K.Cal)

Income Category End use Energy Type	less than 1000 Cooking	 Light&oth	1000-2000 Cooking	 Light&oth	2000-3000 Cooking	 Light&oth	3000-4000 Cooking	 Light&oth	4000-5000 Cooking	 Light&oth	5000and above Cooking	 Light&oth
Fire Wood	1300.00 (100.00)	0.00 (0.00)	9587.40 (100.00)	0.00 (0.00)	15317.80 (94.95)	815.48 (5.05)	1124.04 (100.00)	0.00 (0.00)	1124.04 (91.07)	110.20 (8.93)	1124.04 (77.27)	330.60 (22.73)
Coconut Residue	1190.00 (100.00)	0.00 (0.00)	7175.00 (97.62)	175.00 (2.38)	8067.50 (87.48)	1155.00 (12.52)	315.00 (23.08)	1050.00 (76.92)	140.00 (14.81)	805.00 (85.19)	0.00 (0.00)	140.00 (100.00)
Saw Dust	210.00 (100.00)	0.00 (0.00)	273.00 (76.47)	84.00 (23.53)	3318.00 (98.14)	63.00 (1.86)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	300.00 (100.00)	0.00 (0.00)	1425.00 (84.07)	270.00 (15.93)	2745.00 (85.51)	465.00 (14.49)	0.00 (0.00)	180.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	3000.36 (100.00)	0.00 (0.00)	18460.40 (97.21)	529.00 (2.79)	32409.30 (92.48)	2498.48 (7.16)	1439.04 (53.92)	1230.00 (46.08)	1264.04 (58.00)	915.20 (42.00)	1124.04 (70.49)	470.60 (29.51)
Kerosene	0.00 (0.00)	468.00 (100.00)	0.00 (0.00)	396.00 (100.00)	630.00 (61.40)	396.00 (38.60)	1350.00 (97.40)	36.00 (2.60)	360.00 (95.24)	18.00 (4.76)	270.00 (93.75)	18.00 (6.25)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	287.55 (100.00)	0.00 (0.00)	223.65 (100.00)	0.00 (0.00)	447.30 (100.00)	0.00 (00.00)
Electricity	0.00 (0.00)	79.12 (100.00)	0.00 (0.00)	691.44 (100.00)	0.00 (0.00)	1476.62 (100.00)	0.00 (0.00)	528.90 (100.00)	0.00 (0.00)	374.10 (100.00)	0.00 (0.00)	335.40 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	600.00 (100.00)	0.00 (0.00)	850.00 (100.00)	0.00 (0.00)	550.00 (100.00)	0.00 (0.00)	200.00 (100.00)
All Comm	0.00 (0.00)	547.12 (100.00)	0.00 (0.00)	1087.44 (100.00)	630.00 (20.31)	2472.60 (79.69)	1637.55 (53.65)	1414.90 (46.35)	583.65 (38.25)	742.10 (61.75)	717.30 (56.45)	553.40 (43.55)
All	3000.36 (84.58)	547.12 (15.42)	18460.40 (91.95)	1616.44 (8.05)	33039.30 (86.92)	4971.10 (13.08)	3076.59 (53.77)	2644.90 (46.23)	1874.69 (49.87)	1857.30 (50.13)	1841.34 (64.26)	1024.00 (35.74)

Note: Figures in brackets show percentages to total.

fuels. However it may be noted that, the proportion of fuels used for 'lighting and others' generally increases with income categories.

Energy consumption pattern of the sample households according to income categories for SA III is presented in tables 5.11 (aggregate), 5.12 (per household and per capita) and 5.13 (by proportion). It is evident from the table that energy consumption is the highest in the 2000-3000 income category and lowest in the '5000 and above' category. In terms of per capita figures (Table 5.12), the highest energy consumption is in 3000-4000 category (223.02 10^3 K.Cal) and than the 4000-5000 category (198.90 10^3 K.Cal), when the non commercial fuels are alone are considered (Table 5.11), it is interesting to note that the highest consumption is in '1000-2000' category (95.24 per cent) and the lowest in the '4000-5000' category (68.79 per cent). There is a steady increase in the share of all commercial fuels as income increases.

When the income categories are considered individually (Table 5.11), the single most important fuel is coconut residue in the first income category (38.66 per cent) and firewood (varying from 45.59 per cent to 62.03 per cent) in all other income categories. When the major fuels are considered independently, the highest consumption of fire wood in terms of quantity and per capita is in the 2000-3000 category. The lowest consumption of

Table 5.11

Energy consumption pattern of the sample house holds according to income categories **SA III** (in 10 ^{3}K.Cal)

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	1763.20 (22.13)	10072.44 (50.82)	17323.44 (62.03)	7074.84 (51.17)	3173.76 (45.59)	3394.16 (59.89)	42801.68 (52.09)
Coconut Residue	3080.00 (38.66)	6650.00 (33.55)	5285.00 (18.92)	1820.00 (13.16)	1015.00 (14.58)	525.00 (9.26)	18375.00 (22.36)
Saw Dust	0.00 (0.00)	294.00 (1.48)	903.00 (3.23)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1197.00 (1.46)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (14.28)	0.00 (0.00)	0.00 (0.00)	1974.00 (2.40)
Others	2445.00 (30.69)	1860.00 (9.39)	1890.00 (6.77)	390.00 (2.82)	600.00 (8.62)	210.00 (3.71)	7395.00 (9.00)
All Non Comm	7288.20 (91.48)	18876.28 (95.24)	25401.44 (90.96)	11258.84 (81.43)	4788.76 (68.79)	4129.16 (72.86)	71742.68 (87.31)
Kerosene	558.00 (7.00)	405.00 (2.04)	1035.00 (3.71)	1170.00 (8.64)	468.00 (6.72)	243.00 (4.29)	3879.00 (4.72)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	153.36 (1.11)	651.78 (9.36)	306.72 (5.41)	1111.86 (1.35)
Electricity	120.40 (1.51)	537.50 (2.71)	1040.60 (3.73)	645.00 (4.66)	503.10 (7.23)	438.60 (7.74)	3285.20 (4.00)
Others	0.00 (0.00)	0.00 (0.00)	450.00 (1.61)	600.00 (4.34)	550.00 (7.90)	550.00 (9.70)	2150.00 (2.62)
All Commercial	678.40 (8.52)	942.50 (4.76)	2525.60 (9.04)	2568.36 (18.57)	2172.88 (31.21)	1538.32 (27.14)	10426.06 (12.69)
All	7966.60 (100.00)	19818.78 (100.00)	27927.04 (100.00)	13827.20 (100.00)	6961.64 (100.00)	5667.48 (100.00)	82168.74 (100.00)

Note: Figures in brackets show percentage to total.

Table 5.12

Per household and Per capita energy consumption by income categories **SA III** (in 10^3 K.Cal)

Inc Categ / Engy Type	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above		All	
	Per H.H	Per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita
FW	176.32	53.43	530.12	103.84	692.94	128.32	884.36	126.34	634.75	102.38	848.54	121.22	602.84	112.64
CR	308.00	88.00	350.00	68.56	240.23	43.32	303.33	38.72	253.75	44.13	175.00	26.25	287.11	53.42
SW	0.00	0.00	294.00	42.00	225.75	41.05	0.00	0.00	0.00	0.00	0.00	0.00	239.40	41.28
BG	0.00	0.00	0.00	0.00	0.00	0.00	1974.00	329.00	0.00	0.00	0.00	0.00	1974.00	329.00
OTH	203.75	62.69	206.67	39.57	210.00	33.16	195.00	21.67	300.00	42.86	210.00	30.00	211.29	40.63
ANC	607.35	186.88	993.49	194.60	1016.06	188.16	1250.98	181.59	798.13	136.82	1032.29	147.47	956.57	181.17
KER	79.71	26.57	33.75	7.23	69.00	13.10	167.14	22.94	156.00	29.25	121.50	16.20	84.33	16.30
LPG	0.00	0.00	0.00	0.00	0.00	0.00	76.68	9.59	130.36	25.07	102.24	15.34	111.19	17.93
ELE	15.05	4.46	29.86	6.04	43.36	7.94	71.67	10.40	83.85	14.37	109.65	15.66	47.61	8.83
OTH	0.00	0.00	0.00	0.00	150.00	37.50	200.00	33.33	275.00	39.29	275.00	45.83	215.00	38.39
ALC	56.53	17.39	49.61	9.27	101.02	18.71	285.37	41.43	362.15	62.08	384.58	54.94	139.01	26.33
ALL	663.88	204.27	1043.09	204.32	1117.08	206.08	1536.36	223.02	1160.27	198.90	1416.87	202.41	1095.58	207.50

Note : Per H.H = per house hold . FW = Fire Wood. CR = Coconut Residue. BG= Bio Gas ANC = All Non Commercial.
KER = Kerosene. OTH= Others . ELE= Elcetricity. ALC= All Commercial

Table 5.13

Energy consumption pattern by the proportion of fuels used by different income categories **SA III**

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	4.12	23.53	40.47	16.53	7.42	7.93	100.00
Coconut Residue	16.76	36.19	28.76	9.90	5.52	2.86	100.00
Saw Dust	0.00	24.56	75.44	0.00	0.00	0.00	100.00
Bio Gas	0.00	0.00	0.00	100.00	0.00	0.00	100.00
Others	33.06	25.15	25.56	5.27	8.11	2.84	100.00
All Non Comm	10.16	26.31	35.41	15.69	6.67	5.76	100.00
Kerosene	14.39	10.44	26.68	30.16	12.06	6.26	100.00
LPG	0.00	0.00	0.00	1379	58.62	27.59	100.00
Electricity	3.66	16.36	31.68	19.36	15.31	13.35	100.00
Others	0.00	0.00	20.93	27.91	25.58	25.58	100.00
All Commercial	6.51	9.04	24.22	24.63	20.84	14.75	100.00
All	9.70	24.12	33.99	16.83	8.47	6.90	100.00

Note: Figures in brackets show percentage to total.

Table 5.14

Energy consumption pattern by the mode of procurement of fuel material by income categories **SA III** (in 10^3K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	396.72	1366.48	4385.96	5686.32	8771.92	8551.52	3702.72	3372.12	749.36	2424.40	705.28	2668.88
	(22.50)	(77.50)	(43.54)	(56.46)	(50.64)	(49.36)	(52.34)	(47.66)	(23.61)	(76.39)	(20.78)	(79.22)
Coconut Resi-	0.00	3083.00	595.00	6055.00	840.00	4445.00	350.00	1470.00	0.00	1015.00	0.00	525.00
	(0.00)	(100.00)	(8.95)	(91.05)	(15.89)	(84.11)	(19.23)	(80.77)	(0.00)	(100.00)	(0.00)	(100.00)
Saw Dust	0.00	0.00	294.00	0.00	903.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	7974.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Others	0.00	2445.00	90.00	1770.00	660.00	1230.00	0.00	390.00	180.00	420.00	0.00	210.00
	(0.00)	(100.00)	(4.84)	(95.16)	(34.92)	(65.08)	(0.00)	(100.00)	(30.00)	(70.00)	(0.00)	(100.00)
All Non Comm	396.72	6891.48	5364.96	13511.32	11174.92	14226.52	4052.72	7206.12	929.36	3859.40	705.28	3423.88
	(5.44)	(94.56)	(28.42)	(71.58)	(43.99)	(56.01)	(36.00)	(64.00)	(19.41)	(80.59)	(17.08)	(82.92)
All Comm	678.40	0.00	942.50	0.00	2525.60	0.00	2568.36	0.00	2172.88	0.00	1538.32	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)
All	1075.12	6891.48	6307.46	13511.32	13700.50	14226.50	6621.08	7206.12	3102.24	3859.40	2243.60	3423.88
	(13.50)	(86.50)	(31.83)	(68.17)	(49.06)	(50.94)	(47.88)	(52.12)	(44.56)	(55.44)	(39.59)	(60.41)

Note: Figures in brackets show percentages to total.

Table 5.15

Energy consumption pattern by the end use of fuel material by income categories **SA III** (in 10 ^{3}K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Fire Wood	1763.20 (100.00)	0.00 (0.00)	10072.28 (100.00)	0.00 (0.00)	16353.68 (94.40)	969.76 (5.60)	6391.6 (90.34)	683.24 (9.66)	2865.20 (90.28)	308.56 (9.72)	3261.92 (96.10)	132.24 (3.90)
Coconut Resi-	2940.00 (95.45)	140.00 (4.55)	6405.00 (96.32)	245.00 (3.68)	4690.00 (88.74)	595.00 (11.26)	910.00 (50.00)	910.00 (50.00)	140.00 (13.79)	875.00 (86.21)	105.00 (20.00)	420.00 (80.00)
Saw Dust	0.00 (0.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	903.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	(0.00) (0.00)
Others	2355.00 (96.32)	90.00 (3.68)	1440.00 (77.42)	420.00 (22.58)	1170.00 (61.90)	720.00 (38.10)	270.00 (69.23)	120.00 (30.77)	390.00 (65.00)	210.00 (35.00)	120.00 (57.14)	90.00 (42.86)
All Non Comm	7058.20 (96.84)	230.0 (3.16)	18211.28 (96.48)	665.00 (3.52)	23116.68 (91.01)	2284.76 (8.99)	9545.60 (84.78)	1713.24 (15.22)	3395.20 (70.90)	1393.56 (29.10)	3486.92 (84.45)	642.24 (15.55)
Kerosene	0.00 (0.00)	558.00 (100.00)	0.00 (0.00)	405.00 (100.00)	765.00 (73.91)	270.00 (26.09)	1080.00 (92.31)	90.00 (7.69)	450.00 (96.15)	18.00 (3.85)	225.00 (92.59)	18.00 (7.41)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	651.78 (100.00)	0.00 (0.00)	306.72 (100.00)	0.00 (00.00)
Electricity	0.00 (0.00)	120.40 (100.00)	0.00 (0.00)	537.50 (100.00)	0.00 (0.00)	1040.60 (100.00)	0.00 (0.00)	645.00 (100.00)	0.00 (0.00)	503.10 (100.00)	0.00 (0.00)	438.60 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	450.00 (100.00)	0.00 (0.00)	600.00 (100.00)	0.00 (0.00)	550.00 (100.00)	0.00 (0.00)	550.00 (100.00)
All Comm	0.00 (0.00)	678.40 (100.00)	0.00 (0.00)	942.50 (100.00)	765.50 (30.29)	1760.60 (69.71)	1233.36 (48.02)	1335.50 (51.98)	1101.78 (50.71)	1071.10 (49.29)	531.72 (34.56)	1006.60 (64.44)
All	7058.20 (88.60)	908.40 (11.40)	18211.28 (91.89)	1607.50 (8.11)	23881.68 (85.11)	4045.36 (14.49)	10778.96 (77.95)	3048.24 (22.05)	4496.98 (64.60)	2464.66 (35.40)	4018.64 (70.91)	1648.84 (29.09)

Note: Figures in brackets show percentages to total.

firewood is in the 'less than 1000' category. For coconut residue and 'others', the highest consumption is in 'less than 1000' category. The proportion of commercial fuels like LPG, electricity and 'others' generally increases with income.

Table 5.14 presents the energy consumption pattern by the mode of procurement of fuel materials across the income groups. In all the income categories, the proportion of purchased fuels is less than the collected fuels. This trend is further intensified when the non-commercial fuels alone are considered. However, the share of purchased fuels increases with income.

Table 5.15 presents the energy consumption pattern by the end use of fuel material by income categories in SA III. It can be seen that, in all the income categories the share of fuels used for cooking is higher than the share used for 'lighting and others'. It may, however, be inferred that, the share of energy used for 'lighting and others' increases with income.

Energy consumption pattern of the sample households according to income categories for SA IV is presented in tables 5.16 (aggregate), 5.17 (per household and per capita) and 5.18 (by proportion). It may be observed from Table 5.16 that the energy consumption is the highest in the 1000-2000 income category (22576.46 10^{3} K.Cal.) and the lowest in the 4000-5000 category

(3378.82 10^{3} K.Cal). When the non-commercial fuels alone are considered, the same trend can be observed. For the commercial fuels, however the maximum consumption is in the ' 3000- 4000' income category and the lowest in the 'less than 1000' category.

When the income categories are considered individually, coconut residue (34.36 per cent) is the most important single fuel in the first income category (Table 5.16). In all other income categories, firewood is the most important single fuel. When the major fuels are considered independently (Table 5.18), the maximum amount of firewood is consumed in the 1000-2000 category in terms of aggregate and in 3000-4000 category in terms of per capita. As per aggregate figures, energy consumption is the lowest in the '4000-5000' category and in terms of per capita, it is in the '5000 and above' category. For coconut residue, the aggregate consumption is the highest in the 1000-2000 category and the per capita in the 'less than 1000' category. The lowest consumption of coconut residue is in the ' 5000 and above' category for both aggregate and per capita. For 'others' (non-commercial), the aggregate and per capita consumption is the highest in the ' less than 1000' category. Among commercial fuel, it can be seen that considerable amount of kerosene is being used in the 'less than

1000' category. This is due to the high level of energy requirement for 'lighting and others' in this category (Table 5.20).

Table 5.19 presents the energy consumption pattern by the mode of procurement of fuel material by income categories. It may be noted that in all the income categories, except 4000- 5000' the collected proportion is greater than the purchased proportion. However, this trend is reversed when extensively the non-commercial fuels are considered. A table 5.19 reveals that for all the income categories, the collected proportion is more than the purchased proportion. In this regard it is interesting to record that the purchased portion of the fuel increases with income for the first three income categories, but for the last three, this trend is not maintained. In fact the lowest share of the purchased fuel (10.13 per cent) is in the '5000 and above' category. It may further be noted from Table 5.19 that, for firewood, the purchased share is the highest in 2000-3000 category and the collected share in the '5000 and above' category. For coconut residue, it is interesting to note that the highest collected share (100 per cent) is in the highest two income categories. This high concentration of collected share of fuels in the highest income categories is perhaps due to the fact that, for these fuels, the high-income groups utilize whatever is available from their own land. It is also interesting to note from

Table 5.16

Energy consumption pattern of the sample house holds according to income categories **SA IV** (quantity in 10^{3} K.Cal)

Income Categories / Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Firewood	4055.36 (31.23)	8904.16 (39.44)	6612.00 (34.73)	3526.40 (36.84)	1366.48 (40.44)	1454.64 (32.06)	25919.64 (39.65)
Coconut Residue	4462.50 (34.36)	8575.00 (37.98)	4725.00 (24.82)	1855.00 (19.38)	735.00 (21.75)	1155.00 (25.46)	21507.50 (29.83)
Saw Dust	546.00 (4.20)	1029.00 (4.84)	1218.00 (6.40)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2856.00 (3.96)
Bio Gas	0.00 (0.00)	0.00 (0.00)	2988.68 (15.70)	2143.72 (22.39)	0.00 (0.00)	0.00 (0.00)	5132.40 (7.12)
Others	2910.00 (22.41)	2850.00 (12.62)	2220.00 (11.66)	210.00 (2.19)	0.00 (0.00)	0.00 (0.00)	8190.00 (11.36)
All Non Comm	11973.86 (92.21)	21421.16 (94.88)	17763.68 (93.30)	7735.12 (80.80)	2101.48 (62.20)	2609.64 (57.52)	63604.94 (88.23)
Kerosene	612.00 (4.71)	270.00 (1.20)	198.00 (1.04)	1197.00 (12.50)	153.00 (4.53)	234.00 (5.16)	2664.00 (3.70)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	421.74 (12.48)	383.40 (8.45)	805.14 (1.12)
Electricity	399.90 (3.08)	735.30 (3.26)	877.20 (4.61)	640.70 (6.69)	352.60 (10.44)	460.10 (10.14)	3465.80 (4.81)
Others	0.00 (0.00)	150.00 (0.66)	200.00 (1.05)	0.00 (0.00)	350.00 (10.36)	850.00 (18.73)	1550.00 (2.15)
All Commercial	1011.90 (9.79)	1155.30 (5.12)	1275.20 (6.70)	1873.70 (19.20)	1277.34 (37.80)	1927.50 (42.84)	8484.84 (11.77)
All	12985.76 (100.00)	22576.46 (100.00)	19038.88 (100.00)	9572.82 (100.00)	3378.82 (100.00)	4537.14 (100.00)	72089.88 (100.00)

Note: Figures in brackets show percentage to total.

Table 5.17

Per household and Per capita energy consumption by income categories **SA IV** (in 10^3K.Cal)

Inc Categ	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above		All	
Engy Type	Per H.H	Per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita	Per H.H	per Capita
FW	289.67	64.37	356.17	75.46	472.29	80.63	503.77	82.01	455.49	75.92	363.66	51.95	386.85	73.63
CR	297.50	73.16	329.81	71.46	363.46	60.58	309.17	48.82	245.00	49.00	288.75	41.25	321.01	63.26
SW	546.00	78.00	182.00	39.00	304.50	42.00	0.00	0.00	0.00	0.00	0.00	0.00	259.64	44.63
BG	0.00	0.00	0.00	0.00	2988.68	498.11	2143.72	267.97	0.00	0.00	0.00	0.00	2566.20	366.60
OTH	181.88	42.79	158.33	33.93	170.77	28.46	210.00	19.09	0.00	0.00	0.00	0.00	170.63	33.69
ANC	704.34	171.06	793.38	174.16	1184.25	201.86	966.89	151.67	525.37	95.52	625.41	93.20	848.07	166.51
KER	68.00	14.57	18.00	4.15	19.80	3.54	171.00	27.84	153.00	38.25	78.00	11.70	59.20	11.58
LPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	105.44	19.17	127.80	18.26	115.02	18.72
ELE	36.35	8.16	27.23	5.98	58.48	9.77	80.09	12.56	88.15	16.03	115.03	16.43	50.23	9.60
OTH	0.00	0.00	150.0	30.00	200.00	50.00	0.00	0.00	175.00	31.82	283.33	40.48	221.43	37.80
ALC	59.52	14.46	42.79	9.39	85.01	14.49	229.71	36.03	319.34	58.06	481.88	68.84	113.13	22.21
ALL	763.87	185.51	836.17	183.55	1269.26	216.35	1196.60	187.70	844.71	153.58	1134.29	162.04	961.20	188.72

Note : Per H.H = per house hold . FW = Fire Wood. CR = Coconut Residue. BG= Bio Gas ANC = All Non Commercial.
KER = Kerosene. OTH= Others . ELE= Elcetricity. ALC= All Commercial

Table 5.18

Energy consumption pattern by the proportion of fuels used by different income categories **SA IV**

Income Categories Energy Type	Less than 1000	1000-2000	2000-3000	3000-4000	4000-5000	5000and above	All
Fire Wood	15.65	34.35	25.51	13.61	5.27	5.61	100.00
Coconut Residue	20.75	39.87	21.97	8.62	3.42	5.37	100.00
Saw Dust	19.12	38.24	42.65	0.00	0.00	0.00	100.00
Bio Gas	0.00	0.00	58.23	41.77	0.00	0.00	100.00
Others	35.53	34.80	27.11	2.56	0.00	0.00	100.00
All Non Comm	18.83	33.68	27.93	12.16	3.30	4.10	100.00
Kerosene	22.97	10.14	7.43	44.93	5.74	8.78	100.00
LPG	0.00	0.00	0.00	0.00	52.38	47.62	100.00
Electricity	11.54	21.22	25.31	18.49	10.17	13.28	100.00
Others	0.00	9.68	12.90	0.00	22.58	58.84	100.00
All Commercial	11.93	13.62	15.03	21.66	15.05	22.72	100.00
All	18.01	31.32	26.41	13.28	4.69	6.29	100.00

Note: Figures in brackets show percentage to total.

Table 5.19

Energy consumption pattern by the mode of procurement of fuel material by income categories **SA IV** (in 10^3K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
Mode Energy Type	Purchased	collected	purchased	collected	purchased	Collected	purchased	collected	purchased	collected	purchased	Collected
Fire Wood	2248.08	1807.28	3967.20	4936.96	4319.84	2292.16	1763.20	1763.20	749.36	617.12	264.48	1190.16
	(55.43)	(44.57)	(44.55)	(55.45)	(65.33)	(34.67)	(50.00)	(50.00)	(54.84)	(45.16)	(18.18)	(81.82)
Coconut Resi-	1190.00	3272.50	2905.00	5670.00	1470.00	3255.00	175.00	1680.00	0.00	735.00	0.00	1155.000
	(26.67)	(73.33)	(33.88)	(66.12)	(31.11)	(68.89)	(9.43)	(90.57)	(0.00)	(100.00)	(0.00)	(100.00)
Saw Dust	546.00	0.00	1092.00	0.00	1218.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bio Gas	0.00	0.00	0.00	0.00	0.00	2988.68	2143.72	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Others	420.00	2490.00	240.00	2610.00	1530.00	0.00	210.00	0.00	0.00	0.00	0.00	0.00
	(14.43)	(85.57)	(8.42)	(91.58)	(68.92)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
All Non Comm	4404.08	7569.78	8204.20	13216.96	7697.84	10065.84	1938.20	5769.92	749.36	1352.12	264.48	2345.16
	(36.78)	(63.22)	(38.30)	(61.70)	(43.33)	(56.67)	(25.06)	(74.94)	(35.66)	(64.34)	(10.13)	(89.87)
All Comm	1011.90	0.00	1155.30	0.00	1275.20	0.00	1837.70	0.00	1277.34	0.00	1927.50	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)
All	5415.98	7569.78	9359.50	13216.96	8973.04	10065.84	3775.90	5796.92	2026.70	1352.12	2191.98	2345.16
	(41.17)	(58.29)	(41.46)	(58.54)	(47.13)	(52.87)	(39.44)	(60.56)	(59.98)	(40.02)	(48.31)	(51.69)

Note: Figures in brackets show percentages to total.

Table 5.20

Energy consumption pattern by the end use of fuel material by income categories **SA IV** (in 10^{3}K.Cal)

Income Category	less than 1000		1000-2000		2000-3000		3000-4000		4000-5000		5000and above	
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Fire Wood	3879.04 (95.65)	176.32 (4.35)	8816.00 (99.01)	88.16 (0.99)	6347.52 (96.00)	264.48 (4.00)	2997.44 (85.00)	528.96 (15.00)	1146.08 (83.87)	220.40 (16.13)	1366.48 (93.94)	88.16 (6.06)
Coconut Residue	4287.50 (96.08)	175.00 (3.92)	7700.00 (89.80)	875.00 (10.20)	4375.00 (92.59)	350.00 (7.41)	1400.00 (75.47)	455.00 (24.53)	420.00 (57.14)	315.00 (42.86)	700.00 (60.61)	455.00 (39.39)
Saw Dust	546.00 (100.00)	0.00 (0.00)	1029.00 (100.00)	0.00 (0.00)	1218.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2988.68 (100.00)	0.00 (0.00)	2143.72 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	(0.00) (0.00)
Others	2490.00 (93.56)	420.00 (14.43)	2670.00 (93.68)	180.00 (6.32)	1950.00 (87.84)	270.00 (12.16)	150.00 (71.43)	60.00 (28.57)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	0.00 (0.00)	612.00 (100.00)	20278.00 (94.66)	1143.16 (5.34)	16879.20 (95.02)	884.48 (4.98)	6691.16 (86.50)	1043.96 (13.50)	1566.08 (74.52)	535.40 (25.48)	2066.48 (79.19)	543.16 (20.81)
Kerosene	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	270.00 (100.00)	0.00 (0.00)	198.00 (100.00)	1125.00 (93.98)	72.00 (6.02)	135.00 (88.24)	18.00 (11.76)	180.00 (76.92)	54.00 (23.08)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	421.74 (100.00)	0.00 (0.00)	383.40 (100.00)	0.00 (00.00)
Electricity	0.00 (0.00)	399.90 (100.00)	0.00 (0.00)	735.30 (100.00)	0.00 (0.00)	877.20 (100.00)	0.00 (0.00)	640.00 (100.00)	0.00 (0.00)	352.60 (100.00)	0.00 (0.00)	460.10 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)	000.00 (0.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	850.00 (100.00)
All Comm	0.00 (0.00)	1011.90 (100.00)	0.00 (0.00)	1155.30 (100.00)	0.00 (0.00)	1275.20 (100.00)	1125.00 (61.22)	712.70 (38.78)	556.74 (43.59)	720.60 (56.41)	563.40 (29.23)	1364.10 (70.77)
All	11202.54 (86.27)	1783.22 (13.73)	20278.00 (89.82)	2298.46 (10.18)	16879.20 (88.66)	2159.68 (11.34)	7816.16 (81.65)	1756.66 (18.35)	2122.82 (62.83)	1256.00 (37.17)	2629.88 (57.96)	1907.26 (42.04)

Note: Figures in brackets show percentages to total.

Table 5.19 that none of the households in the highest income categories use 'others' (non-commercial).

Table 5.20 shows energy consumption pattern by the end use of fuel materials. In all the income categories, the share of fuels used for cooking is greater than that used for ' lighting and others'. When the non-commercial fuels alone are considered, this trend is further intensified. On the other hand, when the commercial fuels alone are considered, it can be seen that none of the households in the lowest three income categories use commercial fuels for cooking.

5.3 Size of land holding

Energy consumption at the household level is related to the ownership of or accessibility to land resources. The availability of non-commercial sources is directly linked to the land resources held by a household. The affordability of commercial sources is also linked indirectly to the possession of land holding, since it is the most important asset in rural areas. However as already seen in section 4.4, the extent of influence of land resources on the energy consumption pattern varies considerably across geo-climatic regions.

The present analysis examines the energy consumption pattern of the sample households across twelve, land-holding categories.

The distribution of the households across the land holding categories was presented in an earlier table (Table 4.6). However, considering the number of households in each category and for the convenience of analysis, some rearrangements were made in the size of land holding categories in the present analysis.

Information on the energy consumption pattern of the sample households across land holding categories for SA I is presented in Table 5.21 (aggregate), 5.22 (per household and per capita) and 5.23 (by proportion). It can be seen from Table 5.21 that energy consumption is the highest in the land holding category 'less than 1'(28492.08 10^3 K.Cal) and the lowest in the '15 and above' category (1195.80 10^3 K.Cal), with the exception of 'rented' category. However, the per capita energy consumption is the highest in the 11-13 category and the lowest in the 3-4 category, with the exception of rented category (Table 5.22). When only the non-commercial fuels are considered, the maximum use is in the 'less than 1' category and the minimum in the 'rented, category. If only the commercial fuels are considered, energy consumption is the highest in the 1-2 category and the lowest in the 7-9 category (excluding rented). When the fuels are considered individually, for firewood and coconut residue the maximum amount is consumed in the 'less thanl' category and the minimum amount is consumed in the '15 and above' category. It may be noted that households with low land holding size are consuming comparatively more coconut residue and firewood. Table 5.23 further reveals that 68.37 per cent of 'others' is consumed in 'less than1' category. It is interesting to note that the amount of commercial fuels consumed, especially kerosene and electricity, decreases as the size of land holding increases.

Table 5.24 shows the energy consumption pattern by the mode of procurement of fuel material by the size of land holding in study area I. It is interesting to note that the proportion of purchased fuels is greater than the proportion of collected fuels for all the land holding categories except 5-7 and 7-9. This behavior can be further examined if the non-commercial fuels and commercial fuels are considered separately. It can be observed from Table 5.24 that the proportion of purchased fuels is greater in the lower land holding categories than the higher categories. Hence it is clear that households possessing higher land holdings depend more on collected fuels. Table 5.24 further reveals that for the lower income categories firewood is the mostly a purchased fuel where as coconut residue is the mostly a collected fuel.

Table 5.25 shows the energy consumption pattern by the end use of fuel material according to size of land holding. It can be seen

Table 5.21

Energy consumption pattern of sample households by size of land holding SA **I** (in 10^3kcal)

L.H Size Energy Type	Less than 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 7	7 - 9	9 - 11	11 - 13	13 - 15	15&above	Rented
Fire Wood	8176.84 (28.70)	4672.48 (30.19)	1653.00 (25.06)	881.60 (21.78)	1300.36 (34.75)	2953.36 (47.28)	1520.76 (36.34)	0.00 (0.00)	595.08 (49.43)	0.00 (0.00)	352.64 (29.49)	88.16 (28.42)
Coconut Residue	15610.00 (54.79)	7017.50 (45.34)	3570.00 (54.12)	1085.00 (26.80)	1400.00 (37.42)	1715.00 (27.46)	1645.00 (39.31)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	105.00 (8.78)	210.00 (67.70)
Saw Dust	1470.00 (5.16)	798.00 (5.16)	630.00 (9.55)	378.00 (9.34)	378.00 (10.10)	0.00 (0.00)	798.00 (19.07)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	2010.00 (7.05)	810.00 (5.23)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	120.00 (1.92)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Com	27266.84 (95.70)	13927.98 (85.92)	5853.00 (88.73)	2344.60 (57.91)	3078.36 (82.27)	4788.36 (76.66)	3963.76 (94.72)	0.00 (0.00)	595.08 (49.43)	0.00 (0.00)	457.64 (38.27)	298.16 (96.12)
Kerosene	594.00 (2.08)	1251.00 (8.08)	216.00 (3.27)	981.00 (24.23)	288.00 (7.70)	756.00 (12.10)	18.00 (0.43)	0.00 (0.00)	135.00 (11.21)	0.00 (0.00)	180.00 (15.05)	0.00 (0.00)
LPG	0.00 (0.00)	153.36 (0.99)	230.04 (3.49)	115.02 (2.84)	153.36 (4.10)	76.68 (1.23)	0.00 (0.00)	0.00 (0.00)	153.36 (12.74)	0.00 (0.00)	153.36 (12.82)	0.00 (0.00)
Electricity	631.24 (2.22)	423.98 (2.74)	297.56 (4.51)	357.76 (8.84)	221.88 (5.93)	424.84 (6.80)	202.96 (4.85)	0.00 (0.00)	120.00 (10.00)	0.00 (0.00)	154.80 (12.95)	12.04 (3.88)
Others	0.00 (0.00)	350.00 (2.26)	0.00 (0.00)	250.00 (6.18)	0.00 (0.00)	200.00 (3.20)	0.00 (0.00)	0.00 (0.00)	200.00 (16.61)	0.00 (0.00)	250.00 (20.91)	0.00 (0.00)
All Comm	1225.24 (4.30)	2178.34 (14.08)	743.60 (11.27)	1703.78 (42.09)	663.24 (17.73)	1457.52 (23.34)	220.96 (5.28)	0.00 (0.00)	608.76 (50.57)	0.00 (0.00)	738.16 (61.73)	12.04 (3.88)
All	28492.08 (100.00)	15476.32 (100.00)	6596.60 (100.00)	4048.38 (100.00)	3741.60 (100.00)	6245.88 (100.00)	4184.72 (100.00)	0.00 (100.00)	1203.84 (100.00)	0.00 (100.00)	1195.80 (100.00)	310.20 (100.000)

Note: 1) Figures in brackets show percentages 2) L.H = Land Holding

Table 5.22

Per house hold and per capita energy consumption size of land holding SA I (in 10^3 kcal)

L.H Size	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5- 7
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H
Fire Wood	302.85	57.99	274.85	59.90	275.50	57.00	176.32	41.98	433.45	76.49	590.67
Coconut Residue	557.50	109.16	412.79	89.97	446.25	99.17	271.25	63.82	700.00	116.67	285.83
Saw Dust	245.00	35.00	399.00	46.94	210.00	52.50	189.00	47.25	378.00	54.00	0.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	182.73	36.55	162.00	38.57	0.00	0.00	0.00	0.00	0.00	0.00	120.00
All Non Comm	973.82	190.68	782.23	170.49	731.63	162.58	468.92	111.65	1206.12	181.08	798.06
Kerosene	34.94	6.00	96.23	20.18	72.00	18.00	245.25	57.71	144.00	24.00	151.20
LPG	0.00	0.00	153.36	30.67	230.04	57.51	115.02	28.76	153.36	30.67	76.68
Electricity	24.28	4.57	28.27	6.48	37.20	8.27	59.63	14.31	73.96	13.05	70.81
Others	0.00	0.00	175.00	26.92	0.00	0.00	125.00	27.78	0.00	0.00	100.00
All Comm	43.76	8.57	121.02	26.25	92.95	20.66	283.96	68.15	221.08	39.01	242.92
All	1017.57	199.25	859.80	186.46	824.58	183.24	674.73	161.94	1247.20	220.09	1040.98

Note: (1) L.H = Land Holding.

(2) Since there are no house holds in categories 9 – 11 and 13 – 15, they are not shown in this table.

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L.H Size / Energy Type	5 - 7 Per Capita	7 - 9 Per H.H	7 - 9 Per Capita	11– 13 Per H.H	11– 13 Per Capita	15 and above Per H.H	15 and above Per Capita	Rented Per H.H	Rented Per Capita	All Per H.H	All Per Capita
Fire Wood	88.86	506.92	80.04	595.08	119.02	352.64	58.77	88.16	44.08	321.66	63.05
Coconut Residue	45.13	548.33	86.58	0.00	0.00	105.00	17.50	210.00	105.00	462.25	92.19
Saw Dust	0.00	266.00	42.00	0.00	0.00	0.00	0.00	0.00	0.00	261.88	42.40
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	172.94	35.85
All Non Comm	126.01	321.25	208.62	595.08	119.02	457.64	76.27	298.16	149.08	848.54	169.71
Kerosene	22.24	18.00	3.60	135.00	27.00	180.00	30.00	0.00	0.00	94.02	17.54
LPG	19.17	0.00	0.00	153.36	30.67	153.36	25.56	0.00	0.00	147.88	31.37
Electricity	11.18	67.65	10.68	120.40	24.08	154.80	25.80	12.04	6.02	40.68	8.18
Others	20.00	0.00	0.00	200.00	40.00	250.00	41.67	0.00	0.00	156.25	29.07
All Commercial	38.36	73.65	11.63	608.76	121.75	738.16	123.03	12.04	6.02	127.36	25.54
All	164.37	394.91	220.25	1203.84	240.77	1195.80	199.30	310.20	155.10	953.27	176.53

Note: (1) L.H = Land Holding.

(2) Since there are no house holds in categories 9 – 11 and 13 – 15, they are not shown in this table

Table 5.23

Energy consumption pattern by the proportion of fuels used by size of land holding SA I

L.H Size Energy Type	Less than 1	1-2	2-3	3-4	4-5	5-7	7-9	11-13	15and above	Rented	All
Fire Wood	36.84	21.05	7.45	3.97	5.86	13.31	6.85	2.68	1.59	0.40	100.00
Coconut Residue	48.24	21.69	11.03	3.35	4.33	5.30	5.08	0.00	0.32	0.65	100.00
Saw Dust	33.02	17.92	14.15	8.49	8.49	0.00	17.92	0.00	0.00	0.00	100.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00
Others	68.37	27.55	0.00	0.00	0.00	4.08	0.00	0.00	0.00	0.00	100.00
All Non Comm	44.02	21.47	9.45	3.79	4.97	7.73	6.40	0.96	0.74	0.48	100.00
Kerosene	13.44	28.31	4.89	22.20	6.52	17.11	0.41	3.05	4.07	0.00	100.00
LPG	0.00	14.81	22.22	11.11	14.81	7.41	0.00	14.81	14.81	0.00	100.00
Electricity	22.17	14.89	10.45	12.56	7.79	14.92	7.13	4.23	5.44	0.42	100.00
Others	0.00	28.00	0.00	20.00	0.00	16.00	0.00	16.00	20.00	0.00	100.00
All Commercial	12.83	22.81	7.79	17.84	6.94	15.26	2.31	6.37	7.73	0.13	100.00
All	39.85	21.65	9.23	5.66	5.23	8.74	5.85	1.68	1.67	0.43	100.00

Note: (1) L.H = Land Holding

(2) Since there are no house holds in categories 9 – 11 and 13 – 15, they are not shown in the table.

Table 5.24

Energy consumption pattern by the mode of procurement of fuel material by size of land holding **SA I** (in 10^3 kcal)

L.H Categories	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5- 7
End Use / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	5884.68 (71.97)	2292.16 (28.03)	3724.76 (79.72)	947.72 (20.28)	1300.36 (78.67)	352.64 (21.33)	528.96 (60.00)	352.64 (40.00)	617.12 (47.46)	683.24 (52.54)	1124.04 (38.06)
Coconut Residue	7472.50 (47.87)	8137.50 (52.13)	3290.00 (46.88)	3727.50 (53.12)	1470.00 (41.18)	2100.00 (58.82)	350.00 (32.26)	735.00 (67.74)	542.50 (38.75)	857.50 (61.25)	0.00 (0.00)
Saw Dust	1470.00 (100.00)	0.00 (0.00)	798.00 (100.00)	0.00 (0.00)	630.00 (100.00)	0.00 (0.00)	3780.00 (100.00)	0.00 (0.00)	378.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	1530.00 (76.12)	480.00 (23.88)	360.00 (44.44)	450.00 (55.56)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	16357.18 (59.99)	10909.66 (40.01)	8172.76 (61.46)	5125.22 (38.54)	3400.36 (58.10)	2452.64 (41.90)	1256.96 (53.61)	1087.64 (46.39)	1537.62 (49.95)	1540.74 (50.05)	1124.04 (23.47)
All Comm	1225.24 (100.00)	0.00 (0.00)	2178.34 (100.00)	0.00 (0.00)	743.60 (100.00)	0.00 (0.00)	1703.78 (100.00)	0.00 (0.00)	663.24 (100.00)	0.00 (0.00)	1457.52 (100.00)
All	17582.42 (61.71)	10909.66 (38.29)	10351.10 (66.88)	5125.22 (33.12)	4143.96 (62.82)	2452.64 (37.18)	2960.74 (73.13)	1087.64 (26.87)	2200.86 (58.82)	1540.74 (41.18)	2581.56 (41.33)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table.

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L.H Categories End Use Energy Type	5 - 7 Collected	7 - 9 Purchased	7 - 9 Collected	11 - 13 Purchased	11 - 13 Collected	15 and above Purchased	15 and above Collected	Rented Purchased	Rented Collected	All Purchased	All Collected
Fire Wood	1829.32 (61.94)	506.92 (33.33)	1013.84 (66.67)	198.36 (33.33)	396.72 (66.67)	110.20 (31.25)	242.44 (68.75)	88.16 (100.00)	0.00 (0.00)	14083.58 (63.46)	8110.72 (36.54)
Coconut Residue	1715.00 (100.00)	0.00 (0.00)	1645.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	105.00 (100.00)	210.00 (100.00)	0.00 (0.00)	13335.00 (41.21)	19022.50 (58.79)
Saw Dust	0.00 (0.00)	798.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4452.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	120.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1890.00 (64.29)	1050.00 (35.71)
All Non Comm	3664.32 (76.53)	1304.92 (32.92)	2658.84 (67.08)	198.36 (33.33)	396.72 (66.67)	110.20 (24.08)	347.44 (75.92)	298.16 (100.00)	0.00 (0.00)	33760.56 (54.50)	28183.22 (45.50)
All Commercial	0.00 (0.00)	220.96 (100.00)	0.00 (0.00)	608.76 (100.00)	0.00 (0.00)	783.16 (100.00)	0.00 (0.00)	12.04 (100.00)	0.00 (0.00)	9551.64 (100.00)	0.00 (0.00)
All	3664.32 (58.67)	1525.88 (36.46)	2658.84 (63.54)	807.36 (67.05)	396.72 (32.95)	848.36 (70.94)	347.44 (29.06)	310.20 (100.00)	0.00 (0.00)	43312.44 (60.58)	28183.22 (39.42)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table

Table 5.25

Energy consumption pattern by the end use of fuel materials by size of land holding **SA I** (in 10^3 kcal)

L.H Categories	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5 - 7
End Use Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light& Others	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	7808.16 (95.42)	374.68 (4.58)	4385.96 (93.87)	286.52 (6.13)	1520.76 (92.00)	123.24 (8.00)	793.44 (90.00)	88.16 (10.00)	1035.88 (79.66)	264.48 (20.34)	2424.40 (82.09)
Coconut Residue	15610.00 (100.00)	0.00 (0.00)	6842.50 (97.51)	175.00 (2.49)	3185.00 (89.22)	385.00 (10.78)	892.50 (82.26)	192.50 (17.74)	1120.00 (80.00)	280.00 (20.00)	980.00 (57.14)
Saw Dust	1470.00 (100.00)	0.00 (0.00)	798.00 (100.00)	0.00 (0.00)	630.00 (100.00)	0.00 (0.00)	378.00 (100.00)	0.00 (0.00)	378.00 (100.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	1890.00 (94.03)	120.00 (5.97)	690.00 (85.19)	120.00 (14.81)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Comm	26772.16 (98.19)	494.68 (1.81)	12716.46 (95.63)	581.52 (4.37)	5335.76 (91.16)	517.24 (8.84)	2063.94 (88.03)	280.66 (11.97)	2533.88 (82.31)	544.48 (17.69)	3404.40 (71.10)
Kerosene	0.00 (0.00)	594.00 (100.00)	585.00 (46.76)	666.00 (53.24)	180.00 (83.33)	36.00 (16.67)	945.00 (96.33)	36.00 (3.67)	270.00 (93.75)	18.00 (6.25)	738.00 (97.62)
LPG	0.00 (0.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	230.04 (100.00)	0.00 (0.00)	115.02 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	76.68 (100.00)
Electricity	0.00 (0.00)	631.24 (100.00)	0.00 (0.00)	423.98 (100.00)	0.00 (0.00)	297.56 (100.00)	0.00 (0.00)	357.76 (100.00)	0.00 (0.00)	221.88 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Comm	0.00 (0.00)	1225.24 (100.00)	738.36 (33.90)	1439.98 (66.10)	410.04 (55.14)	333.56 (44.86)	1060.02 (62.22)	643.76 (37.78)	423.36 (63.83)	239.88 (36.17)	814.68 (55.89)
All	26772.16 (93.96)	1719.92 (6.04)	13454.82 (86.94)	2021.50 (13.06)	5745.80 (87.10)	850.80 (12.90)	3123.96 (77.17)	924.42 (22.83)	2957.24 (79.04)	784.36 (20.96)	4219.08 (67.55)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table.

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L.H Categories	5 - 7	7 - 9		11 - 13		15 and above		Rented		All	
End Use / Energy Type	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Fire Wood	528.96 (17.91)	1388.52 (91.30)	132.24 (8.70)	396.72 (66.67)	196.36 (33.33)	264.48 (75.00)	88.16 (25.00)	88.16 (100.00)	0.00 (0.00)	20100.48 (90.57)	2093.00 (9.43)
Coconut Residue	735.00 (42.86)	1330.00 (80.85)	315.00 (19.15)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	105.00 (100.00)	210.00 (100.00)	0.00 (0.00)	30170.00 (93.24)	2187.50 (6.76)
Saw Dust	0.00 (0.00)	798.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4452.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	120.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2580.00 (87.76)	360.00 (12.24)
All Non Comm	1383.96 (28.90)	3518.52 (88.72)	447.24 (11.28)	396.72 (66.67)	198.36 (33.33)	264.48 (57.79)	193.16 (42.21)	298.16 (100.00)	0.00 (0.00)	57302.48 (92.51)	4146.30 (9.49)
Kerosene	18.00 (2.38)	0.00 (0.00)	18.00 (100.00)	135.00 (100.00)	0.00 (0.00)	180.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3033.00 (68.64)	1386.00 (31.36)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	153.00 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1035.18 (100.00)	0.00 (0.00)
Electricity	424.84 (100.00)	0.00 (0.00)	202.96 (100.00)	0.00 (0.00)	120.40 (100.00)	0.00 (0.00)	154.80 (100.00)	0.00 (0.00)	12.04 (100.00)	0.00 (0.00)	2847.46 (100.00)
Others	200.000 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1250.00 (100.00)
All Commercial	642.84 (44.11)	0.00 (0.00)	220.96 (100.00)	288.36 (47.37)	320.40 (52.63)	333.36 (45.16)	404.80 (54.84)	0.00 (0.00)	12.04 (100.00)	4068.18 (42.59)	5483.46 (57.41)
All	2026.80 (32.45)	3516.52 (84.03)	15.97 (15.97)	685.08 (59.61)	518.76 (43.09)	597.84 (49.99)	597.96 (50.01)	298.16 (96.12)	12.04 (3.88)	61370.66 (85.84)	10124.76 (14.16)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 -- 15, they are not shown in this table

from the table that in all the categories with the slight exception of '15 and above', cooking has dominance as an end use. The dominance of cooking is more evident when only the non-commercial fuels are considered. For the commercial fuels, it may be observed from the table that the proportion of energy used for cooking increases with the land holding size. Her it may be noted that, with increase in the size of land holding the proportion of non-commercial fuels like firewood and coconut residue used for 'lighting and others' increases.

The energy consumption pattern in SA II according to land holding category is shown in tables 5.26 (aggregate) 5.27 (Per household and per capita) and 5.28 (by proportion). Table 5.26 reveals that the highest energy consumption in study area II is in the 1-2 category and the lowest in the 9-11 category. When the non-commercial fuels alone are considered this trend is further confirmed. However, when only the commercial fuels are considered, the highest energy consumption is in the 3-4 category and lowest in the 9-11 category. When the fuels are considered individually, it can be seen that firewood is the most important fuel in most of the land holding categories. The quantity of coconut residue is the highest in the 1-2 category and the lowest in the 7-9 category. The per capita figures confirm the above trends (Table 5.27).

Table 5.29 presents the energy consumption pattern by the mode of procurement of the fuel material by size of land holding. It can be noted that the share of purchased fuels increases up to the 4-5 category reaching a maximum of 62.25 per cent, but then decreases for the remaining categories reaching a minimum of 3.12 per cent for the '15 and above' category. The table further reveals that for majority of the land holding categories the proportion of collected non-commercial fuels is greater than the purchased. However, firewood is mostly purchased where as coconut residue and others are mostly collected.

Table 5.30 shows the energy consumption pattern by the end use of fuel materials according to the size of land holding. It can be seen from the table that the share of fuel materials used for cooking shows sign of stagnation. When the non-commercial fuels alone are considered, the share of fuels used for cooking is higher than that used for 'lighting and others' in all the land holding categories. It is wise to mention that the share of non-commercial fuels used for 'lighting and others' increases with the possession of land holding. This behavior may be due to the fact that when the households get fuel material free of cost, they tend to use it for less important end

Table 5.26

Energy consumption pattern by sample house holds by size of land holding SA II (in 10^3kcal)

L.H Size / Energy Type	Less than 1	1-2	2-3	3-4	4-5	5-7	7-9	9-11	11-13	13-15	15&above	Rented
Fire Wood	4914.92 (49.14)	9455.16 (47.96)	6083.04 (43.35)	3306.00 (38.15)	952.68 (25.85)	2262.76 (39.00)	1829.32 (56.33)	198.36 (17.69)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1498.72 (39.63)
Coconut Residue	2940.00 (29.39)	5530.00 (28.05)	4340.00 (30.93)	2730.00 (31.51)	805.00 (22.48)	1802.50 (26.80)	490.00 (15.09)	455.00 (40.57)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1120.00 (29.61)
Saw Dust	630.00 (6.30)	1029.00 (5.54)	966.00 (6.88)	210.00 (2.42)	0.00 (0.00)	294.00 (4.37)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	756.00 (19.99)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (96.88)	0.00 (0.00)
Others	660.00 (6.60)	1905.00 (9.66)	840.00 (5.99)	330.00 (3.81)	270.00 (7.54)	690.00 (10.26)	0.00 (0.00)	390.00 (34.77)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	300.00 (7.93)
All Non Com	9144.92 (91.43)	17982.16 (91.22)	12229.04 (87.15)	6576.00 (75.89)	2000.68 (55.87)	5409.26 (80.44)	2319.32 (71.42)	1043.36 (93.03)	0.00 (0.00)	0.00 (0.00)	2961.00 (96.88)	3674.00 (97.16)
Kerosene	567.00 (5.67)	549.00 (2.78)	981.00 (6.99)	675.00 (7.79)	666.00 (18.60)	468.00 (6.96)	0.00 (0.00)	18.00 (1.60)	0.00 (0.00)	0.00 (0.00)	18.00 (0.59)	0.00 (0.00)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	223.65 (2.58)	287.55 (8.03	191.70 (2.85)	255.60 (7.87)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Electricity	290.68 (2.91)	782.60 (3.97)	571.90 (4.08)	490.20 (5.66)	326.80 (9.13)	455.80 (6.78)	322.50 (9.93)	60.20 (5.37)	0.00 (0.00)	0.00 (0.00)	77.40 (2.53)	107.50 (2.84)
Others	0.00 (0.00)	400.00 (2.03)	250.00 (1.78)	700.00 (8.08)	300.00 (8.38)	200.00 (2.97)	350.00 (10.78)	0.00 (0.00)	0.00 (0.00)	0.000 (0.00)	0.00 (0.00)	0.00 (0.00)
All Comm	857.68 (8.57)	1731.60 (8.78)	1802.90 (12.85)	2088.85 (24.11)	1580.35 (44.13)	1315.50 (19.56)	928.10 (28.58)	78.20 (6.97)	0.00 (0.00)	0.00 (0.00)	95.40 (3.12)	107.50 (2.84)
All	10002.60 (100.00)	19713.76 (100.00)	14031.94 (100.00)	8664.85 (100.00)	3581.03 (100.00)	6724.76 (100.00)	3247.42 (100.00)	1121.56 (100.00)	0.00 (0.00)	0.00 (0.00)	3056.40 (100.00)	3782.22 (100.000)

Note: 1) Figures in brackets show percentages.2) L.H = Land Holding

Table 5.27

Per household and per capita energy consumption size of land holding SA II (in 10^3 K.Cal)

L.H Size	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5- 7
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H
Fire Wood	351.07	94.52	450.25	94.55	467.93	85.68	472.29	94.46	308.56	51.43	655.69
Coconut Residue	226.15	68.37	291.05	59.46	333.85	61.13	303.33	62.05	268.33	50.31	300.42
Saw Dust	210.00	45.00	218.40	43.68	193.20	31.16	210.00	30.00	0.00	0.00	294.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	94.29	22.00	146.54	28.86	168.00	31.00	165.00	27.50	270.00	54.00	345.00
All Non Comm	609.66	172.55	856.29	179.82	940.70	172.24	730.67	149.45	500.17	90.94	901.54
Kerosene	63.00	18.29	45.75	10.36	81.75	15.09	84.38	17.31	166.50	30.27	156.00
LPG	0.00	0.00	0.00	0.00	0.00	0.00	111.83	24.85	143.78	28.76	95.85
Electricity	24.22	6.76	37.27	7.83	43.99	8.05	61.28	11.67	81.70	14.85	75.97
Others	0.00	0.00	200.00	44.44	125.00	20.83	233.33	50.00	150.00	27.27	200.00
All Comm	57.18	16.18	82.46	17.32	138.68	25.39	232.09	47.477	395.09	71.83	219.25
All	666.84	188.73	938.75	197.14	1079.38	197.63	962.76	196.93	895.23	162.77	1120.79

Note: (1) L.H = Land Holding.

(2) Since there are no house holds in categories 11- 13 and 13 – 15, they are not shown in this table.

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L.H Size	5 - 7	7 - 9		9– 11		15 and above		Rented		All	
Energy Type	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	104.91	609.77	79.54	198.36	39.67	0.00	0.00	749.36	83.26	0.00	0.00
Coconut Residue	56.33	245.00	37.69	455.00	91.00	0.00	0.00	560.00	62.22	297.24	60.34
Saw Dust	49.00	0.00	0.00	0.00	0.00	0.00	0.00	378.00	42.00	232.24	39.09
Bio Gas	0.00	0.00	0.00	0.00	0.00	2961.00	592.20	0.00	0.00	2961.00	592.20
Others	49.29	0.00	0.00	390.00	78.00	0.00	0.00	300.00	27.27	168.28	31.68
All Non Comm	169.04	773.11	100.84	1043.36	208.67	2961.00	592.20	1837.36	204.15	844.54	169.81
Kerosene	39.00	0.00	0.00	18.00	3.60	18.00	3.60	0.00	0.00	78.84	16.99
LPG	27.39	127.80	17.04	0.00	0.00	0.00	0.00	0.00	0.00	119.81	23.28
Electricity	14.24	107.50	14.02	60.20	12.04	77.40	15.48	53.75	5.97	49.09	9.66
Others	50.00	175.00	26.92	0.00	0.00	0.00	0.00	0.00	0.00	183.33	34.92
All Commercial	41.11	309.37	40.35	78.20	15.64	95.40	19.08	53.75	5.97	141.15	28.38
All	210.15	1082.47	141.19	1121.56	224.31	3056.40	611.28	1891.11	210.12	985.69	198.19

Note: (1) L.H = Land Holding.
(2) Since there are no house holds in categories 11- 13 and 13 – 15, they are not shown in this table

Table 5.28
Energy consumption pattern by the proportion of fuels used by size of land holding SA II

L.H Size / Energy Type	Less than 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 7	7 - 9	9 - 11	11 – 13	13 - 15	15 and above	Rented	All
FW	15.94	30.66	19.73	10.72	3.00	8.51	5.93	0.64	0.00	0.00	0.00	4.86	100.00
CR	14.55	27.36	21.47	13.51	3.98	8.92	2.42	2.25	0.00	0.00	0.00	5.54	100.00
SW	15.96	27.66	24.47	5.32	0.00	7.45	0.00	0.00	0.00	0.00	0.00	19.15	100.00
BG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	100.00
OTH	12.26	35.38	15.60	6.13	5.01	12.81	0.00	7.24	0.00	0.00	0.00	5.57	100.00
ANC	14.44	28.39	19.31	10.38	3.16	8.54	3.66	1.65	0.00	0.00	4.67	5.80	100.00
KER	14.38	13.93	24.89	17.12	16.89	11.87	0.00	0.46	0.00	0.00	0.46	0.00	100.00
LPG	0.00	0.00	0.00	23.33	30.00	20.00	26.67	0.00	0.00	0.00	0.00	0.00	100.00
ELE	8.34	22.45	16.41	14.06	9.38	13.08	9.25	1.73	0.00	0.00	2.22	3.08	100.00
OTH	0.00	18.18	11.36	31.82	13.64	9.09	15.91	0.00	0.00	0.00	0.00	0.00	100.00
ALC	8.10	16.36	17.03	19.73	14.93	12.43	8.77	0.74	0.00	0.00	0.90	1.02	100.00
ALL	13.53	26.67	18.98	11.72	4.84	9.10	4.39	1.52	0.00	0.00	4.13	5.12	100.00

Note: (1) L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

Table 5.29

Energy consumption pattern by the mode of procurement of fuel material by size of land holding **SA II** (in 10^3 K.Cal)

L.H Categories	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5- 7
End Use / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	2821.12 (57.40)	2093.80 (42.60)	6744.24 (71.33)	2710.92 (28.67)	3857.00 (63.41)	2226.04 (36.59)	1851.36 (56.00)	1454.64 (44.00)	528.96 (57.14)	396.72 (42.86)	140.056 (53.78)
Coconut Residue	560.00 (19.05)	2380.00 (80.95)	962.050 (17.41)	4567.50 (82.59)	1207.50 (27.82)	3132.50 (72.18)	507.50 (18.59)	2222.50 (81.41)	0.00 (0.00)	805.00 (100.00)	0.00 (0.00)
Saw Dust	630.00 (100.00)	0.00 (0.00)	1092.00 (100.00)	0.00 (0.00)	966.00 (100.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	294.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	270.00 (40.91)	390.00 (59.09)	810.00 (42.52)	1095.00 (57.48)	360.00 (42.86)	480.00 (57.14)	150.00 (45.45)	180.00 (54.55)	120.00 (44.44)	150.00 (55.56)	330.00 (47.83)
All Non Comm	4281.12 (46.81)	4863.80 (53.19)	9608.74 (53.43)	8373.42 (46.57)	6390.50 (52.26)	5838.54 (47.74)	2718.86 (41.35)	3857.14 (58.65)	648396 (32.44)	1351.72 (67.56)	2034.56 (37.61)
All Comm	857.68 (100.00)	0.00 (0.00)	1731.60 (100.00)	0.00 (0.00)	1802.90 (100.00)	0.00 (0.00)	2088.85 (100.00)	0.00 (0.00)	1580.35 (100.00)	0.00 (0.00)	1315.50 (100.00)
All	5138.80 (51.37)	4863.80 (48.63)	11340.34 (57.52)	8373.42 (42.48)	8193.40 (58.39)	5838.54 (41.61)	4807.71 (55.49)	3857.14 (44.51)	2229.31 (62.25)	1351.72 (37.75)	3350.06 (49.82)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table.

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L.H Categories	5 - 7	7 - 9		11 - 13		15 and above		Rented		All	
End Use Energy Type	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	1212.20 (46.22)	617.12 (33.73)	1212.20 (66.27)	88.16 (44.44)	110.20 (55.56)	0.00 (0.00)	0.00 (0.00)	1498.72 (100.00)	0.00 (0.00)	19417.24 (62.97)	11416.72 (37.03)
Coconut Residue	1802.50 (100.00)	0.00 (0.00)	490.00 (100.00)	0.00 (0.00)	455.00 (100.00)	0.00 (0.00)	0.00 (0.00)	945.00 (84.38)	175.00 (15.63)	4182.50 (20.69)	16030.00 (79.31)
Saw Dust	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	756.00 (100.00)	0.00 (0.00)	3948.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (1000.00)
Others	330.00 (47.83)	360.00 (52.17)	0.00 (0.00)	0.00 (0.00)	180.00 (46.15)	210.00 (53.85)	0.00 (0.00)	0.00 (0.00)	300.00 (100.00)	2520.00 (46.80)	2865.00 (53.20)
All Non Comm	3374.70 (62.39)	617.12 (26.61)	1702.20 (73.39)	268.16 (25.70)	775.20 (74.30)	0.00 (0.00)	2961.00 (100.00)	3499.72 (95.24)	175.00 (4.76)	30067.74 (47.47)	33272.72 (52.53)
All Commercial	0.00 (0.00)	928.10 (100.00)	0.00 (0.00)	78.20 (100.00)	0.00 (0.00)	95.40 (100.00)	0.00 (0.00)	107.50 (100.00)	0.00 (0.00)	10586.08 (100.00)	0.00 (0.00)
All	3374.70 (50.18)	1545.22 (47.58)	1702.20 (52.42)	346.36 (30.88)	775.20 (69.12)	95.40 (3.12)	2961.00 (96.88)	3607.22 (95.37)	175.00 (4.63)	40653.82 (54.99)	33272.72 (45.01)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table

Table 5.30

Energy consumption pattern by the end use of fuel materials by size of land holding **SA II** (in 10^3 K.Cal)

L.H Size	Less than 1		1 – 2		2 – 3		3 – 4		4 – 5		5-7
End Use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	4286.76 (98.21)	88.16 (1.79)	9455.16 (100.00)	0.00 (0.00)	5972.84 (98.19)	110.20 (1.81)	3041.52 (92.00)	264.48 (8.00)	837.52 (90.48)	88.16 (9.52)	2380.32 (90.76)
Coconut Residue	2800.00 (95.24)	140.00 (4.76)	5215.00 (94.30)	315.00 (5.70)	3727.50 (85.89)	612.50 (14.11)	2100.00 (76.92)	630.00 (23.08)	455.00 (56.52)	350.00 (43.48)	1155.00 (64.08)
Saw Dust	567.00 (90.00)	63.00 (10.00)	1008.00 (92.31)	84.00 (7.69)	966.00 (100.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	294.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	660.00 (100.00)	0.00 (0.00)	1455.00 (92.38)	450.00 (23.62)	600.00 (71.43)	240.00 (28.57)	270.00 (81.82)	60.00 (18.18)	195.00 (72.22)	75.00 (27.78)	690.00 (100.00)
All Non Comm	8853.76 (96.82)	291.16 (3.18)	17133.16 (97.06)	849.00 (4.72)	11266.34 (92.13)	962.70 (7.87)	5621.52 (85.49)	954.48 (14.51)	1487.52 (74.35)	513.16 (25.65)	4519.32 (83.55)
Kerosene	0.00 (0.00)	567.00 (100.00)	315.00 (57.38)	234.00 (42.62)	765.00 (77.98)	216.00 (22.02)	450.00 (66.67)	225.00 (33.33)	630.00 (94.59)	36.00 (5.41)	450.00 (96.15)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	223.65 (100.00)	0.00 (0.00)	287.55 (100.00)	0.00 (0.00)	191.70 (100.00)
Electricity	0.00 (0.00)	290.68 (100.00)	0.00 (0.00)	782.60 (100.00)	0.00 (0.00)	571.90 (100.00)	0.00 (0.00)	490.20 (100.00)	0.00 (0.00)	326.00 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	400.00 (100.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	700.00 (100.00)	0.00 (0.00)	300.00 (100.00)	0.00 (0.00)
All Comm	0.00 (0.00)	857.68 (100.00)	315.00 (23.81)	1416.60 (81.81)	765.00 (42.43)	1037.90 (57.57)	673.65 (32.25)	1415.20 (67.75)	917.55 (58.06)	662.80 (41.94)	641.70 (48.78)
All	8853.76 (88.51)	1148.84 (11.49)	17448.16 (90.38)	2265.60 (11.49)	12031.34 (85.74)	2000.60 (14.26)	6295.17 (72.65)	2369.68 (27.35)	2405.07 (67.16)	1175.96 (32.84)	5161.02 (76.75)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 – 15, they are not shown in this table.

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L.H Categories End Use Energy Type	5 - 7 Light&oth	7 - 9 Cooking	 Light&oth	11 - 13 Cooking	 Light&oth	15 and above Cooking	 Light&oth	Rented Cooking	 Light&oth	All Cooking	 Light&oth
Fire Wood	242.44 (9.24)	1586.88 (86.75)	242.44 (13.25)	198.36 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1278.32 (85.29)	220.40 (14.71)	29577.68 (95.93)	1256.28 (4.07)
Coconut Residue	647.50 (35.92)	0.00 (0.00)	490.00 (100.00)	455.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	980.00 (87.50)	140.00 (12.50)	16887.50 (83.55)	3325.00 (16.45)
Saw Dust	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	756.00 (100.00)	0.00 (0.00)	3801.00 (96.28)	147.00 (3.72)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	300.00 (76.92)	90.00 (23.08)	0.00 (0.00)	0.00 (0.00)	300.00 (100.00)	0.00 (0.00)	4470.00 (83.01)	915.00 (16.99)
All Non Comm	889.94 (16.45)	1588.88 (68.42)	732.44 (31.58)	953.36 (91.37)	90.00 (8.63)	2961.00 (100.00)	0.00 (0.00)	3314.32 (90.19)	360.40 (9.81)	57697.18 (91.09)	5643.28 (8.91)
Kerosene	18.00 (3.85)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	18.00 (100.00)	0.00 (0.00)	18.00 (100.00)	0.00 (0.00)	0.00 (0.00)	2610.00 (66.21)	1332.00 (33.79)
LPG	0.00 (0.00)	255.60 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	958.50 (100.00)	0.00 (0.00)
Electricity	455.80 (100.00)	0.00 (0.00)	322.50 (100.00)	0.00 (0.00)	60.20 (100.00)	0.00 (0.00)	77.40 (100.00)	0.00 (0.00)	107.50 (100.00)	0.00 (0.00)	3485.58 (100.00)
Others	200.00 (100.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2200.00 (100.00)
All Commercial	673.80 (51.22)	255.60 (27.54)	672.50 (72.46)	0.00 (0.00)	78.20 (100.0)	0.00 (0.00)	95.40 (100.00)	0.00 (0.00)	107.50 (100.00)	3568.50 (33.71)	7017.58 (66.29)
All	1563.74 (23.52)	1842.48 (56.74)	1404.94 (43.26)	953.36 (85.00)	168.20 (15.00)	2961.00 (96.88)	95.40 (3.12)	3314.32 (87.63)	467.90 (12.37)	61265.68 (82.87)	12660.86 (17.13)

Note: (1) L.H = Land Holding. (2) Figures in brackets show percentages.
(3) Since there are no house holds in categories 9 - 11and 13 - 15, they are not shown in this table

uses. It may be worth to recall that the proportion of collected fuels showed an increasing tendency with land holding categories.

The energy consumption pattern of the sample households according to size of holding in SA III is presented in Tables 5.31 (aggregate), 5.32 (per household and per capita) and 5.33 (by proportion). It can be observed from the tables that the energy consumption in aggregate and for non-commercial fuels alone are the highest in the 1-2 category and the lowest in the 11-13 category, with the exception of the rented category. When only the commercial sources are considered, energy consumption is the highest in the category '15 and above' and lowest in 11-13. When the land holding categories and fuel used are considered separately, it may be observed that firewood is the single most important source of energy in all the categories. However the households in all the categories also use coconut residue and 'others' in considerable quantities. From Table 5.32 we can see that, per household and per capita figures also support the trends mentioned above. However, the per capita energy consumption for the households in the 'rented' category is relatively low.

Table 5.34 presents the energy consumption pattern by the mode of procurement of fuel material by size of land holding. It can be seen from the table that there is no clear relationship prevailing

Table 5.31

Energy consumption pattern of the sample house holds by size of land holding SA III (in 10 ^{3}K.Cal)

L.H Size / Energy Type	Less than 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 7	7 - 9	9 - 11	11 - 13	13 - 15	15&above	Rented
Fire Wood	5532.04 (37.68)	7890.32 (52.15)	6567.92 (60.04)	3658.64 (57.78)	661.20 (34.58)	4760.64 (57.90)	3658.64 (44.94)	3901.08 (66.51)	661.20 (51.11)	1630.96 (68.64)	3173.76 (50.99)	705.28 (67.09)
Coconut Residue	4340.00 (29.56)	4865.00 (32.16)	3115.00 (28.47)	1260.00 (19.90)	525.00 (27.46)	1750.00 (21.28)	805.00 (9.89)	560.00 (9.55)	280.00 (21.65)	0.00 (0.00)	875.00 (14.06)	0.00 (0.00)
Saw Dust	546.00 (3.72)	294.00 (1.94)	357.00 (3.26)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (24.25)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	3255.00 (22.17)	1110.00 (7.34)	360.00 (3.29)	660.00 (10.42)	240.00 (12.55)	510.00 (6.20)	510.00 (6.26)	0.00 (0.00)	210.00 (16.23)	0.00 (0.00)	540.00 (8.68)	0.00 (0.00)
All Non Com-ercial	13673.04 (93.14)	14159.32 (93.59)	10399.92 (95.07)	5578.64 (88.10)	1426.20 (74.59)	7020.64 (85.39)	6947.64 (85.33)	4461.08 (76.06)	1151.20 (88.99)	1630.96 (68.64)	4588.76 (73.73)	705.28 (67.09)
Kerosene	711.00 (4.84)	360.00 (2.38)	144.00 (1.32)	162.00 (2.56)	225.00 (11.77)	666.00 (8.10)	603.00 (7.41)	711.00 (12.12)	108.00 (8.35)	0.00 (0.00)	36.00 (0.58)	153.00 (14.55)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	115.02 (1.82)	153.36 (8.02)	0.00 (0.00)	230.04 (2.83)	115.02 (1.96)	0.00 (0.00)	153.36 (6.45)	345.06 (5.54)	0.00 (0.00)
Electricity	296.70 (2.02)	460.10 (3.04)	395.60 (3.62)	326.80 (5.16)	107.50 (5.62)	335.40 (4.08)	361.20 (4.44)	378.40 (6.45)	34.40 (2.66)	141.90 (5.97)	404.20 (6.49)	43.00 (4.09)
Others	0.00 (0.00)	150.00 (0.99)	0.00 (0.00)	150.00 (2.37)	0.00 (0.00)	200.00 (3.41)	0.0 (0.00)	20.00 (3.41)	0.00 (0.00)	450.00 (18.94)	850.00 (13.66)	150.00 (14.27)
All Comm	1007.70 (6.86)	970.10 (6.41)	539.60 (4.93)	753.82 (11.90)	485.86 (25.41)	1201.40 (14.61)	1194.24 (14.67)	1404.42 (23.94)	142.40 (11.01)	745.26 (31.36)	1635.26 (26.27)	346.00 (39.21)
All	14680.74 (100.00)	15129.42 (100.00)	10939.52 (100.00)	6332.46 (100.00)	1912.06 (100.00)	8222.04 (100.00)	8141.88 (100.00)	5865.50 (100.00)	1293.60 (0.00)	2376.22 (0.00)	6224.02 (100.00)	1051.28 (100.000)

Note: 1) Figures in brackets show percentages.2) L.H = Land Holding

Table 5.32

Energy consumption pattern of the sample house holds by size of land holding SA **III** (in 10^3K.Cal)

L.H Size	Less than 1		1-2		2-3		3-4		4-5		5-7		7-9
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H
FW	345.75	80.17	464.14	117.77	656.81	126.31	731.73	126.16	661.20	110.20	952.13	119.02	780.22
CR	310.00	68.89	286.18	72.61	311.50	59.90	252.00	43.45	262.50	52.50	350.00	43.75	186.67
SW	273.00	45.50	294.00	36.75	178.50	35.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTH	217.00	55.17	185.00	58.42	180.00	30.00	220.00	34.74	240.00	40.00	255.00	30.00	0.00
ANC	759.61	182.31	832.90	211.33	1039.11	199.18	1115.73	192.37	713.10	142.62	1404.13	175.52	892.22
KER	79.00	20.91	30.00	8.37	36.00	7.20	40.50	6.75	225.00	56.25	166.50	22.20	177.75
LPG	0.00	0.00	0.00	0.00	0.00	0.00	115.02	23.00	153.36	38.34	0.00	0.00	115.02
ELE	22.82	5.49	28.76	7.08	39.56	7.60	65.36	11.27	53.75	10.75	67.08	8.39	75.68
OTH	0.00	0.00	150.00	37.50	0.00	0.00	150.00	37.50	0.00	0.00	200.00	22.22	200.00
ALC	55.98	13.44	57.06	14.48	20.75	59.36	10.37	25.99	242.39	48.59	240.28	30.04	280.88
ALL	815.60	195.74	889.97	225.81	420.75	1093.95	210.38	218.36	956.03	191.21	1644.41	205.55	1173.10

Note: L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

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L.H Size	7 - 9	9 – 11		11 – 13		13 – 15		15 and above		Rented		All	
Ener-gyType	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
FW	118.02	780.22	118.21	661.20	132.24	815.48	163.10	793.44	122.07	705.28	141.06	491.97	96.40
CR	33.54	186.67	26.67	280.00	56.00	0.00	0.00	218.75	33.65	0.00	0.00	229.69	45.04
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	199.50	32.35
BG	329.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1974.00	329.00
OTH	21.25	0.00	0.00	210.00	42.00	0.00	0.00	270.00	33.75	0.00	0.00	184.88	37.35
ANC	187.77	892.22	135.18	1151.20	230.24	815.48	163.10	1147.19	176.49	705.28	141.06	788.38	155.96
KER	19.45	177.75	28.44	108.00	21.60	0.00	0.00	18.00	3.00	153.00	30.60	68.05	13.95
LPG	12.78	115.02	14.38	0.00	0.00	76.68	15.34	115.02	20.30	0.00	0.00	111.19	17.93
ELE	9.76	75.68	11.47	34.40	6.88	7.95	14.19	101.05	15.55	43.00	8.60	38.65	7.52
OTH	0.00	200.00	50.00	0.00	0.00	225.00	45.00	283.33	40.48	150.00	30.00	195.45	35.83
ALC	32.28	280.88	42.56	142.40	28.48	372.63	74.53	408.82	62.89	346.00	69.20	114.57	22.67
ALL	220.05	1173.10	177.74	1293.60	258.72	1188.11	237.62	1556.01	239.39	1051.28	210.26	902.95	178.63

Note: L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

Table 5.33

Energy consumption pattern by the proportion of fuels used by size of land holding SA III

L.H Size Energy Type	Less than 1	1-2	2-3	3-4	4-5	5-7	7-9	9-11	11 – 13	13-15	15 and above	Rented	All
FW	12.92	18.43	15.35	8.55	1.54	11.12	8.55	9.11	1.54	3.81	7.42	1.65	100.00
CR	23.62	26.48	16.95	6.86	2.86	9.52	4.38	3.05	1.52	0.00	4.76	0.00	100.00
SW	45.61	24.56	29.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
BG	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	100.000
OTH	44.02	15.01	4.87	8.92	3.25	6.90	6.90	0.00	2.84	0.00	7.30	0.00	100.00
ANC	19.06	19.74	14.50	7.78	1.99	9.79	9.68	6.22	1.60	2.27	6.40	0.98	100.00
KER	18.33	9.28	3.71	4.18	5.80	17.17	15.55	18.33	2.78	0.00	0.93	3.94	100.00
LPG	0.00	0.00	0.00	10.34	13.79	0.00	20.69	10.34	0.00	13.79	31.03	0.00	100.00
ELE	9.03	14.01	12.04	9.95	3.27	10.21	10.99	11.52	1.05	4.32	12.30	1.31	100.00
OTH	0.00	6.98	0.00	6.98	0.00	9.30	0.00	9.30	0.00	20.93	39.53	6.98	100.00
ALC	9.67	9.30	5.18	7.23	4.66	11.52	11.45	13.47	1.37	7.15	15.68	3.32	100.00
ALL	17.87	18.41	13.31	7.71	2.33	10.01	9.91	7.14	1.57	2.89	7.57	1.28	100.00

Note: (1) L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

Table 5.34

Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA III (in 10^3 K.Cal)

L.H Size	Less than 1		1 - 2		2 - 3		3 - 4		4 - 5		5 - 7		7 - 9
Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
FW	2115.84 (38.25)	3416.20 (61.75)	3526.40 (44.69)	4363.92 (55.31)	3416.20 (52.01)	3151.72 (47.99)	2115.84 (57.83)	1542.80 (42.17)	352.64 (53.33)	308.56 (46.67)	2115.84 (44.44)	2644.80 (55.56)	1851.36 (50.60)
CR	245.00 (5.65)	4095.00 (94.35)	490.00 (10.07)	4375.00 (89.93)	385.00 (12.36)	2730.00 (87.64)	105.00 (8.33)	1155.00 (91.67)	70.00 (13.33)	455.00 (86.67)	350.00 (20.00)	1400.00 (80.00)	140.00 (17.39)
SW	546.00 (100.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	357.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
BG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)
OTH	90.00 (2.92)	3165.00 (97.24)	0.00 (0.00)	1110.00 (100.00)	150.00 (41.67)	210.00 (58.33)	180.00 (27.27)	480.00 (72.73)	90.00 (37.50)	150.00 (62.50)	210.00 (41.18)	300.00 (58.82)	0.00 (0.00)
ANC	2996.84 (21.92)	10676.20 (78.08)	4310.40 (30.44)	9848.92 (69.56)	4308.20 (41.43)	6091.72 (58.57)	2400.84 (43.04)	3177.80 (56.56)	512.64 (35.94)	913.56 (64.06)	2675.84 (38.11)	4344.80 (61.89)	1991.36 (28.66)
ALC	1007.70 (100.00)	0.00 (0.00)	970.10 (100.00)	0.00 (0.00)	539.60 (100.00)	0.00 (0.00)	753.82 (100.00)	0.00 (0.00)	485.86 (100.00)	0.00 (0.00)	1201.40 (100.00)	0.00 (0.00)	1194.24 (100.00)
ALL	4004.54 (27.28)	10676.20 (72.72)	5280.50 (34.90)	9848.92 (65.10)	4847.80 (44.31)	6091.72 (55.69)	3154.66 (49.82)	3177.80 (50.18)	998.50 (52.22)	913.56 (47.78)	3877.24 (47.16)	4344.80 (52.84)	3185.60 (39.13)

Note: L.H = Land Holding. FW = Fire Wood. CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

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L.H Size / EnergyType	7 - 9 Collected	9 – 11 Purchased	9 – 11 Collected	11 – 13 Purchased	11 – 13 Collected	13 – 15 Purchased	13 – 15 Collected	15 and above Purchased	15 and above Collected	Rented Purchased	Rented Collected	All Purchased	All Collected
FW	1807.28 (49.40)	278.32 (32.77)	2622.76 (67.23)	220.40 (33.33)	440.80 (66.67)	617.12 (37.84)	1013.84 (62.16)	396.72 (12.50)	2777.04 (87.50)	705.28 (100.00)	0.00 (0.00)	18711.96 (43.72)	24089.72 (56.28)
CR	665.00 (82.61)	0.00 (0.00)	560.00 (100.00)	0.00 (0.00)	280.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	875.00 (100.00)	0.00 (0.00)	0.00 (0.00)	1785.00 (9.71)	16590.00 (90.29)
SW	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1197.00 (100.00)	0.00 (0.00)
BG	1974.00 (100.00)	0.00 (0.000)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)
OTH	510.00 (100.00)	0.00 (0.00)	0.00 (0.00)	90.00 (42.86)	120.00 (57.14)	0.00 (0.00)	0.00 (0.00)	120.00 (22.22)	420.00 (77.78)	0.00 (0.00)	0.00 (0.00)	930.00 (12.58)	6465.00 (87.42)
ANC	4956.28 (71.34)	1278.32 (28.65)	3182.76 (71.35)	310.40 (26.96)	840.80 (73.04)	617.12 (37.84)	1013.84 (62.16)	516.72 (11.26)	4072.04 (88.74)	705.28 (100.00)	0.00 (0.00)	22623.96 (31.53)	49118.72 (68.47)
ALC	0.00 (0.00)	404.42 (100.00)	0.00 (0.00)	142.40 (100.00)	0.00 (0.00)	745.26 (100.00)	0.00 (0.00)	1635.26 (100.00)	0.00 (0.00)	346.00 (100.00)	0.00 (0.00)	10426.06 (100.00)	0.00 (0.00)
ALL	4956.28 (60.87)	2682.74 (45.74)	3182.76 (54.26)	452.80 (35.00)	840.80 (65.00)	1362.38 (57.33)	1013.84 (42.67)	2151.98 (34.58)	4072.04 (65.42)	1051.28 (100.00)	0.00 (0.00)	33050.02 (40.22)	49118.72 (59.78)

Note: L.H = Land Holding. FW = Fire Wood. CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial

Table 5.35

Energy consumption pattern by the end use of fuel material by size of land holding SA III

(in 10 ^{3}K.Cal)

L.H Size	Less than 1		1-2		2-3		3-4		4-5		5-7		7-9
E use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
FW	5532.04 (100.00)	0.00 (0.00)	7758.08 (98.32)	132.24 (1.68)	6435.68 (97.99)	132.24 (2.01)	3658.64 (100.00)	0.00 (0.00)	661.20 (100.00)	0.00 (0.00)	4.11.28 (84.26)	749.36 (15.74)	3438.24 (93.98)
CR	4130.00 (95.16)	210.00 (4.84)	4725.00 (97.12)	140.00 (2.88)	2835.00 (91.01)	280.00 (8.99)	875.00 (69.44)	385.00 (60.56)	210.00 (40.00)	315.00 (60.00)	1190.00 (68.00)	560.00 (32.00)	560.00 (69.57)
SW	546.00 (100.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	357.00 (100.00)	0.000 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
BG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)
OTH	2955.00 (90.78)	300.00 (9.22)	900.00 (81.08)	210.00 (18.92)	240.00 (66.67)	120.00 (33.33)	450.00 (68.18)	210.00 (31.82)	150.00 (62.50)	90.00 (37.50)	330.00 (64.71)	180.00 (32.59)	270.00 (52.84)
ANC	13163.04 (96.27)	510.00 (3.73)	13677.08 (96.59)	482.24 (3.41)	9867.68 (94.88)	532.24 (5.12)	4983.64 (89.33)	595.00 (10.67)	1021.20 (71.60)	405.00 (28.40)	5531.28 (78.79)	1489.36 (21.21)	6242.24 (89.85)
KER	0.00 (0.00)	711.00 (100.00)	0.00 (0.00)	360.00 (100.00)	90.00 (62.50)	54.00 (37.50)	90.00 (55.56)	72.00 (44.44)	225.00 (100.00)	0.00 (0.00)	630.00 (94.59)	36.00 (5.41)	585.00 (97.01)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	115.02 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	230.04 (100.00)
ELE	0.00 (0.00)	296.70 (100.00)	0.00 (0.00)	460.10 (100.00)	0.00 (0.00)	395.60 (100.00)	0.00 (0.00)	326.80 (100.00)	0.00 (0.00)	107.50 (100.00)	0.00 (0.00)	335.40 (100.00)	0.00 (0.00)
OTH	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)
ALC	0.00 (0.00)	1007.70 (100.00)	0.00 (0.00)	970.10 (100.00)	90.00 (16.68)	449.60 (83.32)	205.02 (27.20)	548.80 (72.80)	378.36 (77.87)	107.50 (22.13)	630.00 (52.44)	571.40 (47.56)	815.04 (68.25)
ALL	13163.04 (89.66)	1517.70 (10.34)	13677.08 (90.40)	1452.34 (9.60)	9957.68 (91.02)	981.84 (8.98)	5188.66 (81.94)	1143.80 (18.06)	1399.56 (73.20)	512.50 (26.80)	6161.28 (74.94)	2060.76 (25.06)	7057.28 (86.68)

Note: L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC All Commercial E use = End use

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L.H Size	7 - 9	9 – 11		11 – 13		13 – 15		15 and above		Rented		All	
E use Energy Type	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
FW	220.40 (6.02)	3482.32 (89.27)	418.76 (10.73)	573.04 (86.67)	88.16 (13.33)	1278.32 (78.38)	352.64 (21.62)	3173.76 (100.00)	0.00 (0.00)	705.28 (100.00)	0.00 (0.00)	40707.88 (95.11)	2093.80 (4.89)
CR	245.00 (30.43)	140.00 (25.00)	420.00 (75.00)	280.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	245.00 (28.00)	630.00 (72.00)	0.00 (0.00)	0.00 (0.00)	15190.00 (82.67)	3185.00 (17.33)
SW	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1197.00 (100.00)	0.00 (0.00)
BG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)
OTH	240.00 (47.06)	0.00 (0.00)	0.00 (0.00)	120.00 (57.14)	90.00 (42.86)	0.00 (0.00)	0.00 (0.00)	330.00 (61.11)	21.00 (38.89)	0.00 (0.00)	0.00 (0.00)	5745.00 (77.69)	1650.00 (22.31)
ANC	705.40 (10.15)	3622.32 (81.20)	838.76 (18.80)	973.04 (84.52)	178.16 (15.48)	1278.32 (78.38)	352.64 (21.62)	3748.76 (81.69)	840.00 (18.31)	705.28 (100.00)	0.00 (0.00)	64813.88 (90.34)	6928.80 (9.66)
KER	18.00 (2.99)	675.00 (94.94)	36.00 (5.06)	90.00 (83.33)	18.00 916.67)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	36.00 (100.00)	135.00 (88.24)	18.00 (11.76)	2520.00 (64.97)	1359.00 (35.03)
LPG	0.00 (0.00)	115.02 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	345.06 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1111.86 (100.00)	0.00 (0.00)
ELE	361.20 (100.00)	0.00 (0.00)	378.40 (100.00)	0.00 (0.00)	34.40 (100.00)	0.00 (0.00)	141.90 (100.00)	0.00 (0.00)	404.20 (100.00)	0.00 (0.00)	43.00 (100.00)	0.00 (0.00)	3285.20 (100.00)
OTH	0.00 (0.00)	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	450.00 (100.00)	0.00 (0.00)	850.00 (100.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	2150.00 (100.00)
ALC	379.20 (31.75)	790.02 (56.25)	614.40 (43.75)	90.00 (63.20)	52.40 (36.80)	153.36 (20.58)	591.90 (79.42)	345.06 (21.10)	1290.20 (78.90)	135.00 (39.02)	211.00 (60.98)	3631.86 (34.80)	6794.20 (65.17)
ALL	1084.60 (13.32)	4412.16 (75.23)	1453.16 (24.77)	1063.04 (82.18)	230.56 917.82)	1431.68 (60.25)	944.54 (39.75)	4093.82 (65.77)	2130.20 (34.23)	840.28 (79.93)	211.00 (20.07)	68445.74 (83.30)	13723.00 (16.70)

Note: L.H = Land Holding. FW = Fire Wood . CR = Coconut Residue. SW = Saw Dust. BG = Bio Gas. OTH = Others
ANC = All Non Commercial. KER = Kerosene. ELE = Electricity. ALC = All Commercial E use = End use

between land holding size and mode of procurement. However, in all the land holding categories there is a higher proportion of collected fuels. This trend is further confirmed when we consider the non-commercial fuels alone.

Table 5.35 presents energy consumption pattern by the end use of fuel materials according to size of land holding in SA III. In all the land holding categories the proportion of fuels used for cooking is much higher than that used for 'lighting and others' When the non-commercial fuels alone are considered, it is observed that, with increase in the size of holding, there is an increasing trend in its consumption for 'lighting and others'.

The energy consumption pattern by the sample households according to the size of land holding in SA IV is presented in Tables 5.36 (aggregate), 5.37 (per household and per capita) and 5.38 (by proportion). From the tables it can be seen that the energy consumption is the highest in the 1-2 category and the lowest in the 11-15 category. When only the non-commercial fuels are considered, the highest consumption is in the 1-2 category itself, but the lowest consumption is in the 11-13 category. When all the commercial fuels are considered, the highest consumption is in the 2-3 and 7-9 categories and the lowest is in the 11-13 category. Table 5.36 further reveals that for most of the households the most important fuel is firewood, with the exception of some for which it is coconut residue. When the fuels are considered individually, the consumption of firewood is the highest in the 2-3 category and lowest in 13-15 category. For coconut residue and 'others' the highest consumption is in the 'less than1' category. Interestingly the share of all the non-commercial fuels decreases as the size of holding increases. The per household and per capita figures given in Table 5.37 also show a similar trend.

Table 5.39 presents the energy consumption pattern by the mode of procurement of fuel material by size of land holding. It can be observed from the table that in all the categories the collected proportion is either higher than or is almost equal to the purchased proportion. When only the non-commercial fuels are considered the dominance of collected share is clearer in all the categories. When the fuels are considered separately it can be seen that the collected share is much higher than the purchased share for coconut residue and 'others', where as the share is almost equal for firewood.

Table 5.40 presents the energy consumption pattern by the end use of fuels material according to land holding category. In all the categories the share of fuel in cooking is greater than that in 'lighting and others'. It may be observed that the share of fuels used for 'lighting and others' is relatively high in the higher land

Table 5.36

Energy consumption pattern by sample house holds by size of land holding SA IV (in 10^3K.Cal)

L.H Size / Energy Type	Less than 1	1- 2	2 - 3	3 - 4	4 - 5	5 - 7	7 - 9	9 - 11	11 - 13	13 - 15	15&above	Rented
Fire Wood	3526.40 (27.99)	4187.60 (31.54)	4496.16 (38.41)	4055.36 (41.48)	1278.32 (51.22)	1895.44 (28.24)	2556.64 (49.22)	1057.92 (40.05)	1146.08 (52.69)	484.88 (22.27)	1234.24 (37.01)	0.00 (0.00)
Coconut Res-idue	4322.50 (34.31)	3990.00 (30.05)	3885.00 (33.19)	3255.00 (33.30)	525.00 (21.03)	1365.00 (20.33)	1190.00 (22.91)	805.00 (30.47)	595.00 (27.35)	700.00 (32.15)	875.00 (26.24)	0.00 (0.00)
Saw Dust	1218.00 (9.67)	0.00 (0.00)	978.00 (6.82)	336.00 (3.44)	0.00 (0.00)	504.00 (7.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	2988.68 (22.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2143.72 (31.93)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	2520.00 (20.00)	1260.00 (12.20)	1500.00 (12.81)	1440.00 (14.73)	240.00 (9.62)	300.00 (4.47)	420.00 (8.09)	150.00 (5.68)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Non Com	11586.90 (91.98)	12786.28 (96.30)	10679.16 (91.22)	9086.36 (92.95)	2043.32 (81.87)	6208.16 (92.48)	4166.64 (80.22)	2012.92 (76.20)	1741.08 (80.04)	1148.88 (54.42)	2109.24 (63.25)	0.00 (0.00)
Kerosene	684.00 (5.43)	126.00 (0.95)	153.00 (1.31)	225.00 (2.30)	315.00 (12.62)	135.00 (2.01)	351.00 (6.76)	198.00 (7.50)	288.00 (13.24)	171.00 (7.85)	18.00 (0.54)	0.00 (0.00)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	115.02 (2.21)	0.00 (0.00)	0.00 (0.00)	383.40 (17.61)	306.72 (9.20)	0.00 (0.00)
Electricity	326.80 (2.59)	365.50 92.75)	524.60 (4.48)	464.40 (4.75)	137.60 (5.51)	369.80 (5.51)	361.20 (6.95)	180.60 (6.84)	146.20 (6.72)	288.10 (13.23)	301.00 (9.03)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	350.00 (2.99)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	200.00 (3.85)	250.00 (9.46)	0.00 (0.00)	150.00 (6.89)	600.00 (17.99)	0.00 (0.00)
All Comm	1010.80 (8.02)	491.50 (3.70)	1027.60 (8.78)	689.40 (7.05)	452.60 (18.13)	504.80 (7.52)	1027.22 (19.78)	628.60 (23.80)	434.20 (19.69)	992.50 (45.58)	1225.72 (36.75)	0.00 (0.00)
All	12597.70 (100.00)	13277.78 (100.00)	11706.76 (100.00)	9775.76 (100.00)	2495.92 (100.00)	6712.86 (100.00)	5193.86 (100.00)	2641.52 (100.00)	2175.28 (0.00)	2177.38 (0.00)	3334.96 (100.00)	0.00 (0.000)

Note: 1) Figures in brackets show percentages. 2) L.H = Land Holding

Table 5.37

Energy consumption pattern by sample house holds by size of land holding SA IV (in 10^3 K.Cal)

L.H Size	Less than 1		1 - 2		2 - 3		3 - 4		4 - 5		5 - 7	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	207.44	56.88	380.69	77.55	408.74	74.94	506.92	79.52	426.11	91.31	473.86	86.16
Coconut Res-idue	254.26	77.19	332.50	71.25	353.18	64.75	406.88	63.82	262.50	58.33	341.25	62.05
Saw Dust	243.60	50.75	0.00	0.00	266.00	42.00	336.00	37.33	0.00	0.00	252.00	42.00
Bio Gas	0.00	0.00	2988.68	498.11	0.00	0.00	0.00	0.00	0.00	0.00	2143.72	267.97
Others	157.50	44.21	162.00	36.00	187.50	32.61	205.71	30.64	120.00	26.67	150.00	23.08
All Non Com	551.76	160.93	983.56	206.23	970.83	177.99	1135.80	178.16	681.11	145.95	1241.63	206.94
Kerosene	52.62	13.68	18.00	3.94	19.13	3.56	45.00	6.82	105.00	22.50	135.00	33.75
LPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	21.79	6.41	28.12	5.90	47.69	8.74	58.05	9.11	45.87	9.83	73.96	12.33
Others	0.00	0.00	0.00	0.00	175.00	38.89	0.00	0.00	0.00	0.00	0.00	0.00
All Comm	48.13	14.04	37.81	7.93	93.42	17.13	86.18	13.52	150.87	32.33	100.96	16.83
All	599.89	174.97	1021.37	214.16	1064.25	195.11	1221.97	191.68	831.97	178.28	1342.59	223.77

Note: (1) L.H = Land Holding

(2) Since there are no house holds in the category 'Rented' it is not shown in the table.

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L.H Size	7 – 9		9 – 11		11 – 13		13 – 15		15 and above		All	
Energy Type Per H.H	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	639.16	79.90	528.96	81.38	573.04	95.51	242.44	40.41	411.41	61.71	386.85	73.63
Coconut Residue	396.67	47.60	402.50	61.92	297.50	49.58	233.33	43.75	291.67	43.75	321.01	63.26
Saw Dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	259.64	44.63
Bio Gas	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	2566.20	366.60
Others	210.00	23.33	150.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	170.63	33.98
All Non Com	1041.66	130.21	1006.46	154.84	870.54	145.09	394.96	74.06	703.08	105.46	848.07	166.51
Kerosene	175.50	19.50	198.00	28.29	144.00	24.00	85.50	15.55	18.00	3.00	59.20	11.58
LPG	115.02	16.43	0.00	0.00	0.00	0.00	127.80	23.96	102.24	15.34	115.02	18.72
Electricity	93.30	11.29	93.30	13.89	73.10	12.18	96.03	18.01	100.33	15.05	50.23	9.60
Others	200.00	28.57	250.00	35.71	0.00	0.00	150.00	37.50	300.000	42.86	221.43	37.80
All Comm	256.81	32.10	314.30	48.35	217.10	36.18	330.83	62.03	408.57	61.29	113.13	22.21
All	1298.47	162.31	1320.76	203.19	1087.64	181.27	725.79	136.09	1111.65	166.75	961.20	188.72

Note: (1) L.H = Land Holding
(2) Since there are no house holds in the category 'Rented' it is not shown in the table

Table 5.38

Energy consumption pattern by proportion of fuels used by different land holding categories **SA IV** (in 10^3K.Cal)

L.H Size Energy Type	Less than 1	1-2	2-3	3-4	4-5	5-7	7–9	9–11	11–13	13–15	15 and above	All
Fire Wood	13.61	16.16	17.35	15.65	4.93	7.31	9.86	4.08	4.42	1.87	4.76	100.00
Coconut Res-idue	20.10	18.55	18.06	15.13	2.44	6.35	5.53	3.74	2.77	3.25	4.07	100.00
Saw Dust	42.65	0.00	27.94	11.76	0.00	17.65	0.00	0.00	0.00	0.00	0.00	100.00
Bio Gas	0.00	58.23	0.00	0.00	0.00	41.77	0.00	0.00	0.00	0.00	0.00	100.00
Others	30.77	19.78	18.32	17.58	2.93	3.66	5.13	1.83	0.00	0.00	0.00	100.00
All Non Com	18.22	20.10	16.79	14.29	3.21	9.76	6.55	3.16	2.74	1.86	3.32	100.00
Kerosene	25.68	4.73	5.74	8.45	11.82	5.07	13.18	7.43	10.81	6.42	0.68	100.00
LPG	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	47.62	38.10	100.00
Electricity	9.43	10.55	15.41	13.40	3.97	10.67	10.42	5.21	4.22	8.31	8.68	100.00
Others	0.00	0.00	22.58	0.00	0.00	0.00	12.90	16.13	0.00	9.68	38.71	100.00
All Comm	11.91	5.79	12.11	8.12	5.33	5.95	12.11	7.41	5.12	11.70	14.45	100.00
All	17.47	18.42	16.24	13.56	3.46	9.31	7.20	3.66	3.02	3.02	4.63	100.00

Note: (1) L.H = Land Holding

(2) Since there are no house holds in the category 'Rented' it is not shown in the table.

Table 5.39

Energy consumption pattern by the mode of procurement of fuel material by size of land holding SA IV (in 10^3K.Cal)

L.H Size	Less than 1		1 - 2		2 - 3		3 - 4		4 - 5		5 - 7	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	1807.28	1719.12	1498.72	2688.88	2821.12	1675.04	2600.72	1454.64	793.44	484.88	1057.92	837.52
	(51.25)	(48.75)	(35.79)	(64.21)	(62.75)	(37.25)	(64.13)	(35.87)	(62.07)	(37.93)	(55.81)	(44.19)
Coconut Residue	1120.00	3202.50	1435.00	2555.00	1680.00	2205.00	1120.00	2135.00	0.00	525.00	280.00	1085.00
	(25.91)	(74.09)	(35.96)	(64.04)	(43.24)	(56.76)	(34.41)	(65.59)	(0.00)	(100.00)	(20.51)	(79.49)
Saw Dust	1218.00	0.00	0.00	0.00	798.00	0.00	336.00	0.00	0.00	0.00	504.00	0.00
	(100.00)	(0.00)	(0.00)	(0.00)	(100.0)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)
Bio Gas	0.00	0.00	0.00	2988.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2143.72
	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)
Others	360.00	2160.00	120.00	1500.00	150.00	1350.00	360.00	1080.00	0.00	240.00	300.00	0.00
	(14.29)	(85.71)	(7.41)	(92.59)	(10.00)	(90.00)	(25.00)	(75.00)	(0.00)	(100.00)	(100.00)	(0.00)
All Non Comm	4505.28	7081.62	3053.72	9732.56	5449.12	5230.04	4416.72	4669.64	793.44	1249.88	2141.92	4066.24
	(38.88)	(61.12)	(23.88)	(76.12)	(51.03)	(48.97)	(48.61)	(51.39)	(38.83)	(61.17)	(34.50)	(65.50)
All Comm	1010.80	0.00	491.50	0.00	1027.60	0.00	689.40	0.00	452.60	0.00	504.80	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)
All	5516.08	7081.62	3545.22	9732.56	6476.72	5230.04	5106.12	4669.64	1246.04	1249.88	2646.72	4066.24
	(43.79)	(56.21)	(26.70)	(73.30)	(55.32)	(44.68)	(52.23)	(47.77)	(49.92)	(50.08)	(39.43)	(60.57)

Note: (1) Figures in brackets show percentages.
(2) L.H = Land Holding
(3) Since there are no house holds in the category 'rented', it is not shown in the table.

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L.H Size	7 - 9		9 - 11		11 – 13		13 – 15		15 and above		All	
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	1454.64	1102.00	617.12	440.80	352.64	793.44	132.24	352.64	196.32	1057.92	13312.16	12606.88
	(56.90)	(43.10)	(58.33)	(41.67)	(30.77)	(69.23)	(27.27)	(72.73)	(14.29)	(85.71)	(51.36)	(48.64)
Coconut Residue	105.00	1085.00	0.00	805.00	0.00	595.00	0.00	700.00	0.00	875.00	5740.00	15767.50
	(8.82)	(91.18)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(26.69)	(73.31)
Saw Dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2856.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5132.40
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)
Others	60.00	360.00	0.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	1350.00	6840.00
	(14.29)	(85.71)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(16.48)	(83.52)
All Non Comm	1619.64	2547.00	617.12	1395.80	352.64	1388.44	132.44	1052.64	176.32	1932.92	23258.16	40346.78
	(38.87)	(61.13)	(30.66)	(63.34)	(20.25)	(79.75)	(11.16)	(88.84)	(8.36)	(91.64)	(36.57)	(63.43)
All Comm	1027.22	0.00	628.60	0.00	434.20	0.00	992.50	0.00	1225.72	0.00	8484.94	0.00
	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)
All	2646.86	2547.00	1245.72	1395.80	786.84	1388.44	1124.74	1052.64	1042.04	1932.92	31743.10	40436.78
	(50.96)	(49.04)	(47.16)	(52.84)	(36.17)	(63.83)	(51.66)	(48.34)	(42.04)	(57.96)	(44.03)	(55.97)

Note: (1) Figures in brackets show percentages.
(2) L.H = Land Holding
(3) Since there are no house holds in the category 'rented', it is not shown in the table

Table 5.40

Energy consumption pattern by the end use of fuel materials by size of land holding SA IV (in 10 ^{3}K.Cal)

L.H Size	Less than 1		1 - 2		2 - 3		3 - 4		4 - 5		5 - 7	
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Fire Wood	3438.24 (97.50)	88.16 (2.50)	4099.44 (97.89)	88.16 (2.11)	4408.00 (98.04)	88.16 (1.96)	3879.04 (95.65)	176.32 (4.35)	1146.08 (89.66)	132.24 (10.34)	1895.44 (100.00)	0.00 (0.00)
Coconut Residue	4042.50 (93.52)	280.00 (6.48)	3780.00 994.74)	210.00 (5.26)	3465.00 (89.19)	420.00 (10.81)	2800.00 986.02)	455.00 (13.98)	525.00 (100.00)	0.00 (0.00)	1295.00 (94.87)	70.00 (5.13)
Saw Dust	1218.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	798.00 (100.00)	0.00 (0.00)	336.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	504.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	2988.68 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2143.72 (100.00)	0.00 (0.00)
Others	2340.00 (92.86)	180.00 97.14)	1560.00 (96.30)	60.00 (3.70)	1200.00 (80.00)	300.00 (20.00)	1170.00 (81.25)	270.00 (18.75)	240.00 (100.00)	0.00 (0.00)	300.00 (100.00)	0.00 (0.00)
All Non Com	11038.74 (95.27)	548.16 (4.73)	12428.12 (97.20)	358.16 (2.80)	9871.00 (92.43)	808.16 (7.57)	8185.04 (90.08)	901.32 (9.92)	1911.08 (93.53)	132.24 (6.47)	6138.16 (98.87)	70.00 (1.13)
Kerosene	0.00 (0.00)	684.00 (100.00)	0.00 (0.00)	126.00 (100.00)	0.00 (0.00)	153.00 (100.00)	135.00 (60.00)	90.00 (40.00)	270.00 (85.71)	45.00 (14.29)	135.00 (100.00)	0.00 (0.00)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Electricity	0.00 (0.00)	326.80 (100.00)	0.00 (0.00)	365.50 (100.00)	0.00 (0.00)	524.60 (100.00)	0.00 (0.00)	464.40 (100.00)	0.00 (0.00)	137.60 (100.00)	0.00 (0.00)	369.80 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Comm	0.00 (0.00)	1010.80 (100.00)	0.00 (0.00)	491.50 (100.00)	0.00 (0.00)	1027.60 (100.00)	135.00 (19.58)	554.40 (80.42)	270.00 (56.66)	182.60 (40.34)	135.00 (26.74)	369.80 (73.26)
All	11038.74 (87.63)	1558.96 (12.37)	12428.12 (93.60)	849.66 (6.40)	9871.00 (84.32)	1835.76 (15.68)	8320.04 (85.11)	1455.72 (14.89)	2181.08 (87.39)	314.84 (12.61)	6273.16 (93.45)	439.80 (6.55)

Note: (1) L.H = Land Holding

(2) Since there are no house holds in the category 'Rented' it is not shown in the table.

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L.H Size End use Energy Type	7 – 9 Cooking	 Light&oth	9 – 11 Cooking	 Light&oth	11 – 13 Cooking	 Light&oth	13 – 15 Cooking	 Light&oth	15 and above Cooking	 Light&oth	All Cooking	 Light&oth
Fire Wood	2204.00 (86.21)	352.64 (13.79)	969.76 (91.67)	88.16 (8.33)	925.68 (80.77)	220.40 (19.23)	484.88 (100.00)	0.00 (0.00)	1102.00 (89.29)	132.24 (10.70)	24552.56 (94.73)	1366.48 (5.27)
Coconut Res-idue	1015.00 (85.29)	175.00 (14.71)	525.00 (65.22)	280.00 (34.78)	455.00 (76.47)	140.00 (23.53)	490.00 (70.00)	210.00 (30.00)	490.00 (56.00)	385.00 (44.00)	18882.50 (87.79)	2625.00 (12.21)
Saw Dust	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2856.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5132.40 (100.00)	0.00 (0.00)
Others	300.00 (71.43)	120.00 (28.57)	150.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	7260.00 (88.64)	930.00 (11.36)
All Non Com	3519.00 (84.46)	647.64 (15.54)	1644.76 (81.71)	368.16 (18.29)	1380.68 (79.30)	360.40 (20.70)	974.88 (82.28)	210.00 (17.72)	1592.00 (75.48)	517.24 (24.52)	58683.46 (92.26)	4921.48 (7.74)
Kerosene	315.00 (89.74)	36.00 (10.26)	180.00 (90.91)	18.00 (9.09)	270.00 (93.75)	18.00 (6.25)	135.00 (78.95)	36.00 (21.05)	0.00 (0.00)	18.00 (100.00)	1440.00 954.05)	1224.00 (45.95)
LPG	115.02 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	383.40 (100.00)	0.00 (0.00)	306.72 (100.00)	0.00 (0.00)	805.14 (100.00)	0.00 (0.00)
Electricity	0.00 (0.00)	361.20 (100.00)	0.00 (0.00)	180.00 (100.00)	0.00 (0.00)	146.20 (100.00)	0.00 (0.00)	288.10 (100.00)	0.00 (0.00)	301.00 (100.00)	0.00 (0.00)	3465.80 (100.00)
Others	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	600.00 (100.00)	0.00 (0.00)	1550.00 (100.00)
All Comm	430.02 (41.86)	597.20 (58.14)	180.00 (28.64)	448.60 (71.36)	270.00 (62.18)	164.20 (37.82)	518.40 (52.23)	474.10 (47.77)	306.72 (25.02)	919.00 (74.98)	2245.14 (26.46)	6239.80 (73.54)
All	3949.02 (76.03)	1244.84 (23.97)	1824.76 (69.08)	816.76 (30.92)	1650.68 (75.88)	524.60 (24.12)	1493.28 (68.58)	684.10 (31.42)	1898.72 (56.93)	1436.24 (43.07)	60928.60 (84.52)	11161.28 (15.48)

Note: (1) L.H = Land Holding
(2) Since there are no house holds in the category 'Rented' it is not shown in the table.

holding categories. This trend is more evident when the non-commercial fuels alone are considered. However, for the commercial fuels, a reverse trend is seen where the share of fuels used for 'lighting and others' decreases as the size of holding increases. Further, Table 5.40 reveals that the consumption of the non-commercial fuels, especially coconut residue and 'others' used for 'lighting and others' increase with land holding category

5.4 Household size

Household size perhaps has the greatest influence on energy consumption. The relation between energy consumption and household size depends on the end uses. For instance, though there may be a direct relationship between energy and household size, such a relation may not be expected in the case of 'lighting and others'.

The distribution of the sample population by household size was presented in Table 4.2. For the present analysis nine household sizes are considered. The Information on energy consumption pattern of the sample households across household size categories for SA I are presented in Table 5.41 (aggregate), 5.42 (per household and per capita) and 5.43 (by proportion). It can be seen from Table 5.41 that energy consumption is the highest in the household size category 5 and the lowest in the category 9. It is interesting to note that the direct relation between energy consumption and household size is limited to only the first three categories. It may be noted from Table 5.43 that energy consumption after displaying an increasing trend along with household size for the first three categories showed a decreasing trend. Both the commercial and non-commercial fuels display this trend even when they are treated independently. The per capita energy consumption is the highest in the household size of '10 and above'and the lowest in the household size of 9 (Table 5.42). When the fuels are considered individually, in all the household sizes except the last two, coconut residue is the most important single fuel.

Table 5.44 shows the energy consumption pattern by the mode of procurement of fuel material by household size. In all the categories except one, the share of fuels purchased is greater than collected. Many households exhibit clearly this trend even when only the non-commercial fuels are considered. It may also be noted that in most of the categories the purchased share of fuels like firewood and 'others' is less than collected share. But for coconut residue the collected share is higher than the purchased share in almost all the categories. It seems there is no clear relation between energy consumption and mode of procurement in this study area.

Table 5.41

Energy consumption pattern by the sample house holds by household size SA I (in 10^3K.Cal)

H.H Size Energy Type	2	3	4	5	6	7	8	9	10 and above
Fire Wood	0.00 (0.00)	1520.76 (31.66)	2909.28 (23.15)	5686.32 (31.40)	2843.16 (29.96)	2181.96 (31.29)	2115.84 (37.93)	2137.88 (54.00)	2799.08 (27.95)
Coconut Residue	0.00 (0.00)	2117.50 (44.08)	5985.00 (47.36)	8085.00 (44.64)	4375.00 (46.11)	3465.00 (49.69)	1855.00 (33.26)	1155.00 (29.17)	5320.00 (53.12)
Saw Dust	0.00 (0.00)	252.00 (5.25)	546.00 (4.34)	756.00 (4.17)	378.00 (3.98)	378.00 (5.42)	546.00 (9.79)	0.00 (0.00)	1596.00 (15.93)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	0.00 (0.00)	210.00 (4.37)	630.00 (5.01)	690.00 (3.81)	300.00 (3.16)	630.00 (9.03)	360.00 (6.45)	120.00 (3.03)	0.00 (0.00)
All Non Commercial	0.00 (0.00)	4100.26 (85.36)	10070.28 (80.13)	15217.32 (84.02)	7896.16 (83.22)	6654.96 (95.44)	4876.84 (87.43)	3412.88 (86.20)	9715.08 (97.00)
Kerosene	0.00 (0.00)	531.00 (11.05)	1116.00 (8.88)	1134.00 (6.26)	603.00 (6.36)	207.00 (2.97)	306.00 (5.49)	333.00 (8.41)	189.00 (1.89)
LPG	0.00 (0.00)	0.00 (0.00)	421.74 (3.36)	460.08 (2.54)	153.36 (1.62)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Electricity	0.00 (0.00)	172.00 (3.58)	708.64 (5.64)	849.68 (4.69)	485.90 (5.12)	110.94 (1.59)	195.22 (3.50)	213.28 (5.39)	111.80 (1.12)
Others	0.00 (0.00)	0.00 (0.00)	250.00 (1.99)	450.00 (2.48)	350.00 (3.69)	0.00 (0.00)	200.00 (3.59)	0.00 (0.00)	0.00 (0.00)
All Commercial	0.00 (0.00)	703.00 (14.64)	2496.38 (19.87)	2893.76 (15.98)	1592.26 (16.78)	317.94 (4.56)	701.22 (12.57)	546.28 (13.80)	300.80 (3.00)
All	0.00 (0.00)	4803.26 (100.00)	12566.66 (100.00)	18111.08 (100.00)	9488.42 (100.00)	6972.90 (100.00)	5578.06 (100.00)	3959.16 (100.00)	10015.88 (100.00)

Note: Figures in brackets shows percentages to total

Table 5.42

Per household and per capita consumption by household size SA I (in 10^3 K.Cal)

H.H Size	2		3		4		5		6	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	0.00	0.00	152.08	50.69	171.13	42.78	334.49	66.90	355.40	59.23
Coconut Residue	0.00	0.00	192.50	64.17	332.50	83.13	539.00	107.80	546..88	91.15
Saw Dust	0.00	0.00	126.00	42.00	182.00	45.50	252.00	50.40	189.00	31.50
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00
Others	0.00	0.00	105.00	35.00	157.00	39.38	230.00	46.00	150.00	25.00
All Non Comm	0.00	0.00	372.75	124.25	530.01	132.50	895.14	179.03	987.02	164.50
Kerosene	0.00	0.00	66.38	22.13	111.60	27.90	103.09	20.62	150.75	25.13
LPG	0.00	0.00	0.00	0.00	140.58	35.15	153.36	30.67	153.36	25.56
Electricity	0.00	0.00	17.20	5.73	37.30	9.32	49.98	10.00	60.74	10.12
Others	0.00	0.00	0.00	0.00	125.00	31.25	150.00	30.00	175.00	29.17
All Commercial	0.00	0.00	63.91	21.30	124.82	31.20	160.76	32.15	199.03	33.17
All	0.00	0.00	436.66	145.55	628.33	157.08	1006.17	201.23	1186.05	197.68

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H.H Size	7		8		9		10 and above		All	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	436.39	62.34	528.96	66.12	534.47	59.39	699.77	65.09	321.66	63.05
Coconut Residue	693.00	99.00	371.00	46.38	288.75	32.08	1330.00	123.72	462.25	92.19
Saw Dust	378.00	54.00	273.00	34.13	0.00	0.00	399.00	37.12	261.88	42.40
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00
Others	210.00	30.00	180.00	22.50	120.00	13.33	0.00	0.00	172.94	35.85
All Non Comm	1330.99	190.14	975.37	121.92	853.22	94.80	2428.77	225.9.	848.54	169.71
Kerosene	41.40	5.91	102.00	12.75	166.50	18.50	47.25	4.40	94.02	17.54
LPG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	147.88	31.37
Electricity	27.74	3.96	39.04	4.88	53.32	5.92	37.27	3.61	40.68	8.18
Others	0.00	0.00	200.00	25.00	0.00	0.00	0.00	0.0	156.25	29.07
All Commercial	63.59	9.08	140.24	17.53	136.57	15.17	75.20	7.00	127.36	25.54
All	1394.58	199.23	1115.61	139.45	989.79	109.98	2503.97	232.93	953.27	176.53

Table 5.43

Energy consumption pattern by the proportion of fuels used by the sample households by house hold size SA I

Size of H.H Energy Type	2	3	4	5	6	7	8	9	10 and above	All
Fire Wood	0.00	6.85	13.11	25.62	12.81	9.83	9.53	9.63	12.61	100.00
Coconut Residue	0.00	6.54	18.50	24.99	13.52	10.71	5.73	3.57	16.44	100.00
Saw Dust	0.00	5.66	12.26	16.98	8.49	8.49	12.26	0.00	35.85	100.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	7.14	21.43	23.47	10.20	21.43	12.24	4.08	0.00	100.00
All Non Commercial	0.00	6.62	16.26	24.57	12.75	10.74	7.87	5.51	15.68	100.00
Kerosene	0.00	12.02	25.25	25.66	13.65	4.68	6.92	7.54	4.28	100.00
LPG	0.00	0.00	4074	44.44	14.81	0.00	0.00	0.00	0.00	100.00
Electricity	0.00	6.04	24.89	29.84	17.06	3.90	6.86	7.49	3.93	100.00
Others	0.00	0.00	20.00	36.00	28.00	0.00	16.00	0.00	0.00	100.00
All Commercial	0.00	7.36	26.14	30.30	16.67	3.33	7.34	5.72	3.15	100.00
All	0.00	6.76	17.58	25.33	13.27	9.75	7.80	5.54	14.01	100.00

Table 5.44

Energy consumption pattern by the mode of procurement of fuel material by household size **SA I** (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	0.00 (0.00)	0.00 (0.00)	947.72 (62.32)	573.04 (37.68)	1873.40 (64.39)	1035.88 (35.61)	3768.84 (66.28)	1917.48 (33.72)	1476.68 (51.94)	1366.48 (48.06)	1520.76 (69.70)
Coconut Residue	0.00 (0.00)	0.00 (0.00)	700.00 (33.06)	1417.50 (66.94)	2380.00 (39.77)	3605.00 (60.23)	3727.50 (46.10)	4357.50 (53.90)	1855.00 (42.40)	2520.00 (57.60)	1400.00 (40.40)
Saw Dust	0.00 (0.00)	0.00 (0.00)	252.00 (100.00)	0.00 (0.00)	546.00 (100.00)	0.00 (0.00)	756.00 (100.00)	0.00 (0.00)	378.00 (100.00)	0.00 (0.00)	378.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	210.00 (100.00)	420.00 (66.67)	210.00 (33.33)	540.00 (78.26)	150.00 (21.74)	180.00 (60.00)	120.00 (40.00)	390.00 (61.90)
All Non Comm	0.00 (0.00)	0.00 (0.00)	1899.72 (46.33)	2200.54 (53.67)	5219.40 (51.83)	4850.88 (48.17)	8792.34 (57.78)	6424.98 (42.22)	3889.68 (49.26)	4006.48 (50.74)	3688.76 (55.43)
All Commercial	0.00 (0.00)	0.00 (0.00)	703.00 (100.00)	0.00 (0.00)	2496.38 (100.00)	0.00 (0.00)	2893.76 (100.00)	0.00 (0.00)	1592.26 (100.00)	0.00 (0.00)	317.94 (100.00)
All	0.00 (0.00)	0.00 (0.00)	2602.72 (54.19)	2200.54 (45.81)	7715.78 (61.40)	4850.88 (38.60)	11686.10 (64.52)	6424.98 (35.48)	5481.94 (57.78)	4006.48 (42.22)	4006.70 (57.46)

Note: (1).) Figures in brackets show percentages to total.

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H.H Size	7	8		9		10 and above		All	
Mode / Energy Type	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	661.20 (30.30)	1432.60 (67.71)	683.24 (32.29)	1057.92 (49.48)	1079.96 (50.52)	2005.64 (71.65)	793.44 (28.35)	14083.56 (63.46)	8110.72 (36.54)
Coconut Residue	2065.00 (59.60)	612.50 (33.02)	1242.50 (66.98)	210.00 (18.18)	945.00 (81.82)	2450.00 (46.05)	2870.00 (53.95)	13335.00 (41.21)	19022.50 (58.79)
Saw Dust	0.00 (0.00)	546.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1596.00 (100.00)	0.00 (0.00)	4452.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	240.00 (38.10)	360.00 (100.00)	0.00 (0.00)	0.00 (0.00)	120.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1890.00 (64.29)	1050.00 (35.71)
All Non Comm	2966.20 (44.57)	2951.10 (60.51)	1925.74 (39.49)	1267.92 (37.15)	2144.96 (62.85)	6051.64 (62.29)	3663.44 (37.71)	33760.56 (54.50)	28183.22 (45.50)
All Commercial	0.00 (0.00)	701.22 (100.00)	0.00 (0.00)	546.28 (100.00)	0.00 (0.00)	300.80 (100.00)	0.00 (0.00)	9551.64 (100.00)	0.00 (0.00)
All	2966.20 (42.54)	3652.32 (65.48)	1925.74 (34.52)	1814.20 (45.82)	2144.96 (54.18)	6352.44 (63.42)	3663.44 (36.58)	43312.20 (60.58)	28183.22 (39.42)

Table 5.45

Energy consumption pattern by the end use of fuel material by household size SA I (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	0.00 (00.00)	0.00 (0.00)	1454.64 (95.65)	66.12 (4.35)	2666.84 (91.67)	242.44 (8.33)	5267.56 (92.64)	418.76 (7.36)	2446.44 (86.05)	396.72 (13.95)	1961.56 (89.90)
Coconut Residue	0.00 (00.00)	0.00 (0.00)	2117.50 (100.00)	0.00 (0.00)	5442.50 (90.94)	542.50 (9.06)	7665.00 (94.81)	420.00 (5.19)	3850.00 (88.00)	525.00 (12.00)	3360.00 (96.97)
Saw Dust	0.00 (00.00)	0.00 (0.00)	252.00 (100.00)	0.00 (0.00)	546.00 (100.00)	0.00 (0.00)	756.00 (100.00)	0.00 (0.00)	378.00 (100.00)	0.00 (0.00)	378.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	0.00 (00.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	570.00 (90.48)	60.00 (9.52)	630.00 (91.30)	60.00 (8.70)	180.00 (60.00)	120.00 (40.00)	510.00 (80.95)
All Non Comm	0.00 (00.00)	0.00 (0.00)	4034.14 (98.39)	66.12 (1.61)	9225.34 (91.61)	844.94 (8.39)	14318.56 (94.09)	898.76 (5.91)	6854.44 (86.81)	1041.72 (13.19)	6209.56 (93.31)
Kerosene	0.00 (0.00)	0.00 (00.00)	90.00 (16.95)	441.00 (83.05)	918.00 (82.26)	198.00 (17.74)	900.00 (79.37)	234.00 (20.63)	585.00 (97.01)	18.00 (2.99)	0.00 (0.00)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	421.74 (100.00)	0.00 (0.00)	460.08 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	0.00 (0.00)
Electricity	0.00 (0.00)	0.00 (00.00)	0.00 (0.00)	172.00 (100.00)	0.00 (0.00)	708.64 (100.00)	0.00 (0.00)	849.68 (100.00)	0.00 (0.00)	485.90 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	450.00 (100.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)
All Commercial	0.00 (0.00)	0.00 (00.00)	90.00 (12.80)	613.00 (87.20)	1339.74 (53.67)	1156.64 (46.33)	1360.08 (47.00)	1533.68 (53.00)	738.36 (46.37)	853.90 (53.63)	0.00 (0.00)
All	0.00 (0.00)	0.00 (0.00)	4124.14 (85.86)	679.12 (14.14)	10565.08 (84.07)	2001.58 (15.93)	15678.64 (86.57)	2432.44 (13.43)	7592.80 (80.02)	1895.62 (19.98)	6209.56 (89.05)

Note: (1).) Figures in brackets show percentages to total

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H.H Size End use Energy Type	7 Light&oth	8 Cooking	 Light&oth	9 Cooking	 Light&oth	10 and above Cooking	 Light&oth	All Cooking	 Light&oth
Fire Wood	220.40 (10.10)	1763.20 (83.33)	352.64 (16.67)	1873.40 (87.63)	264.48 (12.37)	2666.84 (95.28)	132.24 (4.72)	20100.48 (90.57)	2093.80 (9.43)
Coconut Residue	105.00 (3.03)	1575.00 (84.91)	280.00 (15.09)	840.00 (72.73)	315.00 (27.27)	5320.00 (100.00)	0.00 (0.00)	30170.00 (93.24)	2187.50 (6.76)
Saw Dust	0.00 (0.00)	546.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1596.00 (100.00)	0.00 (0.00)	4452.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	120.00 (19.05)	360.00 (100.00)	0.00 (0.00)	120.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2580.00 (87.76)	360.00 (12.24)
All Non Comm	445.40 (6.69)	4244.20 (87.03)	632.64 (12.97)	2833.40 (83.02)	579.48 (16.98)	9582.84 (98.64)	132.24 (1.36)	57302.48 (92.51)	4641.80 (7.49)
Kerosene	207.00 (100.00)	225.00 (73.53)	81.00 (26.47)	315.00 (94.59)	18.00 (5.41)	0.00 (0.00)	189.00 (100.00)	3033.00 (68.64)	1386.00 31.36)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1035.18 (100.00)	0.00 (0.00)
Electricity	110..94 (100.00)	0.00 (0.00)	195.22 (100.00)	0.00 (0.00)	213.28 (100.00)	0.00 (0.00)	111.80 (100.00)	0.00 (0.00)	2847.46 (100.00)
Others	0.00 (0.00)	0.00 (0.00)	200.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1250.00 (100.00)
All Commercial	317.94 (100.00)	225.00 (32.09)	476.22 (67.91)	315.00 (57.66)	231.28 (42.34)	0.00 (0.00)	300.08 (100.00)	4068.18 (42.59)	5483.46 (57.41)
All	763.34 (10.59)	4469.20 (80.12)	1108.86 (19.88)	3148.40 (79.52)	810.76 (20.48)	9582.84 (95.68)	433.04 (4.32)	61370.66 (85.84)	10124.76 (14.16)

Table 5.45 shows the energy consumption pattern by the end use of fuel material according to household size. It may be noted that irrespective of the number of members in the different categories, the amount of energy used for cooking is not varying too much. The same trend is exhibited when the non-commercial fuels alone are considered. The commercial fuels, however, do not display this trend. For 'lighting and others' also, too much variation is not present across the different household size categories.

Energy consumption pattern of the sample households according to household size for SA II is presented in Table 5.46 (aggregate), 5.47 (per household and per capita) and 5.48 (by proportion). It can be seen from Table 5.46 that energy consumption is the highest in the household size of 5 and the lowest in the household size of 2. The direct relation between energy consumption and household size is limited to only the first four categories. After displaying an increasing trend along with household size for the first four categories, energy consumption showed a decreasing trend, with the exception of one category. However, when the commercial and non-commercial fuels display a fluctuating pattern when they are treated independently. The per capita energy consumption is the highest in the household size of

'10 and above'and the lowest in the household size of 9 (Table 5.47). When the fuels are considered individually, in all the household sizes except the last two, coconut residue is the most important single fuel.

Table 5.49 shows the energy consumption pattern by the mode of procurement of fuel material by household size. No clear relation seems to exist between household size and mode of procurement of fuel material. It may be noted from the table that the relationship between energy procured by different modes and household size fluctuate across the household size categories.

Table 5.50 shows the energy consumption pattern by the end use of fuel material according to household size. It may be noted that irrespective of the household size, the amount of energy used for cooking is not varying too much with household size. The same trend is exhibited when the non-commercial fuels alone are considered. For commercial fuels, however, some variations are visible across different household sizes. It is worth mentioning that the households with smaller sizes use greater proportion of the commercial fuels for 'lighting and others.

Energy consumption pattern of the sample households across household size categories for SA III are presented in Table 5.51 (aggregate), 5.52 (per household and per capita) and 4.70 (by

Table 5.46

Energy consumption pattern by the sample house holds by household size SA II (in 10^3K.Cal)

H.H Size Energy Type	2	3	4	5	6	7	8	9	10 and above
Fire Wood	837.52 (36.33)	1586.88 (35.06)	3592.52 (30.12)	9741.68 (44.64)	4143.52 (45.99)	5377.76 (48.13)	1829.32 (40.18)	2292.16 (43.19)	1432.60 (43.38)
Coconut Residue	857.50 (37.20)	1645.00 (36.35)	3605.00 (30.22)	3797.50 (17.40)	2607.50 (28.94)	3500.00 (31.32)	1645.00 (36.13)	1785.00 (33.64)	770.00 (23.32)
Saw Dust	105.00 (4.55)	0.00 (0.00)	588.00 (4.93)	840.00 (3.85)	651.00 (7.23)	714.00 (6.39)	294.00 (6.46)	294.00 (5.54)	462.00 (13.99)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (13.57)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	135.00 (5.86)	435.00 (9.61)	1035.00 (8.68)	1470.00 (6.74)	300.00 (3.33)	750.00 (6.71)	360.00 (7.91)	600.00 (11.31)	300.00 (9.08)
All Non Commercial	1935.02 (83.94)	3666.88 (81.02)	8820.52 (73.95)	18810.18 (86.20)	7702.02 (85.49)	10341.76 (92.56)	4128.32 (90.68)	4971.16 (93.68)	2964.60 (89.77)
Kerosene	243.00 (10.54)	585.00 (1.93)	1179.00 (9.88)	747.00 (3.42)	630.00 (6.99)	342.00 (3.06)	18.00 (0.40)	198.00 (3.73)	0.00 (0.00)
LPG	0.00 (0.00)	63.90 (1.41)	319.50 (2.68)	191.70 (0.88)	191.70 (2.13)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	191.70 (0.00)
Electricity	127.28 (5.52)	209.84 (4.64)	759.38 (6.37)	1123.16 (5.15)	485.90 (5.39)	339.70 (3.04)	156.52 (3.44)	137.60 (2.59)	146.20 (4.43)
Others	0.00 (0.00)	0.00 (0.00)	850.00 (7.13)	950.00 (4.35)	0.00 (0.00)	150.00 (1.34)	250.00 (5.49)	0.00 (0.00)	0.00 (0.00)
All Commercial	370.28 (16.06)	858.74 (18.98)	3107.88 (26.05)	3011.86 (13.80)	1307..60 (14.51)	831.70 (7.44)	424.52 (9.32)	335.60 (6.32)	337.00 (10.23)
All	2305.30 (100.00)	4525.62 (100.00)	11928.40 (100.00)	21822.04 (100.00)	9009.62 (100.00)	11173.46 (100.00)	4552.84 (100.00)	5306.76 (100.00)	3302.50 (100.00)

Note: Figures in brackets shows percentages to total.

Table 5.47

Per household and per capita consumption by household size SA II (in 10^3kcal)

H.H Size	2		3		4		5		6	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	119.65	59.82	198.36	66.12	299.38	74.84	573.04	114.61	517.94	86.32
Coconut Residue	122.50	65.96	182.78	60.93	240.33	60.08	253.17	50.63	372.50	62.08
Saw Dust	105.00	52.50	0.00	0.00	196.00	49.00	210.00	42.00	217.00	36.17
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	2961.00	592.00	0.00	0.00
Others	67.50	33.75	108.75	36.25	147.86	36.96	183.75	36.75	300.00	50.00
All Non Comm	241.88	129.00	407.43	135.81	588.03	147.01	990.01	198.00	962.75	160.46
Kerosene	48.60	24.30	97.50	32.50	90.69	22.67	53.36	10.67	126.00	21.00
LPG	0.00	0.00	63.90	21.30	106.50	26.63	95.85	19.17	191.70	31.95
Electricity	18.18	9.97	29.98	9.99	54.24	13.56	59.11	11.82	60.74	10.12
Others	0.00	0.00	0.00	0.00	170.00	42.50	237.50	47.50	0.00	0.00
All Commercial	46.29	24.69	95.42	31.81	207.19	51.80	158.50	31.70	163.45	27.24
All	288.16	153.69	502.85	167.62	795.23	198.81	1148.53	229.71	1126.20	187.70

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H.H Size	7		8		9		10 and above		All	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	672.22	96.03	609.77	76.22	764.05	95.51	716.30	89.54	453.44	90.96
Coconut Residue	437.50	62.50	548.33	68.54	595.00	74.38	770.00	96.25	297.24	61.44
Saw Dust	238.00	34.00	294.00	36.75	294.00	36.75	462.00	57.75	232.24	40.70
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00
Others	150.00	21.43	180.00	22.50	300.00	37.50	300.00	37.50	168.28	32.64
All Non Comm	1292.72	184.67	1376.00	172.01	1657.05	207.13	1482.30	185.29	844.54	173.54
Kerosene	68.40	9.77	18.00	2.25	198.00	24.75	0.00	0.00	78.84	17.06
LPG	0.00	0.00	0.00	0.00	0.00	0.00	191.70	23.69	119.81	24.58
Electricity	42.46	6.07	52.17	6.52	45.87	5.73	73.10	9.14	49.09	9.87
Others	150.00	21.43	125.00	15.63	0.00	0.00	0.00	0.00	183.33	34.92
All Commercial	103.96	14.85	141.51	17.69	111.87	13.98	168.95	21.12	141.15	29.00
All	1396.68	199.53	1517.61	189.70	1768.92	221.12	1651.25	206.41	985.69	202.54

Table 5.48
Energy consumption pattern by the proportion of fuels used by the sample households by house hold size SA II

Size of H.H Energy Type	2	3	4	5	6	7	8	9	10 and above	All
Fire Wood	2.72	5.15	11.65	31.59	13.44	17.44	5.93	7.43	4.65	100.00
Coconut Residue	4.24	8.14	17.84	18.97	12.90	17.32	8.14	8.83	3.81	100.00
Saw Dust	2.66	0.00	14.89	21.28	16.49	18.09	7.45	7.45	11.70	100.00
Bio Gas	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	100.00
Others	2.51	8.08	19.22	27.30	5.57	13.93	6.69	11.14	5.57	100.00
All Non Commercial	3.05	5.79	13.93	29.70	12.16	16.33	6.52	7.85	4.68	100.00
Kerosene	6.16	14.84	29.91	18.95	15.98	8.68	0.48	5.02	0.00	100.00
LPG	0.00	6.67	33.33	20.00	20.00	0.00	0.00	0.00	20.00	100.00
Electricity	3.65	6.02	21.79	32.22	13.94	9.75	4.49	3.95	4.19	100.00
Others	0.00	0.00	38.64	43.18	0.00	6.82	11.36	0.00	0.00	100.00
All Commercial	3.50	8.11	29.36	28.45	12.35	7.86	4.01	3.17	3.19	100.00
All	3.12	6.12	16.14	29.52	12.19	15.11	6.16	7.18	4.47	100.00

Table 5.49

Energy consumption pattern by the mode of procurement of fuel material by household size **SA II** (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	330.60 (39.47)	506.92 (60.53)	815.48 (51.39)	771.40 (48.61)	2049.72 (57.06)	1542.80 (42.94)	6457.72 (66.29)	3283.96 (33.71)	2710.92 (65.43)	1432.60 (34.57)	3680.68 (68.44)
Coconut Residue	157.50 (18.37)	700.00 (81.63)	297.50 (18.09)	1347.50 (81.91)	19250 (5.34)	3412.50 (94.66)	367.50 (9.68)	3430.00 (90.32)	647.50 (24.83)	1960.00 (75.17)	1242.50 (35.50)
Saw Dust	105.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	588.00 (100.00)	0.00 (0.00)	840.00 (100.00)	0.00 (0.00)	651.00 (100.00)	0.00 (0.00)	714.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	0.00 (0.00)	135.00 (100.00)	90.00 (20.69)	345.00 (79.31)	420.00 (40.58)	615.00 (59.42)	660.000 (44.90)	810.00 (55.10)	150.00 (50.00)	150.00 (50.00)	420.00 (56.00)
All Non Comm	593.10 (30.65)	1341.92 (69.35)	1202.98 (32.81)	2463.90 (67.19)	3250.22 (36.85)	5570.30 (63.15)	8325.22 (44.26)	10484.96 (55.74)	4159.42 (54.00)	3542.60 (46.00)	6057.18 (58.57)
All Commercial	370.28 (100.00)	0.00 (0.00)	858.74 (100.00)	0.00 (0.00)	3107.88 (100.00)	0.00 (0.00)	3011.86 (100.00)	0.00 (0.00)	1307.60 (100.00)	0.00 (0.00)	831.70 (100.00)
All	963.38 (41.79)	1341.92 (58.21)	2061.72 (45.56)	2463.90 (54.44)	6358.10 (53.30)	5570.30 (46.70)	11337.08 (51.95)	10484.96 (48.05)	5467.02 (60.68)	3542.60 (39.32)	6888.88 (61.65)

Note: (1).) Figures in brackets show percentages.

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H.H Size / Mode / Energy Type	7 Collected	8 Purchased	8 Collected	9 Purchased	9 Collected	10 and above Purchased	10 and above Collected	All Purchased	All Collected
Fire Wood	1697.08 (35.16)	947.72 (51.81)	881.60 (48.19)	1476.68 (64.42)	815.48 (35.58)	947.72 (66.15)	484.88 (33.85)	19417.24 (62.97)	11416.72 (37.03)
Coconut Residue	2257.50 (64.50)	385.00 (23.40)	1260.00 (76.60)	297.50 (16.67)	1487.50 (83.33)	595.00 (77.27)	175.00 (22.73)	4182.50 (20.69)	16030.00 (79.31)
Saw Dust	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	462.00 (100.00)	0.00 (0.00)	3948.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)
Others	330.00 (44.10)	180.00 (50.00)	180.00 (50.00)	300.00 (50.00)	300.00 (50.00)	300.00 (100.00)	0.00 (0.00)	2520.00 (46.80)	2865.00 (53.20)
All Non Comm	4284.58 (41.43)	1806.72 (43.76)	2321.60 (56.24)	2368.18 (47.64)	2602.98 (52.34)	2304.72 (77.74)	659.88 (22.26)	30067.74 (47.47)	33272.72 (52.53)
All Commercial	0.00 (0.00)	424.52 (100.00)	0.00 (0.00)	335.60 (100.00)	0.00 (0.00)	337.980 (100.00)	0.00 (0.00)	10586.08 (100.00)	0.00 (0.00)
All	4284.58 (38.35)	2231.24 (49.01)	2321.60 (50.99)	273.78 (50.95)	2602.98 (49.05)	2642.62 (80.02)	659.88 (19.98)	40653.82 (54.99)	33272.72 (45.01)

Table 5.50

Energy consumption pattern by the end use of fuel material by household size **SA II** (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	837.52 (100.00)	0.00 (0.00)	1586.88 (100.00)	0.00 (0.00)	3592.52 (100.00)	0.00 (0.00)	9344.96 (95.93)	396.72 (4.07)	4055.36 (97.87)	88.16 (2.13)	4959.00 (92.21)
Coconut Residue	857.50 (100.00)	0.00 (0.00)	1470.00 (89.36)	175.00 (10.64)	2887.50 (80.10)	717.50 (19.90)	3360.00 (88.48)	437.50 (11.52)	1977.50 (75.84)	630.00 (24.16)	2975.00 (85.00)
Saw Dust	105.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	588.00 (100.00)	0.00 (0.00)	693.00 (82.50)	147.00 (17.50)	651.00 (100.00)	0.00 (0.00)	714.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	135.00 (100.00)	0.00 (0.00)	435.00 (100.00)	0.00 (0.00)	735.00 (71.01)	300.00 (28.99)	1035.00 (70.41)	435.00 (29.59)	240.00 (80.00)	60.00 (20.00)	690.00 (92.00)
All Non Comm	1935.02 (100.00)	0.00 (0.00)	3491.88 (95.23)	175.00 (4.77)	7803.02 (88.46)	1017.50 (11.54)	17393.96 (92.47)	1416.22 (7.53)	6923.86 (89.90)	778.16 (10.10)	9338.00 (90.29)
Kerosene	0.00 (0.00)	243.00 (100.00)	270.00 (46.15)	315.00 (53.85)	855.00 (72.52)	324.00 (27.48)	495.00 (66.27)	252.00 (33.73)	540.00 (85.71)	90.00 (14.29)	270.00 (78.95)
LPG	0.00 (0.00)	0.00 (0.00)	63.90 (0.00)	0.00 (0.00)	319.50 (100.00)	0.00 (0.00)	191.70 (100.00)	0.00 (0.00)	191.70 (100.00)	0.00 (0.00)	0.00 (0.00)
Electricity	0.00 (0.00)	127.28 (100.00)	0.00 (0.00)	209.84 (100.00)	0.00 (0.00)	759.38 (100.00)	0.00 (0.00)	1123.16 (100.00)	0.00 (0.00)	485.90 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	850.00 (100.00)	0.00 (0.00)	950.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Commercial	0.00 (0.00)	370.28 (100.00)	333.90 (38.88)	524.84 (61.12)	1174.50 (37.79)	1933.38 (62.21)	686.70 (22.80)	2325.16 (77.20)	731.70 (55.96)	575.90 (44.04)	270.00 (32.46)
All	1935.02 (83.94)	370.28 (16.06)	3825.78 (84.54)	699.84 (15.46)	8977.52 (75.26)	2950.88 (24.74)	18080.66 (82.86)	3741.38 (17.14)	7655.56 (84.97)	1354.06 (15.03)	9608.00 (85.99)

Note: (1).) Figures in brackets show percentages to total.

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H.H Size	7	8		9		10 and above		All	
End use / Energy Type	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth
Fire Wood	418.76 (7.79)	1829.32 (100.00)	0.00 (0.00)	2159.92 (94.23)	132.24 (5.77)	1212.20 (84.26)	220.40 (15.38)	29577.68 (95.93)	1256.28 (4.07)
Coconut Residue	525.00 (15.00)	1050.00 (63.83)	595.00 (36.17)	1610.00 (90.20)	175.00 (9.80)	700.0 (90.91)	70.00 (9.09)	16887.50 (83.55)	3325.00 (16.45)
Saw Dust	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	462.00 (100.00)	0.00 (0.00)	3801.00 (96.28)	147.00 (3.72)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2961.00 (100.00)	0.00 (0.00)
Others	60.00 (8.00)	360.0 (100.00)	0.00 (0.00)	540.00 (90.00)	60.00 (10.00)	300.00 (100.00)	0.00 (0.00)	4470.00 (83.01)	915.00 (16.99)
All Non Comm	1003.76 (9.71)	3533.32 (85.59)	595.00 (14.41)	4603.92 (92.61)	367.24 (7.39)	2674.20 (90.20)	290.40 (9.80)	57697.18 (91.09)	5643.28 (8.91)
Kerosene	72.00 (21.05)	0.00 (0.00)	18.00 (100.00)	180.00 (90.91)	18.00 (9.09)	0.00 (0.00)	0.00 (0.00)	2610.00 (66.21)	1332.00 (33.79)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	191.70 (100.00)	0.00 (0.00)	958.50 (100.00)	0.00 (0.00)
Electricity	339.70 (100.00)	0.00 (0.00)	156.52 (100.00)	0.00 (0.00)	137.60 (100.00)	0.00 (0.00)	146.20 (100.00)	0.00 (0.00)	3485.58 (100.00)
Others	150.00 (0.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2200.00 (100.00)
All Commercial	561.70 (67.54)	0.00 (0.00)	424.52 (100.00)	180.00 (53.64)	155.60 (46.36)	191.70 (56.73)	146.20 (43.27)	3568.50 (33.71)	7017.58 (66.29)
All	1565.46 (14.01)	3533.32 (77.61)	1019.52 (22.39)	4783.92 (90.15)	522.84 (9.85)	2865.90 (86.78)	436.60 (13.22)	61265.68 (82.87)	12660.80 (17.13)

proportion). It can be seen from Table 4.68 that energy consumption is the highest in the household size of 5 and the lowest in the household size of two. Interestingly, energy consumption increases with household size only for the first five categories. After displaying an increasing trend along with household size for the first five categories, energy consumption showed a mixed trend afterwards. The non-commercial fuels display the same trend even when they are considered independently. But the commercial fuels exhibit a fluctuating trend. When the fuels are considered individually, in all the household sizes, except the last two, firewood is the most important single fuel.

Table 5.54 shows the energy consumption pattern by the mode of procurement of fuel material by household size. In all the categories the collected share of fuels is greater than the purchased. This trend is confirmed if the non-commercial fuels are considered in isolation. It seems there is no notable relation between mode of procurement of energy and household size in this study area.

Table 5.55 shows the energy consumption pattern by the end use of fuel material according to household size. It may be noted that irrespective of the number of members in the different categories, the amount of energy used for cooking is varying only within a limit of 76.27 per cent to 90.34 per cent. The same trend is

Table 5.51

Energy consumption pattern of the sample house holds by household size SA III (in 10^3K.Cal)

H.H Size Energy Type	2	3	4	5	6	7	8	9	10 and above
Fire Wood	595.08 (44.50)	1410.56 (27.64)	6435.68 (45.11)	10755.52 (58.32)	7163.00 (49.78)	7361.36 (56.65)	3173.76 (57.74)	3085.60 (53.93)	2821.12 (63.90)
Coconut Residue	140.00 (10.47)	1890.00 (37.04)	4025.00 (28.21)	3535.00 (19.17)	3465.00 (24.08)	2415.00 (18.58)	945.00 (17.19)	1190.00 (20.79)	770.00 (17.44)
Saw Dust	0.00 (0.00)	0.00 (0.00)	357.00 (2.50)	0.00 (0.00)	210.00 (1.46)	294.00 (2.26)	336.00 (6.11)	0.00 (0.00)	0.00 (0.0)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (13.72)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Others	375.00 (28.04)	1140.00 (22.34)	1530.00 (10.72)	1260.00 (6.83)	750.00 (5.21)	1140.00 (8.77)	300.00 (5.46)	330.00 (5.76)	570.00 (12.91)
All Non Commercial	1110.08 (83.00)	4440.56 (87.02)	12347.68 (86.55)	15550.52 (84.32)	13562.00 (94.25)	11210.36 (86.27)	4754.76 (86.51)	4605.60 (80.46)	4161.12 (94.25)
Kerosene	180.00 (13.46)	396.00 (7.76)	873.00 (6.12)	603.00 (3.27)	324.00 (2.25)	747.00 (5.75)	360.. (6.55)	378.00 (6.60)	18.00 (0.41)
LPG	0.00 (0.00)	0.00 (0.00)	153.36 (1.08)	536.76 (2.91)	0.00 (0.00)	230.04 (1.77)	115.02 (2.09)	0.00 (0.00)	76.68 (1.74)
Electricity	47.30 (3.54)	116.10 (2.28)	541.80 (3.80)	903.00 (4.90)	503.10 (3.50)	507.40 (3.90)	266.60 (4.85)	240.80 (4.21)	159.10 (3.60)
Others	0.00 (0.00)	150.00 (2.94)	350.00 (2.45)	850.00 (4.61)	0.00 (0.00)	300.00 (2.31)	0.00 (0.00)	500.00 (8.73)	0.00 (0.00)
All Commercial	227.30 (17.00)	662.10 (12.98)	1918.16 (13.45)	2892.76 (15.68)	827.10 (5.75)	1784.44 (13.73)	741.62 (1349)	1118.80 (19.54)	253.78 (5.75)
All	1337.38 (100.00)	5102.66 (100.00)	14265.84 (100.00)	18443.28 (100.00)	14389.10 (100.00)	12994.80 (100.00)	5496.38 (100.00)	5724.40 (100.00)	4414.90 (100.00)

Note: Figures in brackets shows percentages to total.

Table 5.52

Per household and per capita consumption by household size SA III (in 10^3 K.Cal)

H.H Size	2		3		4		5		6	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	198.36	99.18	235.09	78.36	378.57	94.64	632.68	126.54	716.30	119.39
Coconut Residue	140.00	70.00	236.25	78.75	268.33	67.08	252.50	50.50	346.50	57.75
Saw Dust	0.00	0.00	0.00	0.00	178.50	44.63	0.00	0.00	210.00	35.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1974.00	329.00
Others	125.00	62.50	190.00	63.33	255.00	63.75	210.00	42.00	187.50	31.25
All Non Comm	370.03	185.01	555.07	185.02	685.98	171.50	914.74	182.95	1232.91	205.48
Kerosene	90.00	45.00	66.00	22.00	62.36	15.59	86.14	17.23	81.00	13.50
LPG	0.00	0.00	0.00	0.00	153.36	38.34	107.35	21.47	0.00	0.00
Electricity	23.65	11.83	19.35	6.45	33.86	8.47	53.12	10.62	45.74	7.62
Others	0.00	0.00	150.00	50.00	175.00	43.75	212.50	42.50	0.00	0.00
All Commercial	75.77	37.88	82.76	27.59	106.56	26.64	170.16	34.03	75.19	12.53
All	445.79	222.90	637.83	212.61	792.55	198.14	1084.90	216.98	1308.10	218.02

Note: Figures in brackets shows percentages.

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H.H Size	7		8		9		10 and above		All	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	817.93	116.85	793.44	99.18	1028.53	114.28	1410.56	134.34	1406.76	158.26
Coconut Residue	301.88	43.13	315.00	39.38	396.67	44.07	385.00	36.67	515.22	57.25
Saw Dust	294.00	42.00	336.00	42.00	0.00	0.00	0.00	0.00	0.00	0.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00
Others	190.00	27.14	300.00	37.50	330.00	36.67	285.00	27.14	554.08	58.32
All Non Comm	1245.60	177.94	1188.69	148.59	1535.20	170.58	2080.56	198.15	2093.69	235.54
Kerosene	93.38	13.34	180.00	22.50	189.00	21.00	18.00	1.64	237.63	26.40
LPG	115.02	16.43	115.02	14.38	0.00	0.00	76.68	6.97	0.00	0.00
Electricity	56.38	8.05	88.87	11.11	80.27	8.92	79.55	7.58	117.85	13.09
Others	300.00	42.86	0.00	0.00	250.00	27.78	0.00	0.00	0.00	0.00
All Commercial	198.27	28.32	185.41	23.18	372.93	41.44	126.89	12.08	319.57	35.95
All	1443.87	206.27	1374.10	171.76	1908.13	212.01	2207.45	210.23	2413.26	271.49

Table 5.53
Energy consumption pattern by the proportion of fuels used by the sample households by household size SA III

Size of H.H Energy Type	2	3	4	5	6	7	8	9	10 and above	All
Fire Wood	1.39	3.30	15.04	25.13	16.74	17.20	7.42	7.21	6.59	100.00
Coconut Residue	0.76	10.29	21.90	19.24	18.86	13.14	5.14	6.48	4.19	100.00
Saw Dust	0.00	0.00	29.82	0.00	17.54	24.56	28.07	0.00	0.00	100.00
Bio Gas	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	100.00
Others	5.07	15.42	20.69	17.04	10.14	15.42	4.06	4.46	7.71	100.00
All Non Comm	1.55	6.19	17.21	21.68	18.90	15.63	6.63	6.42	5.80	100.00
Kerosene	4.64	10.21	22.51	15.55	8.35	19.29	9.28	9.74	0.46	100.00
LPG	0.00	0.00	13.79	48.28	0.00	20.69	10.34	0.00	6.90	100.00
Electricity	1.44	3.53	16.49	27.49	15.31	15.45	8.12	7.33	4.84	100.00
Others	0.00	6.98	16.28	39.53	0.00	13.95	0.00	23.26	0.00	100.00
All Commercial	2.18	6.35	18.40	27.75	7.93	17.12	7.11	10.73	2.43	100.00
All	1.63	6.21	17.63	22.45	17.51	15.81	6.69	6.97	5.37	100.00

Table 5.54

Energy consumption pattern by the mode of procurement of fuel material by household sine **SA III** (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	0.00 (0.00)	595.08 (100.00)	528.96 (37.50)	881.60 (62.50)	2644.80 (41.10)	3790.88 (58.90)	4981.04 (46.31)	5774.48 (53.69)	3460.28 (48.31)	3702.72 (51.96)	3350.08 (45.51)
Coconut Residue	0.00 (0.00)	140.00 (100.00)	0.00 (0.00)	1890.00 (100.00)	245.00 (6.09)	3780.00 (93.91)	280.00 (7.29)	3255.00 (92.08)	455.00 (13.13)	3010.00 (86.87)	210.00 (8.70)
Saw Dust	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	357.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	294.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	375.00 (100.00)	0.00 (0.00)	1140.00 (100.00)	0.00 (0.00)	1530.00 (100.00)	300.00 (23.81)	960.00 (76.19)	90.00 (12.00)	660.00 (88.60)	210.00 (18.42)
All Non Comm	0.00 (0.00)	1110.08 (100.00)	528.96 (11.91)	3911.60 (88.09)	3246.80 (26.29)	9100.88 (73.71)	5561.04 (35.76)	9989.48 (64.24)	4215.28 (31.08)	9346.72 (68.92)	4064.08 (36.25)
All Commercial	227.30 (100.00)	0.00 (0.00)	662.10 (100.00)	0.00 (0.00)	1918.16 (100.00)	0.00 (0.00)	2892.76 (100.00)	0.00 (0.00)	827.410 (100.00)	0.00 (0.00)	1784.44 (100.00)
All	227.30 (17.00)	1110.08 (83.00)	1191.06 (23.34)	3911.60 (76.66)	5164.96 (36.21)	9100.88 (63.79)	8453.80 (45.84)	99989.48 (54.16)	5042.38 (35.04)	9346.72 (64.96)	5848.52 (45.01)

Note: (1).) Figures in brackets show percentages to total.

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H.H Size	7	8		9		10 and above		All	
Mode Energy Type	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Fire Wood	4011.28 (54.49)	1146.08 (36.11)	2027.68 (63.89)	1366.48 (44.29)	1719.12 (55.71)	1234.24 (43.75)	1586.88 (56.25)	18711.96 (43.72)	24089.72 (56.28)
Coconut Residue	2205.00 (91.30)	245.00 925.93)	700.00 (74.07)	210.00 (17.65)	980.00 (82.35)	140.00 (18.18)	630.00 (81.82)	1785.00 (9.71)	16590.00 (90.29)
Saw Dust	0.00 (0.00)	336.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1197.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)
Others	930.00 (81.58)	90.00 (30.00)	210.00 (70.00)	120.00 (36.36)	210.00 (63.64)	120.00 (21.05)	450.00 978.95)	930.00 (12.58)	6465.00 (87.42)
All Non Comm	7146.28 (63.75)	1817.08 (38.22)	2937.68 (61.78)	1696.48 (36.84)	2909.12 (63.16)	1494.24 (35.91)	2666.88 (64.09)	22623.96 (31.53)	49118.72 (68.47)
All Commercial	0.00 (0.00)	741.62 (100.00)	0.00 (0.00)	1118.80 (100.00)	0.00 (0.00)	253.78 (100.00)	0.00 (0.00)	10426.06 (100.00)	0.00 (0.00)
All	7146.28 (54.99)	2558.70 (46.55)	2937.68 (53.45)	2815.28 (49.18)	2909.12 (50.82)	1748.02 (39.59)	2666.88 (60.41)	33050.02 (40.22)	49118.72 (59.78)

Table 5.55

Energy consumption pattern by the end use of fuel material by household size SA III (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	595.08 (100.00)	0.00 (0.00)	1410.56 (100.00)	0.00 (0.00)	6325.48 (98.29)	110.20 (1.71)	9962.08 (92.62)	793.44 (7.38)	7030.76 (98.15)	132.24 (1.85)	6290.56 (94.01)
Coconut Residue	140.00 (100.00)	0.00 (0.00)	1890.00 (100.00)	0.00 (0.00)	3500.00 (86.96)	525.00 (13.04)	2765.00 (78.22)	770.00 (21.78)	2975.00 (85.86)	490.00 (14.14)	1890.00 (78.26)
Saw Dust	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	357.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	294.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)	0.00 (0.00)
Others	285.00 (76.00)	90.00 (24.00)	1050.00 (92.11)	90.00 (7.89)	1350.00 (88.24)	180.00 (11.76)	960.00 (76.19)	300.00 (23.81)	540.00 (72.00)	210.00 (28.00)	810.00 (71.05)
All Non Comm	1020.08 (91.89)	90.00 (8.11)	4350.56 (97.97)	90.00 (2.03)	11532.48 (93.40)	815.20 (6.60)	13687.08 (88.02)	1863.44 (11.98)	12729.76 (93.86)	832.24 (6.14)	9914.56 (88.44)
Kerosene	0.00 (0.00)	180.00 (100.00)	0.00 (0.00)	396.00 (100.00)	495.00 (56.70)	378.00 (43.30)	495.00 (82.09)	108.00 (17.91)	270.00 (83.33)	54.00 (16.67)	675.00 (90.36)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	536.76 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	230.04 (100.00)
Electricity	0.00 (0.00)	47.30 (100.00)	0.00 (0.00)	116.10 (100.00)	0.00 (0.00)	541.80 (100.00)	0.00 (0.00)	903.00 (100.00)	0.00 (0.00)	503.10 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	850.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
All Commercial	0.00 (0.00)	227.30 (100.00)	0.00 (0.00)	662.10 (100.00)	648.36 (33.80)	1269.80 (66.20)	1031.76 (35.67)	1861.00 (64.33)	270.00 (32.64)	557.10 (67.36)	905.04 (50.72)
All	1020.08 (76.27)	317.30 (23.73)	4350.56 (85.26)	752.10 (14.74)	12180.84 (85.38)	2085.00 (14.62)	14718.84 (79.81)	3724.44 (20.19)	12999.76 (90.34)	1389.34 (9.66)	10819.60 (83.26)

Note: (1).) Figures in brackets show percentages. To total

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H.H Size / End use / Energy Type	7 Light&oth	8 Cooking	8 Light&oth	9 Cooking	9 Light&oth	10 and above Cooking	10 and above Light&oth	All Cooking	All Light&oth
Fire Wood	440.80 (5.99)	3041.52 (95.83)	132.24 (4.17)	2732.96 (88.57)	352.64 (11.43)	2688.88 (95.31)	132.24 (4.69)	40707.88 (95.11)	2093.80 (4.89)
Coconut Residue	525.00 (21.74)	770.00 (81.48)	175.00 (18.52)	700.00 (58.82)	490.00 (41.18)	560.00 (72.73)	210.00 (27.27)	15190.00 (82.67)	3185.00 (17.33)
Saw Dust	0.00 (0.00)	336.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1197.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)
Others	330.00 (28.95)	210.00 (70.00)	90.00 (30.00)	210.00 (63.64)	120.00 (36.36)	330.00 (57.89)	240.00 (42.11)	5745.00 (77.69)	1650.00 (22.31)
All Non Comm	1295.80 (11.56)	4357.52 (91.65)	397.24 (8.35)	3642.96 (79.10)	962.64 (20.90)	3578.88 (86.01)	582.24 (13.99)	64813.88 (90.34)	6928.80 (9.66)
Kerosene	72.00 (9.64)	225.00 (62.50)	135.00 (37.50)	360.00 (95.24)	18.00 (4.76)	0.00 (0.00)	18.00 (100.00)	2520.00 (64.97)	1359.00 (35.03)
LPG	0.00 (0.00)	115.02 (100.00)	0.00 (0.00)	0.00. (0.00)	0.00 (0.00)	76.68 (100.00)	0.00 (0.00)	1111.86 (100.00)	0.00 (0.00)
Electricity	507.40 (49.28)	0.00 (27.39)	266.60 (72.61)	0.00 (58.18)	258.80 (41.82)	76.68 (30.22)	177.10 (69.78)	3631.86 (34.83)	6794.20 (65.17)
Others	300.00 (100.00)	0.00 (0.00)	500.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2150.00 (100.00)
All Commercial	879.40 (49.28)	340.02 (27.39)	901.60 (72.61)	360.00 (58.18)	258.80 (41.82)	76.68 (30.22)	177.10 (69.78)	3631.86 (34.83)	6794.20 (65.17)
All	2175.20 (16.74)	4697.54 (78.34)	1298.84 (21.66)	400296 (76.62)	1221.44 (23.38)	3655.56 (82.80)	759.34 (17.20)	68445.74 (83.30)	13723.00 (16.70)

exhibited when the non-commercial fuels alone are considered. However, it may be noted that the smaller sized households use the commercial sources mostly for 'lighting and others'

Energy consumption pattern of the sample households according to household size for SA IV is presented in Table 5.56 (aggregate), 5.57 (per household and per capita) and 5.58 (by proportion). It can be seen from Table 5.56 that energy consumption is the highest in the household size of 5 and the lowest in the household size of 2. Note that energy consumption increases with hold size for the first four categories, then declines for the next two and then stagnates. A similar trend is displayed by non-commercial fuels when they are treated independently. However, commercial fuels do not exhibit a definite trend. The trends exhibited by the per capita and per household figures (Table 5.57) also are in agreement with the general trend.

Table 5.59 shows the energy consumption pattern by the mode of procurement of fuel material by household size. In all the categories except two, the share of fuels collected is greater than purchased. It may further be noted from Table 5.59 that though household size and mode of procurement for the first four categories (2-5) exhibit no specific trend, generally the proportion of purchased fuels increases with household size.

Table 5.60 shows the energy consumption pattern by the end use of fuel material according to household size. It may be noted that irrespective of the household size, the amount of energy used for cooking is varying only within a limited range. For instance, Table 5.60 reveals that the lowest share of fuels used for cooking is 74.98 (in the '10 and above' category) and the highest share is 92.14 (interestingly, in the household size of 2). This trend is confirmed when the non-commercial fuels alone are considered. For the commercial fuels, however, some variations are visible across different household sizes. For the 'lighting and others', also there is no specific relation between the household size and end use.

In this chapter we have analysed the energy consumption pattern in relation to three parameters, viz, income, size of holding and household size. The important conclusions are the following

Low income households consume more energy in terms of quantity. But they mostly consume non-commercial sources of energy. Among the non-commercial fuels , firewood is the dominant fuel. But the lower income groups use lesser proportion of firewood and higher proportion of coconut residue. The higher income groups consume a grater proportion of commercial fuels. Generally the proportion of collected fuel is less than the purchased fuels in all the categories, with the exception of SA III. The share of energy

Table 5.56

Energy consumption pattern by the sample house holds by household size SA IV (quantity in 10 ^{3}K.Cal)

H.H Size / Energy Type	2	3	4	5	6	7	8	9	10 and above
Fire Wood	0264.48 (19.67)	1234.24 (26.12)	3306.00 (30.65)	7758.08 (44.21)	5333.68 (34.48)	4540.24 (41.66)	573.04 (15.37)	1278.32 (35.08)	1630.96 (42.96)
Coconut Residue	665.00 (44.42)	1697.50 (35.92)	3955.00 (36.67)	5705.00 (32.51)	4445.00 (1.36)	2590.00 (8.48)	280.00 (7.51)	980.00 (26.89)	1190.00 (31.35)
Saw Dust	0.00 (0.00)	168.00 (3.55)	294.00 (2.73)	588.00 (3.35)	210.00 (1.36)	924.00 (8.48)	0.00 (0.00)	672.00 (18.44)	0.00 (0.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2988.68 (19.32)	0.00 (0.00)	2143.72 (57.50)	0.00 (0.00)	0.00 (0.00)
Others	450.00 (30.06)	1200.00 (25.39)	1410.00 (13.07)	20240.00 (11.62)	990.00 (6.40)	990.00 (9.08)	0.00 (0.00)	540.00 (14.82)	570.00 (15.02)
All Non Commercial	1379.48 (92.14)	4299.74 (90.98)	8965.00 (83.12)	16091.08 (91.69)	13967.36 (90.31)	9044.24 (82.99)	2996.76 (80.38)	3470.32 (95.24)	3390.96 (89.33)
Kerosene	36.00 (2.40)	306.00 (6.47)	873.00 (8.09)	432.00 (2.46)	378.00 (2.44)	387.00 (3.55)	0.00 (0.00)	36.00 (0.99)	218.00 (5.69)
LPG	0.00 (0.00)	0.00 (0.00)	76.68 (0.71)	153.36 (0.87)	153.36 (0.99)	268.38 (2.46)	153.36 (4.11)	0.00 (0.00)	0.00 (0.00)
Electricity	81.70 (5.46)	120.40 (2.55)	520.30 (4.82)	722.40 (4.12)	718.10 (4.64)	748.20 (6.87)	227.90 (6.11)	137.60 (3.78)	189.20 (4.98)
Others	0.00 (0.00)	0.00 (0.00)	350.00 (3.25)	150.00 (0.85)	250.00 (1.62)	450.00 (4.13)	350.00 (9.39)	0.00 (0.00)	0.00 (0.00)
All Commercial	117.70 (7.86)	426.40 (9.02)	1819.98 (16.88)	1457.76 (8.31)	1499.46 (9.69)	1853.58 (17.01)	731.26 (19.62)	173.60 (4.76)	405.20 (10.67)
All	1497.18 (100.00)	4726.14 (100.00)	10784.98 (100.00)	17548.84 (100.00)	15466.82 (100.00)	10897.82 (100.00)	3728.02 (100.00)	3643.92 (100.00)	3769.16 (100.00)

Note: Figures in brackets shows percentages to total.

Table 5.57

Per household and per capita consumption by household size SA IV (in 10^3K.Cal)

H.H Size	2		3		4		5		6	
Energy Type	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita	Per H.H	Per Capita
Fire Wood	123.24	66.12	176.32	58.77	236.14	59.04	408.32	81.66	484.88	80.81
Coconut Residue	166.25	83.13	212.19	70.73	282.50	70.63	316.94	63.39	404.09	67.35
Saw Dust	0.00	0.00	168.00	56.00	147.00	36.75	196.00	39.20	210.00	35.00
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2988.68	498.11
Others	150.00	75.00	150.00	50.00	156.67	39.17	156.92	31.38	165.00	27.50
All Non Comm	275.90	137.95	477.75	159.25	597.67	149.42	846.90	169.38	1163.95	193.99
Kerosene	18.00	9.00	61.20	20.40	67.15	16.79	43.20	8.64	54.00	9.00
LPG	0.00	0.00	0.00	0.00	76.68	19.17	153.36	30.67	76.68	12.78
Electricity	16.34	8.17	20.07	6.69	43.36	10.84	38.02	7.60	59.84	9.97
Others	0.00	0.00	0.00	0.00	175.00	43.75	150.00	30.00	250.00	41.67
All Commercial	23.54	11.77	47.38	15.79	121.33	30.33	76.72	15.34	124.69	2083
All	299.44	149.72	252.13	175.04	719.00	179.75	923.62	184.72	1288.90	214.82

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H.H Size / Energy Type	7 Per H.H	7 Per Capita	8 Per H.H	8 Per Capita	9 Per H.H	9 Per Capita	10 and above Per H.H	10 and above Per Capita	All Per H.H	All Per Capita
Fire Wood	504.47	72.07	573.04	71.63	639.16	71.02	815.48	77.66	386.85	73.63
Coconut Residue	370.00	52.86	280.00	35.00	490.00	54.44	595.00	56.67	321.01	63.26
Saw Dust	462.00	66.00	0.00	0.00	336.00	37.3	0.00	0.00	259.64	44.63
Bio Gas	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00
Others	198.00	28.29	0.00	0.00	270.00	30.00	285.00	27.14	170.63	33.98
All Non Comm	1004.92	143.56	1498.38	187.30	1735.16	192.80	1695.48	161.47	848.07	166.51
Kerosene	96.75	13.82	0.00	0.00	18.00	2.00	108.00	10.29	59.20	11.58
LPG	134.19	19.17	153.36	19.17	0.00	0.00	0.00	0.00	115.02	18.72
Electricity	83.13	11.88	113.95	14.24	68.80	7.64	94.60	9.01	50.23	9.60
Others	225.00	32.14	350.00	43.75	0.00	0.00	0.00	0.00	221.43	37.80
All Commercial	205.95	29.42	365.63	45.70	86.80	9.64	202.60	19.30	113.13	22.21
All	1210.87	172.98	1864.01	233.00	1821.96	202.44	1898.08	180.77	961.20	188.72

Table 5.58

Energy consumption pattern by the proportion of fuels used by the sample households by house hold size SA IV

Size of H.H Energy Type	2	3	4	5	6	7	8	9	10 and above	All
Wood	1.02	4.76	12.76	29.93	20.58	17.52	2.21	4.93	6.29	100.00
Coconut Residue	3.09	7.89	18.39	26.53	20.67	12.04	1.30	4.56	5.53	100.00
Saw Dust	0.00	5.88	10.29	20.59	7.35	32.35	0.00	23.53	0.00	100.00
Bio Gas	0.00	0.00	0.00	0.00	58.23	0.00	41.77	0.00	0.00	100.00
Others	5.49	14.65	17.22	24.91	12.09	12.09	0.00	6.59	6.96	100.00
All Non Commercial	2.17	6.76	14.09	25.30	21.96	14.22	4.71	5.46	5.33	100.00
Kerosene	1.35	11.49	32.77	16.22	14.19	14.53	0.00	1.35	8.11	100.00
LPG	0.00	0.00	9.52	19.05	19.05	33.33	19.05	0.00	0.00	100.00
Electricity	2.36	3.47	15.01	20.84	20.72	21.59	6.58	3.97	5.46	100.00
Others	0.00	0.00	22.58	9.68	16.13	29.03	22.58	0.00	0.00	100.00
All Commercial	1.39	5.03	21.45	17.18	17.67	21.85	8.62	2.05	4.78	100.00
All	2.08	6.56	14.96	24.34	21.45	15.12	5.17	5.05	5.27	100.00

Table 5.59

Energy consumption pattern by the mode of procurement of fuel material by household size **SA IV** (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
Mode / Energy Type	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased
Fire Wood	132.24 (50.00)	132.24 (50.00)	528.96 (42.86)	705.28 (57.14)	1366.48 (41.33)	1939.52 (58.67)	4275.76 (55.11)	3482.32 (44.89)	2556.64 (47.93)	2777.04 (52.07)	2600.72 (57.28)
Coconut Residue	87.50 (13.16)	577.50 (86.84)	262.50 (15.46)	1435.00 (84.54)	1260.00 (31.86)	2695.00 (68.14)	2065.00 (36.20)	3640.00 (63.80)	980.00 (22.05)	3465.00 (77.95)	385.00 (14.86)
Saw Dust	0.00 (0.00)	0.00 (0.00)	168.00 (0.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	588.00 (0.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	924.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1974.00 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	450.00 (100.00)	0.00 (0.00)	1200.00 (100.00)	300.00 (21.28)	1110.00 (78.72)	180.00 (8.82)	1860.00 (91.98)	300.00 (30.30)	690.00 (69.70)	360.00 (36.36)
All Non Comm	219.74 (15.93)	1159.74 (84.07)	959.46 (22.31)	3340.28 (77.89)	3220.48 (35.92)	5744.52 (64.08)	7108.76 (44.18)	8982.32 (55.82)	4046.64 (28.97)	9920.72 (71.03)	4269.72 (47.21)
All Commercial	117.70 (100.00)	0.00 (0.00)	426.40 (100.00)	0.00 (0.00)	1819.98 (100.00)	0.00 (0.00)	1457.76 (100.00)	0.00 (0.00)	1499.46 (100.00)	0.00 (0.00)	1853.58 (100.00)
All	337.44 (22.54)	1159.74 (77.46)	1385.86 (29.35)	3340.28 (70.68)	5040.46 (46.74)	5744.52 (53.26)	8566.52 (48.82)	8982.32 (51.18)	5546.10 (35.86)	9920.72 (64.14)	6123.30 (56.19)

Note: (1).) Figures in brackets show percentages to total.

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H.H Size	7	8		9		10 and above		All	
Mode	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Energy Type									
Fire Wood	1939.52	0.00	573.04	837.52	440.80	1013.84	617.12	13312.16	12606.88
	(42.72)	(0.00)	(100.00)	(65.52)	(34.48)	(62.16)	(37.84)	(51.36)	(48.64)
Coconut Residue	2205.00	0.00	280.00	350.00	630.00	350.00	840.00	5740.00	15767.50
	(85.14)	(0.00)	(100.00)	(35.71)	(64.29)	(29.41)	(70.59)	(26.69)	(73.31)
Saw Dust	0.00	0.00	0.00	672.00	0.00	0.00	0.00	2856.00	0.00
	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)	(0.00)	(0.00)	(100.00)	(0.00)
Bio Gas	0.00	0.00	2143.72	0.00	0.00	0.00	0.00	0.00	5132.40
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)
Others	630.00	0.00	0.00	90.00	450.00	120.00	450.00	1350.00	6840.00
	(63.64)	(0.00)	(0.00)	(16.67)	(83.33)	(21.05)	(78.95)	(16.48)	(83.52)
All Non Comm	4774.52	0.00	2996.76	1949.52	1520.80	1483.84	1907.12	23258.16	40346.78
	(52.79)	(0.00)	(100.00)	(56.18)	(43.82)	(43.76)	(56.24)	(36.57)	(63.43)
All Commercial	0.00	731.26	0.00	173.60	0.00	405.20	0.00	8484.94	0.00
	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)	(100.00)	(0.00)
All	4774.52	731.26	2996.76	2123.12	1520.80	1889.04	1907.12	31743.10	40346.78
	(43.81)	(19.62)	(80.38)	(58.26)	(41.74)	(49.76)	(50.24)	(44.03)	(55.97)

Table 5.60

Energy consumption pattern by the end use of fuel material by household size SA IV (in 10^3 K.Cal)

H.H Size	2		3		4		5		6		7
End use / Energy Type	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking	Light&oth	Cooking
Fire Wood	264.48 (100.00)	0.00 (0.00)	1234.24 (100.00)	0.00 (0.00)	3306.00 (100.00)	0.00 (0.00)	7625.84 (98.30)	132.24 (1.70)	4892.88 (91.74)	440.80 (8.26)	4187.60 (92.23)
Coconut Residue	665.00 (100.00)	0.00 (0.00)	1529.50 (93.81)	105.00 (6.19)	3640.00 (92.04)	315.00 (7.96)	5215.00 (91.41)	490.00 (8.59)	3710.00 (83.46)	735.00 (16.54)	2135.00 (82.43)
Saw Dust	0.00 (0.00)	0.00 (0.00)	168.00 (100.00)	0.00 (0.00)	294.00 (100.00)	0.00 (0.00)	588.00 (100.00)	0.00 (0.00)	210.00 (100.00)	0.00 (0.00)	924.00 (100.00)
Bio Gas	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2988.68 (100.00)	0.00 (0.00)	0.00 (0.00)
Others	450.00 (100.00)	0.00 (0.00)	1200.00 (100.00)	0.00 (0.00)	1410.00 (100.00)	0.00 (0.00)	1860.00 (91.18)	180.00 (8.82)	1870.00 (87.88)	120.00 (12.12)	690.00 (69.70)
All Non Comm	1379.48 (100.00)	0.00 (0.00)	4194.74 (97.56)	105.00 (2.44)	8650.00 (96.49)	315.00 (3.51)	15288.84 (95.01)	802.24 (4.99)	12671.56 (90.72)	1295.80 (9.28)	7936.60 (87.75)
Kerosene	0.00 (0.00)	36.00 (100.00)	0.00 (0.00)	306.00 (100.00)	405.00 (46.39)	468.00 (53.61)	270.00 (62.50)	162.00 (37.50)	270.00 (71.43)	108.00 (28.57)	315.00 (81.40)
LPG	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	76.68 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	268.38 (100.00)
Electricity	0.00 (0.00)	81.70 (100.00)	0.00 (0.00)	120.40 (100.00)	0.00 (0.00)	520.00 (100.00)	0.00 (0.00)	722.40 (100.00)	0.00 (0.00)	718.10 (100.00)	0.00 (0.00)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	150.00 (100.00)	0.00 (0.00)	250.00 (100.00)	0.00 (0.00)
All Commercial	0.00 (0.00)	117.70 (100.00)	0.00 (0.00)	426.40 (100.00)	481.68 (26.47)	1338.30 (73.53)	423.36 (29.04)	1034.40 (70.68)	423.36 (28.23)	1076.10 (71.77)	583.38 (31.47)
All	1379.48 (92.14)	117.70 (7.86)	4194.74 (88.76)	531.40 (11.24)	9131.68 (84.67)	1653.30 (15.33)	15712.20 (89.53)	1836.64 (10.47)	13094.92 (84.66)	2371.90 (15.34)	8519.98 (78.18)

Note: (1).) Figures in brackets show percentages to total

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H.H Size End use Energy Type	7 Light&oth	8 Cooking	 Light&oth	9 Cooking	 Light&oth	10 and above Cooking	 Light&oth	All Cooking	 Light&oth
Fire Wood 352.64	573.04 (7.77)	0.00 (100.00)	(0.00)	1102.00 (86.21)	176.32 (13.79)	1366.48 (83.78)	264.48 (16.22)	24552.56 (94.73)	1366.48 (5.27)
Coconut Residue	455.00 (17.57)	175.00 (62.50)	105.00 (37.50)	840.00 (85.71)	140.00 (14.29)	910.00 (76.47)	280.00 (23.53)	18882.50 (87.79)	2625.00 (12.21)
Saw Dust	0.00 (0.00)	0.00 (100.00)	0.00 (0.00)	672.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2856.00 (100.00)	0.00 (0.00)
Bio Gas	0.00 (0.00)	2143.72 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5132.40 (100.00)	0.00 (0.00)
Others	300.00 (30.30)	0.00 (0.00)	0.00 (0.00)	390.00 (72.22)	150.00 (27.78)	390.00 (68.42)	180.00 (31.58)	7260.00 (88.64)	930.00 (11.36)
All Non Comm	1107.64 (12.25)	2891.76 (96.50)	105.00 (3.50)	3004.00 (86.56)	466.32 (13.44)	2666.48 (78.63)	724.48 (21.37)	58683.46 (92.26)	4921.48 (7.74)
Kerosene	72.00 (18.60)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	36.00 (100.00)	180.00 (83.33)	36.00 (16.67)	1440.00 (54.05)	1224.00 (49.95)
LPG	0.00 (0.00)	153.36 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	805.14 (100.00)	0.00 (0.00)
Electricity	748.20 (100.00)	0.00 (0.00)	227.90 (100.00)	0.00 (0.00)	137.60 (100.00)	0.00 (0.00)	189.20 (100.00)	0.00 (0.00)	3465.80 (100.00)
Others	450.00 (0.00)	0.00 (0.00)	350.00 (100.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1550.00 (100.00)
All Commercial	1270.20 (68.53)	153.36 (20.97)	577.90 (79.03)	0.00 (0.00)	173.60 (100.00)	180.00 (44.42)	225.20 (55.58)	2245.14 (26.46)	6239.80 (73.54)
All	2377.84 (21.82)	3045.12 (81.68)	682.90 (18.32)	3004.00 (82.44)	639.92 (17.56)	2846.48 (74.98)	949.68 (25.02)	60928.60 (84.52)	11161.21 (15.46)

used for cooking is greater than 'lighting and others'. But the proportion of energy used for 'lighting and others' increases with income.

When analysed in terms of size of holding it was found that energy consumption is higher in the lower land holding categories and lower in the higher land holding categories. The proportion of energy used for cooking showed an increasing trend with land holding. Similarly it is also observed that the proportion of non-commercial fuels like firewood and coconut residue used for 'lighting and others' increased with land holding size.

When analysed in terms of household size, it was observed that up to limit energy consumption increased with household size and then decreased. It seems there is no clear relation between household size and the mode of procurement or end uses.

CHAPTER VI

ATTITUDES OF THE RURAL HOUSEHOLDS TOWARDS ENRGY CONSUMPTION AND CONSERVATION

This chapter is divided in two sections. In the first section, an assessment of the attitudes of the rural households towards energy sources, uses and devices is made. In the second section, an attempt is made to identify the factors influencing the adoption of energy conservation practises and shift to improved energy technologies at the household level in the rural areas.

Section I

Household attitudes towards energy sources, uses and devices

The attitudes of the households to energy sources, uses and devices may vary across the regions depending on the availability and accessibility to fuel materials. In this section an attempt is made to understand the attitudes of the rural households in this regard.

6.1 Attitude towards energy sources and uses

Here an attempt is made to understand the factors responsible for a household's decision to use a particular fuel and to place it to a particular end use

6.1 (a) Attitude towards the fuel in current use

The decision of a household to use a particular fuel is influenced by a number of factors varying from the availability of the fuel to tradition. Table 6.1 explores the reasons for using the cooking fuel in current use.

It can be seen from Table 6.1 that in SA I, among the households using firewood for cooking, the most important reason for using firewood is its free availability (28 households) followed by tradition / familiarity. In SA II and SA IV also the most important reason is free availability. However, in SA III, easy availability is also as important as free availability. This may be due to the fact that SA III is in the vicinity of forest. In SA IV also, easy availability is an important reason for using firewood, mainly due to the topography of the village. The reason 'others' is also important for the firewood using households in all the study areas. 'Others' include factors like convenience, better taste of dishes and easy to store. It may be noted that, except in the case of the first five reasons, uniformity is lacking in the responses between study areas.

For coconut residue, free and easy availability are the most important reasons in all the study areas. In the present study, it was revealed that coconut trees were there in 69 households (92 per cent) in SA I, 70 in SA II (93.33 per cent), 66 in SA III (88.00 per cent) and 67 in SA IV (89.33 per cent). It may also be noted that 22 households in SA I, 14 in SA II, 18 each in SA III and SA IV used coconut residue because of its affordability.

Table 6.1

Reason for using the cooking fuel in current use

(No. of households)

Reason Codes	SA I FW	CR	SD	OTH	KER	LPG	SA II FW	CR	SD	OTH	KER	LPG	SA III FW	CR	SD	OTH	KER	LPG	SA IV FW	CR	SD	OTH	KER	LPG
I	12	41	-	2	3	-	21	28	11	14	3	3	49	41	1	14	4	-	38	41	1	14	4	-
II	28	63	-	8	-	-	30	56	-	27	-	-	49	57	-	33	-	-	40	57	-	33	-	-
III	12	22	11	8	2	2	18	14	9	10	6	3	15	18	5	22	11	5	15	18	5	22	11	5
IV	9	-	10	-	9	7	12	-	5	1	9	4	12	1	2	7	15	10	12	1	2	7	15	10
V	26	10	8	2	1	1	16	10	1	3	3	2	29	10	1	10	2	3	29	10	1	10	2	-
VI	4	12	-	6	-	-	-	8	1	3	-	-	-	10	2	17	-	-	-	10	2	17	-	-
VII	1	-	-	-	3	7	4	-	1	-	3	7	-	-	-	-	10	10	-	-	-	-	10	10
VIII	4	-	-	-	9	7	1	-	-	-	6	8	-	-	-	1	9	10	-	-	-	1	9	10
IX	3	-	-	-	8	7	2	-	-	-	11	8	6	-	-	2	15	10	6	-	-	2	15	10
X	7	-	1	3	6	5	7	3	5	6	5	6	13	8	3	9	9	7	10	8	2	6	7	5

Note: House holds were allowed to indicate more than one reason

Reason codes: I. Easy availability, II. Free availability, III. Affordability, IV. Efficient burning, V. Tradition / Familiarity VI. absence of alternative fuel, VII. Cleanliness, VIII. No smoke/less smoke IX. Fast cooking / Time saving, X. Others

Fuel code: FW = Firewood. CR = Coconut Residue. SD = sawdust. OTH = Other Non Commercial. KER = Kerosene. Biogas is excluded since there are only 4 households using it. Electricity and 'Others' are excluded since no household uses it for cooking.

The major reasons for using sawdust is affordability, efficient burning and tradition / familiarity in SA I. In SA II however, apart from the above-mentioned reasons, 11 households used sawdust due to its easy availability. This may be due to the presence of some sawmills in the locality. Households in SA II also reported that sawdust and firewood are brought to the houses by vendors.

For 'others' in SA I the important reasons for using are free availability for those who collected them and affordability for those purchased them. It may also be noted that in SA II, III and IV, easy availability is also an important reason. This may be because SA I being coastal area, 'others' are not available easily. It can also be observed that in SA III and SA IV reasons such as tradition / familiarity and shortage of alternate fuel are also expressed by many households. This probably brings out two factors, one, other non-commercial sources is available in plenty in these areas, and second, at least some of the households are forced to use these inefficient sources of energy due to the absence of alternative fuels.

The important reasons for using kerosene are efficient burning, comparatively smoke free environment, fast cooking and easy availability. While only two households in SA I used kerosene because it was affordable, in SA II it is 6 and SA III and SA IV it is 11. It is interesting to note that only a limited number of households use kerosene due to familiarity / tradition. It may also be noted that none of the households use kerosene due to the absence of an alternate fuel. As observed from Table 6.1, a number of households expressed other reasons, which include convenience and 'easy to store'. Some of the households use kerosene as a fuel to start fire (for firewood and coconut residue), rather than to cook. These households used kerosene for its excellent burning characteristics especially as a ' starter fuel'.

LPG is used by households in all the study areas for reasons like cleanliness, absence of smoke, efficient burning and fast cooking. It can also be seen from the table that some of the sample households were using LPG because it was either affordable or familiar.

It may be noted that some of the households used LPG due to 'other' reasons. Here 'others' include convenience, easy to store, easy to transport and status symbol.

From the foregoing discussion, it may be inferred that the criteria for the use of a particular fuel for a particular end use seem to be easy availability, free availability, affordability and tradition in the case of non-commercial fuels and cleanliness, reduced smoke, time saving and efficient burning in the case of commercial fuels.

6.1 (b) Difficulties faced with he current cooking fuel

In section 6.1 (a) it was revealed that the households have certain criteria for using the current cooking fuel. However, that does not imply that households are not facing a problem with the current cooking fuel.

It may be observed from the Table 6.2 that for firewood and coconut residue, almost all the households in all the study areas are facing difficulties. In SA I, SA II and SA IV for firewood, the most important problems are cost, scarcity and smoke. However in SA III, the most important reasons are cost and smoke. The vicinity of forest to SA . III perhaps reduces the severity of the scarcity problem. For coconut residue, the most important problems in all the study areas are prolonged cooking time, smoke and difficulties to store. It may be observed from the table that a large number of households in all the categories reported health related problems

For sawdust, the important difficulties are cost and time in SA I and expensive and health related problems in SA II. For sawdust the major problem common to all the study areas is cost. Besides, in SA I, smoke and cooking time are also considered as major difficulties. For 'others' important difficulties in all the study areas are smoke and time consuming cooking procedure.

Table 6.2

Difficulties experienced with the present cooking fuel

(No. of households)

	STUDY AREAS																							
Difficulty	SA I						SA II						SA III						SA IV					
Codes	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG
I	36	13	4	12	10	5	32	16	2	8	9	4	15	19	2	6	13	7	26	18	3	8	7	5
II	49	14	13	6	16	7	43	21	12	4	12	8	31	23	4	1	12	8	42	22	7	3	6	7
III	18	36	8	13	6	-	28	32	4	18	8	-	30	34	2	21	10	-	24	33	2	23	7	-
IV	12	21	11	15	2	-	14	37	6	14	1	-	18	41	-	17	2	-	17	34	5	21	3	-
V	8	31	2	8	-	-	13	27	4	9	-	-	5	19	1	5	-	-	7	12	3	14	-	-
VI	14	13	-	7	-	2	8	19	-	5	-	1	10	12	-	8	-	3	17	10	-	9	-	4
VII	3	4	1	6	9	-	6	7	3	9	7	-	8	9	-	12	13	-	4	9	2	5	3	-
VIII	3	8	9	11	4	-	4	3	5	9	8	-	6	8	1	2	7	-	9	4	3	5	5	-
IX	25	28	6	10	4	-	24	31	7	16	4	-	21	26	-	13	8	-	17	29	3	15	6	-
X	3	2	1	-	7	2	4	2	1	1	10	2	1	-	2	4	11	3	-	3	1	3	8	1

Note: Households were allowed to indicate more than one difficulty

Difficulty codes: I. Scarcity II. Expensive III. Smokey IV. Time consuming V. Difficulty to store VI. Difficulty to transport VII. Adverse smell of food VIII. Lack of cleanliness IX. Health related problems X. Others.

Fuel code: FW = Firewood. CR = Coconut Residue. SD = Sawdust. OTH = Other non-commercial. KER = Kerosene. Biogas is excluded since there are only 4 households using it. Electricity and 'Others' are excluded since no household uses it for cooking.

Some households also express problems like ill health and difficulty to store.

For kerosene the difficulties common to all the study areas are scarcity, cost, smoke and adverse smell of food. It may be noted that in all the study areas many households also expressed the reason 'others'. 'Others' include inadequate and irregular availability through public distribution system and risk involved in use. For LPG, it is interesting to note that there is considerable uniformity between the study areas in the problems identified. Difficulties expressed. The difficulties common to all the study areas are scarcity and cost. Some households have expressed the difficulty to transport. This may be due to the fact that in rural areas the supply network of LPG is incomplete, especially in remote areas.

From the foregoing discussion, it may be inferred that scarcity, cost, smoke and time for cooking are the most important difficulties faced with the non-commercial fuels. For commercial fuels, scarcity, cost, irregular and inadequate supply and risk to use are the most important difficulties. It may be further observed that the responses of the households regarding the difficulties faced with the non-commercial fuels highlights the inefficient burning characteristics of these flues.

Hence it is evident that households are facing difficulties with the cooking fuel in use. However, a number of factors hold back the households from shifting to a new fuel. These factors, as revealed from the survey, are the non-affordability of the new fuel, high cost of the devices (stoves) required for the new fuel, the free or cheep availability of the present fuel, the supply problems related to the new fuel, unfamiliarity with the new fuel or device and the fear of waste of 'home produced' fuel if they are not used. Interestingly, a large number of households felt that, though they were facing problems with the current cooking fuel, they were not interested in shifting to another fuel. Nonetheless, it may be mentioned that some of the female members of the households reported that, though they wanted to change the fuel, male members who controlled monetary resources were not interested in doing so. Even in the households where women also earned income, they could not spend it without the permission of the male members, mostly husbands. Hence it seems that the choice of the favorite fuel by the cooks, depends much on the decision of men. Thus it could be observed that the rural energy problem is having a strong gender dimension also.

6.1 (c) Energy transition at the household level

The foregoing section revealed that many of the households are interested in the substitution of the existing cooking fuels. The details of the households who have practised energy transition in the past five years is presented in Tables 6.3, 6.4 and 6.5. Table 6.5 consolidates the information presented in the previous two tables.

Major fuels given up during the past five years are coconut residue and 'others' (Table6.4). Firewood is the next fuel given up by the maximum number of households. It may be noted that, a large number of households (10 Nos.) abandoned kerosene. Only one household discarded LPG. For all the fuels other than kerosene and LPG the maximum number of households discontinued use 3-5 years back. However, for all the fuels except LPG, the number of households giving up the fuel is evenly distributed over the reference period.

Major fuels adopted during the last five years are kerosene followed by firewood and LPG (Table 6.4). The adoption rate is more or less evenly spread across the reference period, though the majority of the fuel adoptions (72 per cent) took place more than two years ago. The lowest adoption rate is for 'others'.

Table 6.5 gives consolidated figures of households giving up or adopting a specific cooking fuel. The table presents a comparative view of the fuels adopted or given up by the households. It could be seen from the table that while 11 households discontinued using firewood, 21 households adopted it. For kerosene, while 10 households abandoned the fuel 28 adopted it. The adoption rate is the highest for LPG, where 21 households

Table 6.3
Time period since giving up old cooking fuel.

	FUELS																							
Giving	SA I						SA II						SA III						SA IV					
Up	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG
Recently	1	-	-	-	1	-	-	1	-	1	-	-	-	1	-	1	-	-	-	1	-	1	-	-
1-2 years	-	2	1	1	-	-	2	-	1	1	1	-	-	-	-	-	1	1	1	-	-	-	-	-
2-3 years	2	1	-	-	2	-	-	-	-	-	2	-	1	-	-	1	-	-	-	2	1	2	2	-
3-5 years	-	1	2	3	-	-	1	4	1	2	-	-	1	2	-	3	1	-	2	1	-	-	-	-

Table 6.4
Time period since adopting the new cooking fuel.

	FUELS																							
Adopted	SA I						SA II						SA III						SA IV					
	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG
Recently	2	-	1	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
1-2 years	-	1	-	1	1	1	1	-	1	-	-	1	1	1	-	1	2	1	1	2	-	-	2	1
2-3 years	1	1	-	-	2	2	-	-	-	-	2	1	2	1	3	2	3	4	4	2	1	-	3	2
3-5 years	2	-	-	-	6	1	2	1	-	-	1	3	3	-	-	-	2	3	1	-	-	-	1	1

Fuel code: FW = Firewood. CR = Coconut Residue. SD = sawdust. OTH = Other Non Commercial. KER = Kerosene. Biogas is excluded since there are only 4 households using it. Electricity and 'Others' are excluded since no household uses it for cooking.

Table 6.5

Households giving up or adopting a specific cooking fuel (No of house holds)

Study area	Fire wood		Coconut Residue		Saw Dust		Others *		Kerosene		LPG	
	A	B	A	B	A	B	A	B	A	B	A	B
SA I	3	5	4	2	3	1	4	1	3	10	-	4
SA II	3	4	5	1	2	1	4	-	3	4	-	5
SA III	2	6	3	2	-	3	5	3	2	7	1	8
SA IV	3	6	4	4	1	1	3	-	2	7	-	4
ALL	11	21	16	9	6	6	16	4	10	28	1	21

Note: (1) A = No of households giving up the fuel
(2) B = No of households adapting the fuel.
(3) *Others = other non-commercial fuels.

adopted it while only 1 household deserted it. Thus it may be observed that for firewood, kerosene and LPG more households adopted them, than dropped them. For sawdust the number of households giving up and adopting the fuel are the same. For coconut residue and 'others' the number of households that have discontinued use is more than adopted. For instance, while 16 households discarded coconut residue, only 9 adopted. Similarly, for others, while 16 households dropped it, only 4 adopted.

From the foregoing discussion, it can be seen that the adoption rate is more significant in the case of LPG and kerosene while the 'rejection' rate is more significant in the case of others and coconut residue.

The attitude of the households behind adopting or giving up a specific fuel is examined in Table 6.6 and 6.7. Table 6.6 examines the reasons for giving up the old fuel. Table 6.7 analyses the reason for adopting the new fuel.

Table 6.6 reveals that the most important reason for giving up firewood is the increased availability of the new fuel. This perhaps indicates the increased availability of commercial fuels like kerosene and LPG. Other important reasons for giving up firewood are high price and decreased availability. For coconut residue, the major reasons for giving up the fuel are time consuming cooking procedure, smoke and health related problems. 'Others' is also an important reason for giving up coconut residue. Others include storage problems, adverse smell of food and the associated inconveniences.

For sawdust, all the reasons have almost the same weightage, though non-availability / decreased availability is sighted as the most important one. For 'others', which is the fuel dropped by the maximum number of households, the major reason for giving up is time consuming cooking procedure. Smoke and health problems are also important reasons. Eight households gave up 'others' for reasons like storage problems, adverse smell of food and lack of cleanliness. The major reason attributed to giving up kerosene is availability of new fuel, mainly LPG. Three households gave up kerosene because the new fuels became affordable. For LPG, there is only one household who abandoned it. The reason for giving up was difficulties in transportation. This particular household residing in a remote corner of SA III had to transport LPG on their own, since the LPG vendor in the near by town was not delivering to homes in such interior areas. This case, though is an isolated example, may be viewed as an instance where supply constraints prevent people from shifting to better fuels.

Hence it may be inferred from Table 6.6 that the major reason for dropping non-commercial fuels are 'time consuming cooking', smoke and health related problems. [Further information on one of

Table 6.6

Reason for giving up the old fuel (No. of households)

Reason Codes	SA I FW	SA I CR	SA I SD	SA I OTH	SA I KER	SA I LPG	SA II FW	SA II CR	SA II SD	SA II OTH	SA II KER	SA II LPG	SA III FW	SA III CR	SA III SD	SA III OTH	SA III KER	SA III LPG	SA IV FW	SA IV CR	SA IV SD	SA IV OTH	SA IV KER	SA IV LPG
I	1	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	-	2	1	-	-	-	-
II	2	-	2	-	-	-	1	-	1	-	1	-	1	1	-	1	-	-	1	1	-	-	-	-
III	-	2	1	4	-	-	-	2	1	2	-	-	1	2	-	4	-	-	-	3	-	3	-	-
IV	-	1	-	2	1	-	1	3	-	3	-	-	-	2	-	3	1	-	1	3	-	3	-	-
V	2	-	1	-	2	-	2	1	-	1	2	-	1	-	-	-	-	-	1	1	-	-	2	-
VI	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	1	-	-	-
VII	-	1	2	4	1	-	-	2	-	-	1	-	-	1	-	3	-	1	-	3	-	1	-	-

Note: Households were allowed to express more than one reason, if applicable

Reason codes: I. High price, II. Non availability/decreased availability, III.Cooking is time consuming IV. Smoke and health problems V. New fuel became available, VI. New fuel became affordable, VII.Others.

Fuel code: FW = firewood. CR = Coconut Residue. SD = Saw Dust. OTH = Other Non Commercial. KER = Kerosene.

Table 6.7

Reason for adopting the new fuel (No of households)

Reason Codes	STUDY AREAS SA I						SA II						SA III						SA IV					
	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG	FW	CR	SD	OTH	KER	LPG
I	-	-	1	-	1	-	-	1	-	-	-	1	-	-	1	2	-	-	-	1	-	-	1	-
II	2	-	-	-	-	-	1	1	-	-	1	-	1	1	1	-	-	-	2	2	1	-	3	1
III	1	2	-	1	3	-	-	-	-	-	1	2	2	1	2	1	4	5	-	1	-	-	1	2
IV	1	-	-	-	1	-	1	-	-	-	1	1	-	-	1	-	-	-	1	-	-	-	1	1
V	2	-	-	-	6	4	3	-	1	-	3	5	1	-	1	-	2	6	3	-	-	-	3	4
VI	1	-	-	-	4	4	1	-	-	-	1	5	1	-	-	-	2	7	2	-	-	-	1	3
VII	2	1	-	-	2	-	-	-	1	-	1	-	2	1	-	-	1	1	2	1	-	-	-	1

Note: Households were allowed to express more than one reason if applicable

Difficulty codes: I. High prices of old fuel, II. Scarcity/ irregular supplies of old fuel III. Increased availability of new fuel. IV. Affordability of new fuel, V. Faster cooking, VI. Healthier kitchen environment. VI. Others.

Fuel code: FW = firewood. CR = Coconut Residue. SD = Saw Dust. OTH = Other Non Commercial. KER = Kerosene. Biogas is excluded since there are only 4 households using it. Electricity and 'Others' are excluded since no household uses it for cooking.

the possible causes of smoke – poor ventilation – is discussed in section 6.1 (d)]. For the commercial fuels, the major reason attributed for giving up is the availability of new fuel.

The most important reason for adopting firewood is to save time by faster cooking (Table 6.7) Scarcity or irregular supply of the old fuel and other reasons like efficient burning, cleaner cooking etc are also relevant reasons. Only a limited number of households have desired to adopt coconut residue as a new fuel. The reasons are scarcity or irregular supply of the old fuel and increased availability of new fuel. For sawdust, no single reason seems to dominate the adoption decision. 'Others', the least adopted among the non-commercial fuels, was adopted due to the high price of old fuel and its increased availability. Here it may be noted that, increased price of superior (efficient) fuel may force households to shift to 'inferior' (inefficient) fuels. For kerosene, the most important reason to adopt is faster cooking. Increased availability of kerosene and concern for healthier kitchen environment, also prompted some households to adopt kerosene. LPG is the most adopted fuel. The major reasons are faster cooking and healthier kitchen environment.

The foregoing analysis reveals that major reasons for the adoption of non-commercial fuels are scarcity or irregular supplies of the old fuel, increased availability (mostly in SA III) and faster cooking. For the commercial fuels, the important reasons are faster cooking and healthier kitchen environment. This may be considered as an attitudinal change on the part of the rural households, rather than a reflection of the commercialization of the rural fuel markets. The increased health consciousness and concern for time management may be considered as the results of the attitudinal changes taking place in rural Kerala.

6.1 (d) Attitude towards energy devices and kitchen environment

The attitudes of the households to kitchen environment and energy devices deserve equal attention as the attitude to energy sources. This is because, the efficiency and other burning characteristics of the fuel depend to a great extend on the energy device. Similarly the kitchen environment, especially factors like air suction devices, also have influence on the health of the members of households.

The position of the kitchen in the household can be either inside the house, attached to it or it could be out side the house. Some households do not have a separate kitchen, but use a part of a room to cook. Some times they even cook in the open air (except during heavy rains). Table 6.8 gives details of the households according to the position of the kitchen. For instance, in SA I, 61 households had separate kitchen, of which 58 is inside the house and 3 is out side the house. Fourteen houses did not have a separate kitchen. Out of these, twelve used part of a room in the house as the cooking place, but two households cooked in the open. When all the study areas are considered, it can be seen of the fuel that majority of them (251) had a separate kitchen. However, 38 households used a room in the house as the cooking place. Of this, 18 used the dining room, 13 used the bedroom (often the only one of two the rooms) and 7 used the storeroom as the cooking place. It may be noted that five households cooked in the open. Here it seems worth recording that in some of the sample households, the women reported to the researcher that they were never consulted by the men of the household regarding the location of the kitchen or facilities in it. Some households without separate kitchen, reported that male members of the household who are the income earners are not interested in spending money for the construction of kitchen. This may be identified as further evidence for the gender dimension of the household energy problems.

The kitchen environment has important bearing on the health of the members of the households, mostly women and children who spend long hours in kitchen. The kitchen environment depends on the fuels burnt, type of choolah used and the air suction device in the kitchen. The type of fuel used by the households for cooking and the rational behind such decisions were discussed in the earlier

Table 6.8
Households according to the position of kitchen (No of house holds)

Study area	House holds with separate kitchen Inside the house	Outside the house	Total	House holds without separate kitchen Inside the house	Outside the house	Total
SAI	58	3	61	12	2	14
SA II	66	-	66	9	-	9
SA III	65	2	67	7	1	8
SA IV	61	2	63	10	2	12
ALL	250	7	257	38	5	43

Note: Some households had more than one kitchen. Similarly some households use facility outside the house for cooking occasionally. Only the major cooking arrangement is considered for this table

Table 6.9
Households according to air suction device in the kitchen (No of house holds)

Study area	Air suction device Chimney	Chimney tile	Window	No arrangement
SA I	26	42	8	3
SA II	39	38	6	1
SA III	31	34	11	2
SA IV	28	51	6	2
ALL	124	165	31	8

Note: Only house holds with kitchen are considered. Some households had more than one device sections. Here, details of the air suction devices and type of choolah used by the household are presented.

Table 6.9 shows households according to the air suction devices in the kitchen. For instance in SA I, 26 households had chimney and 42 had chimney tile. Eight households made use of windows for ventilation. Three households did not have any arrangement for air suction. When all the households are considered, it can be seen that the majority of the households (165) used chimney tile as air suction device, followed by chimney (124) and windows (31). Eight households did not have any arrangement for air suction.

The environment in the kitchen also depends on the type of choolah used. Information on the type of choolah used is presented in Table 6.10. It may be observed from the table that in all the study areas, the type of choolah used by the maximum number of households is 'brick mud choolah'. The traditional three stone choolah is also used by large number (103) of households. It may further be noted that only a limited number of households' (33) used the smokeless choolah, due to different reasons (see Table 6.18).

Another energy related device used in the kitchen is the vessel. The distribution of the sample household by the type of vessels used is presented in Table 6.11. It may be observed from the

Table 6.10
Households by type of choolah used. (No of households)

Study Area	Choolah Type							
	I	II	III	IV	V	VI	VII	VIII
SA I	26	34	13	10	17	16	7	0
SA II	21	43	17	10	17	13	8	1
SA III	30	40	12	6	5	16	10	1
SA IV	26	29	16	7	11	9	7	2
ALL	103	146	58	33	50	54	32	4

Choolah Type codes: (I) Three stone choolah (II) Brick mud choolah (III) Improved wood choolah (IV) Smokeless Choolah (V) Saw dust stove (VI) Kerosene stove (VII) LPG stove (VIII) Bio Gas Stove.

Table 6.11
Households by type of vessels used (No of households)

Study area	Type of vessel used						
	Earthen	Aluminum	Cast Iron	Steel	Hindalium	Bronze	Copper
SA I	31	68	21	59	41	12	3
SA II	28	71	28	67	33	16	6
SA III	29	72	23	64	51	13	8
SA IV	26	70	19	71	30	18	7
ALL	114	281	91	261	155	59	24

table that the most popular vessel in the rural areas is aluminum vessels, followed by the steel vessels. Another important type is hindalium vessels. It is interesting to note that a large number (114) of households still use the traditional earthen vessels. Of the different types of vessels used by the households, it could be observed that, some households had specific use for each type of vessel.

6.1 (e) Attitude towards energy used for lightning

The households have a limited choice of lighting energy. The choice is between electricity and kerosene. Table 6.12 presents the distribution of the households by the fuel used for lighting. It may be noted that in SA I there is five (6.67 per cent) unelectrified households. The numbers of unelectrified households are 4 (5.33 per cent) in SA II and 6 each (8.00 per cent) in study areas III and IV. On the whole, 279 (93 per cent) houses were electrified and 21 (7.00 per cent) house were unelectrified. Table 6.12 also reveals that kerosene is also used as a supplementary fuel by many households. The high number of such users may be due to the frequent power failures in the state, especially load shedding. Other supplementary fuels include candles, solar lamps and battery powered lamps. Hence it can be seen from Table 6.12 that electricity is the most important 'major lighting fuel' in all the study areas. The most important supplementary fuel is kerosene.

Table 6.13 presents the difficulties faced by the households with the present lighting fuels. It shows that all the households are facing difficulties with the present lighting fuel. The important difficulties faced by the households are irregular supply and cost of the fuel. A large number of households also face difficulties like inadequate supply (for kerosene) and inadequate light. A number of households reported other difficulties like low voltage, voltage fluctuations, poor quality of lamps, high cost of lamps and poor battery life. Hence it is evident that irrespective of the region, almost all the households are facing difficulties with the lighting fuels like irregular supply and high cost.

6.1 (f) Certain characteristics of fuel use and fuel procurement

During the process of literature review, the researcher came across various issues relevant to energy use and procurement, which are presented in Table 6.14.

It may be noted from Table 6.14 that, for the first three characteristics, (viz., increase in collection time of fuel, increase in the distance traveled to collect fuel and change in the persons collecting fuel) it is only in SA II that the number of positive responses were greater than the negative responses. For the characteristic 'change in the means of transport', the proportion of households responding in the negative is the highest in SA II. For the same characteristic, it is in SA III that the maximum numbers of

Table 6.12
Households by fuel used for lightning (No of households)

Fuels Study area	Major fuel Electricity	Major fuel Kerosene	Supplementary fuels Kerosene	Candles	Solar lamps	Others
SAI	70	5	42	19	-	6
SA II	71	4	36	25	2	7
SA III	69	6	48	12	1	10
SA IV	69	6	55	9	1	5
ALL	279	21	181	65	4	28

Note: 1) These fuels are used only as supplementary fuels and not as a major lightning fuel.
2) Some households did not less any supplementary fuel and some used more than one fuel.

Table 6.13
Difficulty faced with present fuels used for lighting at present (No of households).

Study area Difficulty	SA I	SA II	SA III	SA IV	ALL
1. Irregular supply	70	71	69	69	279
2. Inadequate supply	28	22	31	33	114
3. Expensive / unaffordable	71	72	71	73	287
4. Inadequate light	27	38	54	44	163
5. Health problem	3	4	5	5	17
6. Others	11	8	16	13	48

Note: Households were allowed to express more than one reason, if applicable

Table 6.14

Households by certain characteristics of fuel use and fuel procurement

(No of households)

Study area	SA I		SA II		SA III		SA IV		ALL	
Characteristics code	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
I	26 (37.14)	44 (62.86)	29 (40.85)	42 (59.15)	47 (63.51)	27 (36.49)	33 (44.59)	41 (55.41)	135 (46.71)	154 (53.29)
II	18 (25.71)	52 (74.29)	22 (30.99)	49 (69.01)	43 (60.56)	28 (39.44)	40 (47.62)	44 (52.38)	123 (41.55)	173 (58.45)
III	29 (41.43)	41 (58.57)	32 (45.07)	39 (54.93)	39 (52.70)	35 (47.30)	30 (40.54)	44 (59.46)	130 (44.98)	159 (55.02)
IV	14 (20.00)	56 (80.00)	8 (11.27)	63 (88.73)	21 (28.38)	53 (71.62)	17 (22.79)	57 (77.03)	60 (20.76)	229 (79.24)
V	- (0.00)	70 (100.00)	- (0.00)	71 (100.00)	16 (21.62)	58 (78.38)	7 (9.46)	67 (90.54)	23 (7.96)	266 (92.04)
IV	- (0.00)	70 (100.00)	- (0.00)	71 (100.00)	22 (29.73)	52 (70.27)	- (0.00)	74 (100.00)	22 (7.61)	267 (92.39)
VII	43 (66.15)	22 (33.85)	27 (44.26)	34 (55.74)	25 (41.67)	35 (58.33)	30 (48.39)	32 (51.61)	125 (50.40)	123 (49.60)
VIII	65 (100.00)	- (0.00)	56 (91.80)	5 (8.20)	51 (72.86)	19 (27.14)	62 (100.00)	- (0.00)	234 (90.70)	24 (9.30)
IX	73 (97.33)	2 (2.67)	72 (96.00)	3 (4.00)	71 (94.67)	4 (5.33)	72 (96.00)	3 (4.00)	288 (96.00)	12 (4.00)

Characteristic code: I) Increase in collection time of fuel II). Increase in distance traveled to collect fuel. III). Change in the persons collecting fuel (from adults to children, male to female etc) IV). Change in the means of transport of fuel from collecting site. V). Change in collection from dead to green wood. VI). Cutting younger tras for fuel. VII). Increase in the proportion of purchased bio fuels VIII). Increase in the price of purchased bio fuels X). Increase in the proportion of household Expenditure devoted to fuel purchase.

Note: 1) Households were also given the option 'No opinion /'Not applicable'.

2) Figures in brackets show percentages of Yes / No to total response of Yes/ No.

affirmative responses are obtained (23.38 per cent). Only households in SA III and IV had changed from collecting dead to green wood. Here also greater numbers of positive responses is in SA III. Further it may be noted that only households in SA III started cutting younger trees for fuel. All the study areas have experienced increase in the proportion of purchased bio-fuels. For this characteristic, the proportion of positive responses, however, is greater in SA I only. Majority of the households in all the study areas have experienced increase in the price of purchased bio-fuel and increase in the proportion of household expenditure devoted to fuel purchase.

When the entire study area is considered, it can be observed that it is only for the last three characteristics (viz increase in the proportion of purchased bio-fuels, their prices and household expenditure on fuel) that majority of the households respond in the affirmative. Hence it may be inferred that, these are the common problems faced by the rural households. It may be further noted that the high rate of positive responses in SA III is due to the fact that the major source of fuel collection is either woodland under public ownership or forestland (Common Property Resources, CPR).

It may be inferred from the foregoing analysis that the rural fuel markets are getting more and more commercialized. The expenditure on fuel by the rural households is on the rise. At the same time, the difficulty of fuel collection is also increasing.

Section II. Approaches towards energy conservation practises and improved energy technologies

A method propagated to solve the rural household energy problem is to practise better energy management techniques. The adoption of energy conservation practises and energy efficient technologies are the best means of achieving better energy management.

6.2 Energy conservation – a rural approach

Energy conservation is one of the easiest ways to bridge the gap between the energy demand and supply. A number of studies on rural energy have brought out the fact that there is considerable wastage of energy at the rural household level. For instance, Rao[1] observes that even though energy consumed in rural areas appeared to be quite heavy when measured in terms of absolute weights like kilograms, the actual consumption measured in terms of efficiency parameter (caloric value) found to be very low, indicating low efficiency. Gopalan has also made a similar observation[2]. It is generally observed that considerable wastage of energy occur in rural areas due to the ignorance of the rural masses supplemented by their inefficient energy gadgets. Hence, understanding the energy conservation practises followed by the rural households will benefit policy formulations.

Among the numerous methods available to conserve energy, developing countries choose such technologies or practises that are not too capital intensive. In developing countries where rural areas are inhabited predominantly by poor and illiterate, it is necessary to assure that the conservation practices introduced does not involve costly gadgets or complicated procedures.

6.2 (a) Approach to energy conservation practises

In order to measure the awareness of energy conservation practises of the sample households, energy conservation tips developed by Petroleum Conservation Research Association (PCRA) were used[3]. PCRA claims that these tips if practised can achieve considerable energy conservation. The households were given a set of 14 tips and asked whether they practised these, if applicable to the fuel they used. This exercise is not expected to give a comprehensive picture of energy conservation or quantify the energy saved by these methods. It is only believed that this will provide a crude indication of the approach of the rural households towards energy conservation.

The fourteen energy saving tips presented to the households are the following.

1 Getting items to be cooked ready before setting on flame

2 Soaking rice and pulses in water before cooking

3 Drying the vessel before putting them on flame

4 Covering the vessel before cooking

5 Cooking vegetables and rice together

6 Using pressure cooker

7 Not heating dishes immediately out of refrigerator

8 Using hay box

9 Not using plenty of water while cooking

10 Cooking on a blue flame instead of yellow

11 Lowering the flame after boiling

12 Servicing or cleaning stoves from time to time (for LPG, kerosene etc)

13 Using shades for ordinary bulbs

14 Cleaning the kerosene lamps from time to time

Table 6.15 presents the energy conservation practises adopted by the sample households. From the table, it may be observed that only 19 per cent of the households prepared items to be cooked ready before setting on flame. Among the study areas, the maximum number of households practicing this tip is in SA II. Majority of the households (92.33 per cent) soaked rice and pulses before cooking. The maximum number of households' practicsed this in SA II. 27.67 per cent of the households dried vessels before cooking and the maximum numbers are in SA IV. Only 14.76 per cent of the

Table 6.15
Energy conservation practices adopted by the households (No of house holds)

Practice codes	Study Area				
	SA I	SA II	SA III	SA IV	ALL
I	15 (20.00)	16 (21.33)	12 (16.00)	14 (18.67)	57 (19.00)
II	67 (89.33)	71 (94.67)	69 (92.00)	70 (93.33)	277 (92.33)
III	14 (18.67)	21 (28.00)	19 (25.33)	29 (38.67)	83 (27.67)
IV	63 (84.00)	67 (89.33)	58 (77.33)	53 (70.67)	241 (86.33)
V	10 (13.33)	7 (9.33)	2 (2.67)	5 (6.67)	24 (8.00)
VI	9 (12.00)	16 (21.33)	11 (14.67)	8 (10.67)	44 (14.67)
VII	1 (11.11)	3 (27.27)	1 (12.50)	2 (33.33)	7 (20.59)
VIII	12 (16.00)	14 (18.67)	6 (8.00)	7 (9.33)	39 (13.00)
IX	NA	NA	NA	NA	NA
X	3 (13.04)	6 (28.57)	2 (7.69)	4 (25.00)	15 (17.44)
XI	11 (47.82)	12 (57.14)	17 (65.38)	9 (56.25)	49 (56.98)
XII	- (0.00)	2 (9.52)	1 (3.85)	3 (18.75)	6 (6.98)
XIII	52 (74.29)	61 (85.92)	56 (81.12)	48 (69.56)	219 (78.49)
XIV	9 (19.15)	16 (40.00)	6 (11.11)	3 (4.92)	34 (16.83)

Practice code: I. Getting items to be cooked ready before setting on flames II. Soaking rice and pulses in water before cooking II.Drying the vessel before putting them on flame IV. Covering the vessel while cooking V.Cooking vegetables and rice together VI.Using pressure cooker VII.Not heating dishes immediately out of refrigerator VIII. Using hay box IX.Not using plenty of water while cooking X.Cooking on a blue flame instead of yellow XI. Lowering the flame after boiling XII.Servicing or cleaning stoves from time to time (for LPG, kerosene etc) XIII. Using shades for ordinary bulbs XIV.Clean the kerosene lamp from time to time.

Note 1) NA = Not available.

2) These practices are not applicable to all households. Responses are given by only the uses households.

3) Figures in brackets show percentages. Only those households for which a particular tip is applicable is considered for taking percentage.

households used pressure cooker with the highest number of users being in SA II. 20.59 per cent of the households kept the dishes for some time after taking out of refrigerator to get to the room temperature before cooking. It is interesting to note that only 13 per cent of the households used hay box (fire less cooker), which is a very simple and highly effective energy saving measure. 17.44 per cent of the household took care to cook on a blue flame rather than yellow. It may be noted that more than half of the households (56.98 per cent) lowered the flame after boiling. However, the households paid only scant attention to servicing or cleaning stoves occasionally. Only 6.98 per cent of the households practised this tip. A large number of households (78.49 per cent) used shades for ordinary bulbs, and the maximum number of households practicing this tip is in SAII. It seems cleaning the lamps is not a common practise among the sample households. Only 16.83 per cent practised it.

From the foregoing description, it can be seen that the energy saving tips practised by the majority of the households were soaking rice and pulses before cooking, covering the vessel while cooking and using shades for bulbs. Among the tips applicable to all the households, the least practised tip is cooking vegetables and rice together.

If the different study areas are compared by a crude measure like identifying the study area with the maximum number of households practicing each tip, SA II comes first with the maximum number of households practicing eight tips (I, II, IV, VIII, X, XIII, XIV).

It may be interesting to explore what influenced the households' decision in accepting the energy conservation tips. During the process of data collection, it was revealed that in most cases fuel conservation was not the reason for practicing the tips. Rather, the major considerations were practice, custom, tradition, convenience, time saving and feasibility of doing other works simultaneously. In fact, many of the households who practised the energy saving tips did not even know that such practises helped to save energy. For instance, many of the households, who used shades for bulbs, did so either by practice or as a decoration. Similarly, soaking of rice and pulses before cooking and covering the vessels while cooking were practised as a custom or tradition. Many of the households who used pressure cookers and hay box did so to save time and for the feasibility of doing other works simultaneously. Households had their own reasons for not practicing many of the energy conservation tips. Firstly, as already stated, many did not know that these tips could really help them to reduce energy bills and so felt that it was 'inconvenient' to practise them. Secondly, factors like taste of the dish, unpleasant odour etc worked as disincentive. For instance, many households are inclined to cook rice and vegetables together or use a pressure cooker since they felt that doing so would reduce the taste of food. Similarly, unpleasant odour of food was attributed to refusing to use hay box.

From the foregoing analysis it may be inferred that the rural households are not very much very much conscious about energy conservation practices. However, it may be recorded that it seems that the rural households had their own internal mechanism of coping with energy shortages. For instance, some households in SA II mentioned that they have a food habit where more rice and less gravy is consumed. This is an energy saving practice since cooking of gravy require more energy. Similarly, for heating water, when there are plenty of twigs and leafs, they swept the fuel material to the choolah using a broomstick. On the other hand, when there are not enough twigs and leaves, they punched the available leaves on an iron road and put in the choolah. Whether the households were conscious of the energy saving dimension of what they did is unclear. Hence, it seems deeper investigation into the food habits and cooking practices of the rural households may shed further light on energy conservation practices acceptable for the rural household sector.

6.2 (b) Approach to improved energy technologies.

The rural energy crisis stems from the fact that the households have been consuming the energy sources far more rapidly than they were being renewed. To tackle this problem, energy conservation needs to be practised and to achieve this more efficient and improved energy technologies must be introduced. In section 6.2 (a) it was revealed that many households were aware of the benefits of energy saving tips, which include some improved technologies also. In this section, the awareness and adoption rates of improved energy technologies and the reasons for adopting / not adopting them is discussed.

Table 6.16 shows the awareness and adoption of improved energy technologies by the rural households. It may be noted from the table that for smokeless choolah the highest adoption rate is in SA I and the lowest in SA III. For the improved kerosene stove the highest adoption rates can be found in SA I and SA IV and the lowest in SA II. Hay box is mostly adopted in SA I and the least adoption is in SA III. The highest adoption rate for pressure cooker is in SA II and the lowest is in SA I. For tube lights, the highest adoption is in SA II and the lowest in SA IV. The highest adoption rate for compact fluorescent lamps (CFL) is in SA III and the lowest in study areas IV and I. For electronic chock, the highest adoption is in SA II and the lowest in SA IV. Electronic regulators for fans

Table 6.16

Awareness and adoption of improved energy technologies by households (No. of households)

Type of Technology	SA I		SA II		SA III		SA IV		ALL	
	A	B	A	B	A	B	A	B	A	B
1.Smokless choolah	61	10 (16.39)	72	10 (13.88)	64	6 (9.37)	68	7 (10.29)	265	33 (12.45)
2. Improved Kerosene Stove	31	9 (29.03)	35	7 (20.00)	49	12 (24.48)	24	7 (29.16)	139	35 (25.17)
3. Hay box	38	12 (31.58)	51	14 (27.45)	44	6 (13.63)	27	7 (25.92)	160	39 (24.37)
4. Pressure Cooker	52	9 (17.30)	65	16 (24.61)	57	11 (19.29)	44	8 (18.18)	218	44 (20.18)
5. Tube light	75	16 (21.33)	75	23 (30.66)	75	19 (25.35)	75	14 (18.66)	300	72 (24.00)
6. C F L	26	3 (11.53)	33	6 (18.18)	21	5 (23.80)	18	2 (11.11)	98	16 (16.32)
7. Electronic chock	18	7 (38.58)	24	11 (45.83)	25	9 (36.00)	18	5 (27.77)	85	32 (37.64)
8. Electronic regulator	8	1 (12.50)	13	4 (30.76)	12	6 (50.00)	4	- (0.00)	37	11 (29.72)
9. Solar lamps	18	- (0.00)	21	2 (9.52)	28	1 (3.57)	14	1 (7.14)	81	4 (4.39)
10. Solar cooker/ Water heater	21	- (0.00)	33	1 (3.03)	27	- (0.00)	19	- (0.00)	100	1 (1.00)
11.Biogas	62	- (0.00)	71	1 (1.40)	74	1 (1.35)	69	2 (2.89)	276	4 (1.44)

Note: A = No. of households aware of the technology. B = No. of households adopted the technology.

are mostly adopted in SA III. The lowest adoption is in SA IV. Interestingly, the highest adoption rate for solar lamps and biogas is in SA IV. For solar cooker and water heaters, it may be noted that only one household has adopted the technology.

From the forgoing analysis, certain inter regional variations in the adoption of improved energy technologies may be noted. For the smokeless choolah, the highest adoption rate is in SA I, which is a relatively fuel scarce region where as the adoption rate is the lowest in SA III which is relatively a fuel abundant region. This trend is further exhibited when the high adoption rate for improved kerosene stove and hay box in SA I is taken in to account. Similarly it may be noted that the adoption rate for many of the improved technologies are low in SA III. The relatively high adoption rates of SA II might be due to the high level of social development of the region. Similarly the relatively low level of adoption (with the exception of improved kerosene stove) in SA IV might be due to the comparatively low level of social development of the region. It may be further observed that, tough used by only a few households, electronic chock has the highest rate of adoption. Other highly adopted technologies are electronic regulators, tube lights, improved kerosene stoves and hay box.

The rationale for adopting the improved energy technologies is often the considerations other than energy conservation, as evident from Table 6.17. The table explores the reason for adopting the improved technologies. For smokeless choolah, the most important reason in all the study areas seems to be persuasion of officials or NGOs. Other considerations are healthier kitchen environment, faster cooking and subsidies. For improved kerosene stove (like nuthan stove, pumping stove etc), the 'faster cooking', saving money, reducing expenditure on energy, healthier kitchen environment and subsidies are the relevant reasons for adoption. It may be noted that one household in SA II adopted improved kerosene stove to save energy.

The important reason for the adoption of hay box is to save energy expenditure in SA I, to save time in SA II and SA IV and the non availability of fuel in use and 'others' in SA II. 'Others include feasibility of doing other works simultaneously. Faster cooking is the most important reason for the adoption of pressure cooker in all the study areas. Reducing energy bills is also an important consideration, expressed mostly by LPG using households. It is interesting to note that a significant number of households adopted tube lights to save energy. Subsidized rates offered for the tube lights by local bodies and NGOs prompted some households. However, the most important reason is 'others' which include better quality of light, especially for households with school going children. For compact fluorescent lamps (CFL), the most important consideration is certainly to avail financial assistance. For electronic chocks, the most important consideration is low voltage problem, which is included in 'others'. It may be noted that the only other reason for adopting electronic chock is that it was offered at a subsidized rate. For electronic regulators the most important reason is voltage problem. However, it may be noted that one household in SA III adopted it to conserve energy. The major reason for the adoption of solar lamps, solar cookers, water heaters and biogas plants seems to be the subsidized rates at which they are offered. It may also be noted that healthier kitchen environment was also a consideration for installing biogas plant.

It is interesting to observe from the forgoing analysis that energy conservation was the least motive in adopting the improved energy technologies. However, the households seemed to realize the importance of cutting energy bills since some of the households have adopted the improved energy technologies for this purpose. It is evident from the table that the dominant considerations for adopting improved energy technologies are either the subsidized rates offered or the persuasion of NGOs or officials. Low voltage and related problems seem to be the most important considerations for adopting electricity based improved technologies.

The rationale of the households for not adopting the improved energy technologies is presented in Table 6.18. For smokeless

Table 6.17

Reasons for adopting the improved energy technologies (No. of house holds)

Reasons / Type of Technology	SA I 1	2	3	4	5	6	7	8	SA II 1	2	3	4	5	6	7	8	SA III 1	2	3	4	5	6	7	8	SA IV 1	2	3	4	5	6	7	8
A	-	-	1	2	-	2	5	-	-	-	1	3	-	2	6	-	-	-	-	1	1	2	3	1	-	-	-	-	1	3	4	-
B	-	3	1	7	-	1	-	-	1	2	1	7	-	-	-	1	-	3	1	11	-	2	-	-	-	2	-	7	-	-	-	-
C	1	4	-	2	-	-	-	2	-	2	-	6	3	-	-	3	-	1	-	1	2	-	-	2	-	1	-	3	2	-	-	1
D	-	3	4	6	-	-	-	-	-	4	3	12	2	1	-	-	-	-	3	9	-	-	-	2	-	-	3	7	-	1	-	-
E	2	-	-	-	-	6	-	15	8	-	-	-	-	5	-	23	4	-	-	-	-	-	-	19	-	-	-	-	-	-	-	14
F	1	-	-	-	-	3	-	1	-	-	-	-	-	4	-	3	-	3	-	-	-	4	1	4	-	1	-	-	-	-	-	2
G	-	-	-	-	-	4	-	6	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	9	-	-	-	-	-	2	-	5
H	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
I	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-
J	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	2	-	-	2	-	-

Code for type of technology: A = Smoke less choolah. B = Improved kerosene stove, C = Hay box. D = Pressure cooker, E = Tube light. F = CFL, G = Electronic chock, H = Electronic regulator. I = Solar lamps. J = Solar cooker/ Water heater. K = Biogas.

Code for reason: 1). To save energy. 2). To save money/ to reduce expenditure on energy. 3). Healthier kitchen environment. 4). Faster cooking / to save time. 5). Non availability of the fuel in use. 6). Received at subsidized rate / free of cost. 7). Persuasion of officials / NGOs. 8). Others.

Note: Households were allowed to express more than one reason, if applicable.

Table 6.18

Reasons for not adopting the improved energy technologies

(No. of households)

Reasons / Type of Technology	SA I							SA II							SA III							SA IV						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A	-	-	-	17	32	4	14	1	-	1	27	32	3	3	-	-	-	21	30	13	11	-	-	-	17	38	8	9
B	12	3	2	16	3	2	44	17	6	4	15	2	3	40	16	22	-	11	2	1	26	9	14	4	12	-	-	51
C	-	-	14	2	20	-	37	-	-	7	6	21	2	24	-	-	5	13	24	9	31	-	-	2	8	13	5	48
D	24	-	2	33	3	-	23	31	-	1	22	2	-	10	14	6	3	11	12	-	18	7	-	5	27	2	-	34
E	47	-	-	-	14	-	-	40	-	-	-	13	2	-	35	-	-	-	21	-	-	18	-	-	-	43	-	-
F	8	-	1	-	15	-	49	17	-	3	-	7	-	42	4	-	6	-	7	-	54	3	-	4	-	9	-	57
G	4	-	-	-	7	2	57	3	-	2	-	8	1	51	6	-	3	-	5	2	50	1	-	-	-	12	1	57
H	2	-	4	-	-	-	67	1	-	3	-	5	-	62	3	-	3	-	-	-	63	-	-	-	-	4	-	71
I	6	2	-	4	4	2	57	2	-	-	7	10	-	54	7	-	2	7	11	1	47	2	-	-	3	8	-	61
J	2	1	-	18	3	-	54	1	11	-	3	17	-	42	3	16	-	-	8	-	48	-	7	-	-	12	-	56
K	2	7	-	1	2	48	13	-	12	3	5	4	46	4	1	19	-	2	-	51	1	-	15	-	-	1	52	6

Code for type of technology: A = Smoke less choolah. B = Improved kerosene stove. C = Hay box. D = Pressure cooker. E = Tube light. F = CFL. G = Electronic chock. H = Electronic regulator. I = Solar lamps. J = Solar cooker/ Water heater. K = Biogas.

Code for reason: 1). Unaffordable/ lack of or difficulty in getting financial assistance. 2). Present fuel available freely / cheaply. 3). Lack of information about the benefits of the improved technology. 4). Unfamiliar / operation is risky. 5). Have not felt the need. 6). Others. 7). Not aware of the technology at all.

Note: Households were allowed to express more than one reason, if applicable.

choolah the relevant reasons are 'unfamiliar', 'have not felt the need' and 'others' which include 'the available fuel is not suitable'. For improved kerosene stove, the responses are evenly distributed, though 'unaffordable', 'risky operation' and 'present fuel available cheaply' have a dominant role. It may be noted that a large number of households were not aware of the technology at all. For hay box, the important reasons are 'lack of information of the benefits' and 'have not felt the need'. Non-affordability and 'risky operations' are the most important constraints in the adoption of pressure cookers. For tube lights, CFL, electronic chock and electronic regulators the high cost and the lack of need are the important disincentives for the adoption of improved technologies. For solar lamps, solar cookers and water heaters the most important reason for not adopting the technology is 'have not felt the need'. For biogas the most important reason is 'others' which include a number of factors like lack of information that the cattle possessed by them may provide enough dung to set up a plant, news of failures of biogas plants and difficulty to manage the plant. Lack of financial resources and lack of information about the benefits of biogas plants are also relevant reasons for not adopting the technology.

The forgoing analysis reveals that many of the households are not at all aware of the improved technologies. Though factors like unaffordability, difficulty in getting financial assistance and unfamiliar operations are relevant reasons, many of the households have not felt the need to adopt the technology, perhaps due to the lack of information about the benefits of the improved technology.

In this regard, it might be relevant to examine two more factors namely the proportion of the sample households by the mode of procurement of non-commercial fuels and also the distribution of households by monthly expenditure on fuels. Table 6.19 shows information on the proportion of the sample households purchasing or collecting the fuel material. It may be noted that in all the study areas, the number of households collecting the fuel material is higher than the number of households purchasing them. This high rate of collected fuel material is due to the cropping pattern of Kerala, which is dominated by coconut, arecanut, rubber, tapioca and other trees like mango, jack etc. It may be noted from the table that the proportion of collected fuel is the highest for coconut residue followed by 'others'. Further it may be noted that except a few households in SA III, none of the households had to walk long distances to collect fuel material. Naturally, the households are unlikely to have great concern about fuel saving and hence the adoption of improved technologies. This argument is further supported by the information given in Table 6.20, which presents information on the distribution of households, by monthly expenditure on fuel. It may be noted from the table that 3.33 per

Table 6.19

Proportion of the sample households by the mode of procurement of non -commercial fuel (No of households)

Study areas		SA I		SA II		SA III		SA IV		ALL	
Mode		Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected	Purchased	Collected
Energy Type											
Fire Wood	1	69	69	68	68	71	71	67	67	275	275
	2	54	37	56	55	59	69	51	61	220	222
	3	78.26	53.62	82.35	80.88	83.10	97.18	76.12	91.04	80.00	80.73
Coconut Res-idue	1	70	70	68	68	64	64	67	67	269	269
	2	48	68	24	64	17	64	43	67	132	263
	3	68.57	97.14	35.29	94.12	26.56	100.00	64.18	100.00	49.07	97.77
Saw Dust	1	17	17	17	17	5	5	11	11	50	50
	2	17	0	17	0	5	0	11	0	50	0
	3	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Others	1	17	17	32	32	35	35	48	48	132	132
	2	11	9	23	28	10	34	14	45	58	116
	3	64.71	52.94	71.88	87.50	28.57	97.14	29.17	93.75	43.94	87.88
All Non Com	1	73	73	75	75	75	75	75	75	298	298
	2	65	70	61	71	60	74	62	74	248	289
	3	89.04	95.89	81.33	94.67	80.00	98.67	82.67	98.67	83.22	96.98

Note: (a)Bio Gas is excluded since it is completely home produced. (b) Since all commercial fuels are purchased, they are excluded. (c) 1= Number of households in that category using the particular fuel, 2= Number of households purchasing / collecting the particular fuel, 3= proportion of households purchasing / collecting a fuel to total no of house holds in each category.

Table 6.20
Distribution of households by monthly expenditure on fuels (In Rs).

Study area Expenditure		SA I	SA II	SA III	SA IV	ALL
Nil		1	2	3	4	5
	1	1.33	2.67	5.33	4.00	3.33
	2	10.00	20.00	40.00	30.00	100.00
Less than100		16	12	31	18	77
	1	21.33	16.00	41.33	24.00	25.67
	2	20.78	15.58	40.26	23.38	100.00
100 - 200		18	12	24	17	71
	1	24.00	16.00	32.00	22.67	23.67
	2	25.35	16.90	33.80	23.94	100.00
200 – 300		12	16	4	18	50
	1	16.00	21.33	5.33	24.00	16.67
	2	24.00	32.00	8.00	36.00	100.00
300 – 400		14	14	5	7	40
	1	18.67	18.67	6.67	9.33	13.33
	2	35.00	35.00	12.50	17.50	100.00
400 – 500		5	3	3	6	17
	1	6.67	4.00	4.00	8.00	5.67
	2	29.41	17.65	17.65	35.29	100.00
500 and above		9	16	4	6	35
	1	12.00	21.33	5.33	8.00	11.67
	2	25.71	45.71	11.43	17.14	100.00
All		75	75	75	75	75
	1	100.00	100.00	100.00	100.00	100.00
	2	25.00	25.00	25.00	25.00	100.00

Note: (a) 1= Percentage of each category calculated column wise (b) 2 = Percentage of each category calculated row wise cent of the households are not at all spending on energy. Nearly 50 per cent of the households are spending less than 200 rupees monthly for energy bills. This low figure is perhaps due to two reasons. Firstly, the availability of fuels other than firewood in abundance is holding back the prices of firewood. Secondly, Kerala depends to a large extent on hydro electricity, which is relatively cheap. This helps to keep the expenditure on electricity low. It may be recorded that the researcher was told by a number of households that illegal tapping of electricity provided for agriculture at subsidized rates for domestic purpose is a common practise in rural areas. This also perhaps is responsible for the low expenditure on energy.

Hence, it may be inferred that the major factors preventing the adoption of improved technologies in the rural areas are lack of information about the benefits, high cost of the alternate technology, unfamiliarity, the disincentive created by the free availability of energy materials and the low expenditure on energy.

References

1.Rao Hemalatha, (1990), Rural energy crisis: A Diagnostic Analysis, Ashish, New Delhi

2. Gopalan Sarala, (1989), Domestic fuels and devices for cooking – practices, problems, policies and perspectives, Ph.D. thesis (unpublished), IIT, Delhi.

3. 'Fuel saving tips for house wives', PCRA / D –201 /R-1, PCRA, New Delhi (PCRA is a registered society under the Ministry of Petroleum and Natural Gas, Government of India)

CHAPTER VII

SUMMARY AND CONCLUSIONS

The world is still predominantly rural. Fifty five per cent of the world population lives in rural areas. About 40 per cent of the total energy consumption of developing countries owe to rural energy. The energy demand in rural areas is basically for meeting end uses like cooking, lighting, heating and water pumping. This demand is determined by different factors like level of development of the area, demography, resource endowments, agro-climatic patterns, forest resources, cropping pattern, technology, tradition and socio-economic factors. The energy sources in rural areas are diverse. They include traditional sources like, human, draught, wind, fuel wood, agricultural residue, cow dung and commercial sources like coal, charcoal, kerosene electricity and LPG. New and renewable sources of energy are also used in rural areas.

Comparing the demand pattern and energy sources, it is evident that rural households face an energy crisis, which is directly or indirectly linked to the 'oil crisis'. The energy problem in the rural household sector is identified in terms of symptoms such as acute shortage of fuel material, rising fuel prices, increased fuel substitution, longer fuel collection time and greater health hazards related to fuels or cooking practices.

The energy problem facing the rural areas is daunting not only because they retard development, but also they threaten the survival of the poor. Thus the problem is multidimensional. Hence an understanding of the pattern of energy use is relevant and essential for formulating effective rural energy policies. Since the household energy use pattern is highly region specific, micro level studies are a pre-requisite for proper understanding of the problem. Notable studies are available on Gujarath, Karnataka, Tamilnadu and Maharastra.

Kerala is a distinct region of India in respect of geo-climatic and socio-economic conditions. The cropping pattern with the predominance of coconut and plantation crops, high rate of literacy among women and the presence of a strong middle class are a few factors capable of influencing the energy demand at the household level. Rural household energy studies in Kerala, though are limited, throw a great deal of light on various aspects of the rural household energy problem. However, there are serious limitations to these studies. The limitations have resulted in a lacuna of vital information for formulating policies for tackling the rural energy problem.

Against this backdrop, the present study critically analysed the micro level issues that influence the rural household energy behavior in Kerala. The objectives of the study were

1 To examine the energy consumption pattern at the household level in rural Kerala
2 To assess the variations in rural household energy consumption pattern across geo-climatic and socio-economic clusters
3 To assess the attitudes of the rural households towards energy sources, uses and devices
4 To identify the factors influencing the adoption of energy conservation practices and shift to the improved energy technologies at the household level in rural areas

In order to gather the data required for analysing the above objectives, a primary survey was conducted at the household level in four sample villages representing different geographical regions in Kerala. The four villages were Pallipuram panchayat in Ernakulam district, Mundathicode and Mattathur panchayats in Trichur district and Kottayi panchayat in Palakkad district.

Data were collected from 75 households in each village using a pre-tested schedule. The memory recall and physical measurement methods were also employed to collect data. Major inferences derived in relation to the objectives are listed below;

1) The highest energy consumption was recorded in Mattahtur village (SA III) situated in the vicinity of reserve forest. The lowest energy consumption was recorded in the costal village (Pallipuram, SA I). Thus it is evident that energy consumption and availability of fuels are proportionally related.
2) The share of commercial sources was the highest in the mid land village (Mundathicode, SA II) which is very close to Trichur town. It is also noted that the share of commercial fuels was lowest in Kottayi village, a typical agricultural village. These trends establish that nearness to commercial centers and the degree of urbanization motivate and initiate a shift towards commercial sources.
3) The study reassured the 'apriori belief' that the most frequently used source of rural energy is firewood. Among the sample villages, except the costal village used firewood as the major fuel. The costal village Pallipuram preferred coconut residue, which is a natural outcome.
4) Commercial fuels played relatively an insignificant role in sample villages. However, among them, kerosene is the most important one and LPG is the least preferred. From the study it

was felt that LPG could not create much impact on rural community. This may be due to the easy accessibility to cheap alternative fuels in rural areas in relation to the cost of LPG and the limited supply of LPG.

5) The share of purchased fuels is high in the midland and the share of collected fuel is high in the village close to the forest and agricultural land. This confirms the earlier argument that nearness to source of fuel material is an important determinant in deciding the type of fuel.

6) In all the villages the most important end use is cooking. For other purposes like lighting, water heating and domestic transportation majority of the rural flock preferred different fuels subject to the convenience and availability. It was interesting to note that not a single household used electricity for cooking.

In the above discussion we presented the broad trends in aggregate behavior emerged from the study and also the extent of inter village variations. The major factors which created inter village variations are the location of the village, the natural endowments and the distance between the household and the source of fuel.

The study also examined the possibilities of inter household variations in energy use with respect to three parameters, income, size of holding and household size and the following conclusions emerged.

7) The study derived that the volume of energy consumed and income status are inversely related. This is a typical phenomenon evident in all villages. One of the reasons for this trend is the increased use of non-commercial fuels by the low-income households. These non-commercial sources have only limited energy generation capacity and the extent of transmission loss is high.

8) Among the non-commercial sources, firewood is the dominant fuel in all the income categories. Hence it may be inferred that the type of fuel and the income levels are not significantly associated. Rather than income, status and availability still influence the preferences for fuels. However, a narrow preference towards coconut residue by the lower income groups was also noticed, mainly due to relatively low cost of coconut residue compared to firewood.

9) Except in the village near to the forest, the proportion of collected fuels is less than the purchased fuels irrespective of the

income categories. This is against the apriori belief that the lower income group prefers to have more collected fuels.

10) As mentioned earlier, a major portion of energy is used for cooking among all income categories. Within this broad trend, some association was noticed between the levels of income and the proportion of energy used for 'lighting and others'. This suggests that the energy used for 'lighting and others' is linked to the socio-economic profile of the households. One of the arguments to prove this claim is the high correlation observed between the use of electricity for lighting among higher income brackets. On the other hand, the lower income groups depends to a greater extend, on kerosene for 'lighting and others'.

11) Energy consumption is higher in the lower land holding categories and lower in the higher land holding categories. Thus energy consumption and size of land holdings are inversely related. This may be because lower land holdings imply lower income levels and as mentioned earlier, lower income households follow inefficient cooking practices which results in huge quantities being purchased.

12) The proportion of share of non-commercial fuels like firewood and coconut residue for 'lighting and others' (especially water heating) increased with land holding size. This shows the

tendency of the households to divert freely / cheaply available fuel to less urgent needs.

13. It was also observed that the proportion of purchased fuel varies inversely with the size of land holding. This implies that the households are particular about making full use of fuel sources available in their homesteads. This is especially true in the sample villages dominated by large land holdings

14. The study established that the level of energy consumed and the family size are directly related to a large extent. However, beyond a point, the rate of change is marginal due to the economies of scale in energy use.

15. It was also felt that the magnitude of the use of commercial sources of energy and the family size are inversely related. Very small families belong to the category of nuclear families, which are at the higher level of social awareness. So their inclination towards commercial sources are quite natural. This would have been more clearly established in urban studies.

16. As a corollary to the earlier argument, it may be said that higher family size may lead to more volume of collected fuels compared to the purchased. But the present study failed to establish such a relation.

Hence the broad trends based on the association between energy use and socio-economic characteristics indicate that among the chosen parameters only income and size of land holding could reveal some level of inter household variations

17) The factors responsible for household's decision to use a particular fuel and to put it for a particular purpose was also examined in the present study. It was found that the major factors responsible for using a particular fuel for a particular end use (cooking) are easy availability, affordability and tradition in the case of non-commercial fuels and cleanliness, smoke free environment, time saving and efficiency in burning in the case of commercial fuels.

18) During the course of the study the researcher could identify certain difficulties in relation to cooking fuel experienced by the sample households. These difficulties mainly include scarcity, cost, irregular and inadequate supply and risk to use.

19) Even though these difficulties exist, people are inclined to change because of the non-affordability of the new fuel, supply problems related to the new fuel and unfamiliarity. These trends indicate that the magnitude of energy transition was very limited in the sample households. Among the limited adoption, a

significantly higher rate was recorded for LPG. The major fuel given up was coconut residue.

20. Important reasons for adopting non-commercial fuels were scarcity, irregular supply of the old fuel, increased availability and faster cooking time. In the case of commercial fuels, the important reasons were faster cooking and healthier kitchen environment.

21. Major reasons for giving up non-commercial fuels were time consuming cooking procedure, smoke and health problems. In the case of commercial fuels, the major reason attributed is the availability of alternative fuel.

22. Electricity was the most important source of lighting fuel and the major problems relating to the lighting fuels were irregular supply, inadequate supply and relatively high cost.

23. Kerosene was used by a good per cent of households either as a major lighting fuel or as a supplementary fuel.

24. The measurement of the approaches of the rural households towards energy conservation practices brought out interesting conclusions. It was found that many of the households were not practicing even the simplest of the energy conservation methods. The researcher tried to explore the attributes behind this problem and identified that the lack of awareness and relatively easy and

cheap availability of traditional fuels were the factors behind this lazy approach. Even these households who adopted the new and improved technologies did so, for reasons like compulsion from NGOs and the attraction of subsidies associated with the improved technologies.

25. Factors like unaffordability, difficulties in getting financial assistance and unfamiliar or complicated operations restricted the households from adopting the improved technologies.

26. The study also revealed that the rural household energy problem was also having a gender dimension.

A few suggestions

1) The study established that preferences for rural fuel are very much influenced by the local availability of fuel materials. Hence while formulating rural energy policies, stress should be given on identification and managing of locally available fuels instead of popularising the commercial sources like kerosene and LPG.

2) Because of the inter village variations in energy use, it is advisable to formulate micro level policies suitable to that particular village. This suggestion receives added significance in the days of decentralization.

3) It was observed that there is a tendency to over exploit the common property resources. This leads to waste of fuel and depletion of common property resources. Hence a policy prescription is quite essential to use, sustain and manage common property resources.
4) The present study as similar studies earlier, identified over dependence on firewood. As suggested in the case of common property resources, the use of forest resources as a source of energy is to be scientifically managed. This may be discussed as part of forest management policy. In this context, the possibilities of a shift from firewood to non-conventional sources like solar energy and community biogas can be explored.
5) The importance of energy conservation is widely debated in recent years. But the present study revealed that these practices are not effectively followed in rural areas. Thus an awareness programme is the need of the hour, which should be initiated at the household level. This awareness package should include the details on problems due to non-conservation, methods available for conservation and the benefits of conservation.
6) There are alternative methods for energy conservation. But all these alternatives are primarily designed considering the interests and conveniences of the implementing agencies with out

consulting the rural masses. Naturally the rural masses were not enthusiastic to adopt such technology. Hence designing of energy technologies in consultation with the rural population will improve the situation. Decentralisation can do a lot in this direction.

7) The central government or the state governments may initiate the setting up of energy research institutes (like Energy Management Center, Trivandrum). These institutions may concentrate on intensive research on various energy dimensions covering technology and socio-economic aspects.

8) The above mentioned suggestions can be incorporated in a holistic manner if the central or the state governments could declare a domestic cooking fuel policy (similar recommendation was made by Sarala Gopalan, 1989).

Scope for further studies

The present study was a humble attempt to examine the micro level issues that influence the rural household energy behavior in Kerala. Discussing the entire complexities involved in the research problem are beyond the scope of the present study. A few points which came to the notice of the researcher that require scholarly enquiry are mentioned below for the attention of research aspirants.

1) The problem of rural energy is deep routed with gender dimensions. So far no serious attempts are made to explore these dimensions.
2) Rural households follow certain traditions in energy conservation. Research in these issues will help to crystalise the practices and to extend these practices into other villages where the conservation practices are absent or unpopular.
3) Estimation of energy conservation potential in rural areas is another area for research.
4) If there are studies on stratification of rural areas based on geo-climatic and socio-economic clusters, such stratification may enable proper grouping of issues. This will be useful for local policy formulations.
5) Studies on cooking practices and the nature of cooking devices may throw more insight into the areas of energy loss. This knowledge will help to optimize energy use.
6) Bio technological research on specific species for specific locations may also be undertaken.

Conclusion

This small step on rural energy research tried to explore the demand and supply aspects of rural energy behavior in Kerala across geo-climatic and socio-economic clusters. The problems of energy conservation and adoption were also studied. The study emphasizes that the use pattern of rural energy is primarily decided by the easy availability of cheap fuel at the doorsteps. The geo-climatic and socio-economic factors are exerting only a limited influence. Many more quality centered and useful research works on rural energy are yet to come.

ANNEXURE I

QUESTIONNAIRE FOR HOUSEHOLD ENERGY CONSUMPTION SURVEY

Section A: GENERAL INFORMATION

(1) Address of the household

(2) Household details

Sl. No	Name of members	Rel-ation With head	Age	Sex	Educ-tion	Occupatio		Annual income from			
						Prim -ary	Seco-ndary others	Prim-ary occu-pation	Seco-ndary Occu-pation	Out-Side	Total

Education codes: (1) Illiterate (2) Below S.S.L.C (3) Pre - Degree (4) Graduation (5) Post graduate (6) Professional diploma (7) Professional degree.

3. Caste/Religion/Denomination.

4. Whether SC/ST Yes/No.

Section B : HOUSING DETALAS

5. Ownership of the house [ ] 1. Own 2. Rented 3. Quarters

6. If rented/quarters who pays the electricity bill
(1) Self (2) Landlord / Company.

7. Plinth area of the house in sq.feet ___________________.

8. No of rooms including kitchen ________.

9. Roof type of the house (Tick more than one if necessary).
(1) Grass (2) Coconut leaves (3) Palm leaf (4) Tiles (5) Asbestos
(6) Concrete (7) Others (specify).

10. Wall type (Tick more than one if necessary)
(1) Coconut leaves (2) Mud (3) Tiles (4) Stone (5) Ferp-cement(6) Wood (7) Others (specify).

11. Whether double storied / single storied.

Section C : LAND OWNERSHIP

12. Do you own land Yes/No.

13 If yes give details

Details	Land attached with house site	Away from house site
(a) Land owned (in acres or cents).		
(b) Source of irrigation.		
(c) Use of land		
(i) Cultivation.		
(ii) Plantation.		
(d) No of trees in land		
(i) Coconut		
(ii) Arecaunt		
(iii) Rubber		
(iv) Jack/mango		
(v) Others.		

Section D : CONSUMPTION DETAILS

14. Monthly consumption expenditure of the house hold.

Expenses on	1	2	3
A. Food items			
1. Rice, wheat & other cereals			
2. Pulses			
3. Vegetables and fruits			
4. Tapioca			
5. Edible oil			
6. Milk and Milk products			
7. Beverages , Sugar, Jaggery			
8. Fish /meat / egg			
9. Other food items			
10. Tea/food taken out side the house.			

B. Non – Food items

11. Toilet (Soaps ,pastes etc) 12. Fuel and light 13. Clothing and foot wear 14. Medicine 15. Tobacco /liquor 16. Taxes 17. Education 18. Travel 19. Recreation (News paper ,cinema etc) 20. Others.			

TOTAL

Codes (1) Cash purchase (2) Value of the home grown consumption
(3) Total.

Section E : OWNERSHIP OF LIVE STOCK

15. No of cattle owned at present.

Cattle					Buffalo			
Age	Female			Male	Female			Male
	Crossed	indigenous	total		Crossed	indigenous	total	
3Year And above								
Below 3 years								

16. Out put of cowdung per month quantity in kg.__________________.
17. How is dung used (please tick) (1) As fuel (2) As fertilizer (3) In biogas plant (4) Others (specify).

18. Do you own a biogas plant Yes/No.
(If yes ,go to 19,if no go to 20).
(a) If yes , state the reasons for setting up the plant.

(b) Name of the model ,agency etc.

(c) Uses to which biogas is put cooking /lightning /others.

(d) Quantity of dung used per month in the plant _______ kg.

19. If no, and if the house hold has more than 3 cattle or 25 kg wet dung daily, ask why the Plant has not been set up. (Tick the relevant reasons).

(1) They not aware that 3 cattle can provide enough dung to set up a plant . (2) Lack of Financial resources. (3) Availability of other fuels. (4) Lack of information about the benefits of biogas . (5) Others (specify).

Section F : ENERGY FOR LIGHTING.

20. Is the house electrified. Yes/No.
(If yes go to section F – 1, If no, go to section F –II, section F –III is applicable to all h house holds).

Section F-I (For electrified house holds).

21. Collect the following information from electricity meter as directed.

	When all the house hold Equipment are in use		Between 6.30 p.m. to 9.30 p.m.	
(a) For disk to rotate 5 times		Min		Min
		Sec		Sec
(b) For disk to rotate 10 times		Min		Min
		Sec		Sec

22. Duration of taking meter reading [ ] (please tick).
Code (1) Once in month (2) Once in three month (3) Once in six months (4) more than s Six months.
23. Electricity consumption for the last month.

Sl. No.	Meter 1		Meter 2. I	
	Monthly/in 3 months/in 6 months	Consumption (in units)	Monthly/in 3months/in 6 months.	Consumption (in units)

I Fill this column only if there are more than one connection for domestic purposes in the same building.

24. Details regarding light and uses.

Sl. No.	Type Of room	No of tube light		No of ordinary bulbs						Hours of daily use
		20 w	40 w	15w	25w	40w	60w	100w	others	

Codes for type of room. (1) Bed room (2) living room (3) Dining room (4) Toilet/bath room (5) Corridor (6) Kitchen (7) Office room (8) Out side the house (9) Others (specify).

25. Whether electric chock is used for tube lights Yes/No/N.A.

26. Whether reflectors are used for ordinary bulbs Yes/No.

27. If fans are used ,type of regulator : No of regulator/Ordinary regulator/electronic regulator.

28 No of plug points __________.

29. Details of electricity using equipment's in the house (Tick the relevant ones).
(1) Fan (2) Mixer (3) Grinder (4) Refrigerator (5) Air cooler/conditioner
(6) Hot plate (7) Iron box (8) Kettle (9) Geyser (10) Electronic heater
(11) Emerson coil (12) T.V (13) V.C.R/V.C.P (14) Radio/Tape recorder
(15) Washing machine (16) Others (Please specify).

30 Is there electric motor pump set used for domestic use Yes/No.

31. If yes , details.

Sl.No	Power	Is there ISI mark	Starter (Yes/No)	Daily use in hour

SECTION F - II

32 Why the house holds is not electrified. (if not electrified)

33 Details of kerosene lamp used.

Sl. No	1	2	3	4	5	6	7	8	9	10
Model										
Type										
Frequency of filling Kerosene										

Codes for model (1) 100 ml chimney with out glass (2) 100 ml chimney with glass (3) 200 ml chimney with out glass (4) 200 ml chimney with glass (5) 300 ml with glass (6) 300 ml with out glass (7) 400 ml with out glass (8) 400 ml with glass (9) 500 ml with out glass (10) 500 ml with glass (11) Others (please specify).

Codes for type: (1) with wick (2) Kerosene burns as gas.

Codes for frequency: (1) once in a day (2) once in a two days (3) once in a week (4) Once in two weeks (5) Others (specify).

34 Quantity of kerosene used per week for lightning ______ (in litters)

35 Money spent for kerosene per week Rs _____________

36 Are you the holder of

(a) Ration card Yes/No

(b) Kerosene permit Yes/No

If yes ,quantity per month _________ litters

37 Do you purchase kerosene from private vendors Yes/No

If yes , quantity ________ litters/month.

Price Rs __________ per/litter.

Price Rs __________ per/month.

38. Daily use of kerosene lamp.

Sl.No						
Daily use in hours						

Section F-III

39. When do you use kerosene lamp: Always/when electricity fails

40. When do you use candle when electricity fails /others

41. Do you use inverter /generator Yes/No.

42. Do you use any special type of lamp Yes/No.
If yes, (1) Solar (2) Emergency lamp (3) gas lamp (4) Bio gas lamp (5) others (please specify).

Section G: COOKING FUELS.

Note: The following question relate to cooking fuels ,cooking practices and fuel collection .
ASK THESE QUESTIONS ONLY TO THE PERSONS WHO DO COOKING IN THE HOUSE HOLD .

43. **Specify the reason for adoption of the fuel in current use for cooking** (Tick the relevant reasons) also indicate if more than one reason.

Fuels	1	2	3	4	5	6	7	8	9	10
Reasons. Easy availability										
Free availability										
Efficient burning										
Affordable										
Convenience										
Tradition/Familiarity										
Lack of alternate fuel										
Lack pd competing use for fuel										
Free labor to collect										
Cleanliness										
No smoke/less smoke										
Better taste of dishes										
Fast cooking /Time saving										
Easy to store										
Goatees to use the fuel is in expensive										
Others (please specify)										

Codes: 1. Fire wood 2. Coconut residue 3. Rubber residue 4. Twigs and leaves 5. Other agriculture waste 6. Kerosene 7. Saw dust 8. LPG 9. Electricity. 10. Others.

44. **MENTION THE DIFFICULTIES FACED WITH THE PRESENT COOKING FUEL** (Tick the relevant reasons difficulty also indicate if more than one).

Difficulty	1	2	3	4	5	6	7	8	9	10
Scarcity										
Very expensive										
Smokey										
Difficult to store										
Difficult to transport										
Inadequate availability										
Delay in availability										
Adverse smell in food										
Food not tasty										
Takes longer time to prepare food										
Irregular supply										
No home delivery										
Lack of cleanliness										
Uncomfortable										
Health related problems.										
Unsafe										
No problem.										
Others (please specify)										

Codes: 1. Fire wood 2. Coconut residue 3. Rubber residue 4. Twigs and leaves 5. Other agriculture waste 6. Kerosene 7. Saw dust 8. LPG 9. Electricity. 10. Others.

45. Have you ever changed or substituted cooking fuels Yes/No
if Yes give the following details.

DETAILS	NAMES OF THE OLD FUELS GIVING UP								
	1	2	3	4	5	6	7	8	9
I Fuel giving up since when									
(a) Recently									
(b) Last year									
(c) Two years									
(d) Five years									
II Reason for giving up old fuel									
(a) Inconvenience									
(b) High price									
(c) Smoke & health problem									
(d) Lack of cleanliness									
(e) Time consuming									
(f) Food is not tasty									
(g) Non availability									
(h) Risky to use									
(i) Storage problems									
(j) High maintenance cost									
(k) Unreliable									
(l) New fuel become available									
(m)New fuel become affordable									
III. Reasons for adopting new fuel									
(a) Increased income of H.H									
(b) Increase availability of new fuel									
(c) Efficient burning									
(d) Faster cooking									
(e) Less expensive									
(f) Less smoke									
(g) Cleaner cooking									
(h) Healthier kitchen environment									
(i) Fuel conservation									

Codes: 1. Fire wood 2. Coconut residue 3. Rubber residue 4. Twigs and leaves 5. Other agriculture waste 6. Kerosene 7. Saw dust 8. LPG 9. Electricity. 10.Others.

Section H :KITCHEN DETAILS

46. Is there a separate kitchen in the house: Yes/No.

(a) If yes, where is it situated inside the house /out side.

(b) If No, where cooking done open air /inside a room.

47. Give the following information regarding the type of stoves, choolahs in kitchen and their uses (see codes).

Location of the kitchen	Type of choolah/stove						Ventilation	Other uses
A. FOR H.H WITH SEPARATE KITCHEN Kitchen inside								
Use of each choolah							N.A	N.A
Kitchen outside								
Use of each choolah							N.A	N.A
B. FOR H.H WITH NO SEPARATE KITCHEN Cooking in open							N.A	N.A
Use of each choolah							N.A	N.A
Cooking in a room								
Use of each choolah							N.A	N.A

Codes for type of choolah/stove: (1) Three stove choolah (2) Brick mud choolah (3) Improved wood stove (4) Smoke less choolah (5) Saw dust stove. (7) LPG stove (8) Electric stove (9) Bio gas stove (10) Micro wave (11) Solar.

Codes for use of each stove choolah (1) Cooking main meal (2) Cooking tae coffee snacks etc (3) Cooking special dishes for festivals etc (4) Heating water.

Codes for ventilation of kitchen/the room used as cooking place.
(1) chimney (2) chimney tile (3) Window (4) Exhaust fan (5) No ventilation

Codes for other uses of kitchen or the room used as cooking place.
(1) As store room (2) As dining room (3) As sleeping room
(Note: N.A indicates columns for which data need not be collected.).

48. How many times do you cook meal in a day

49. Do you heat water for drinking/washing/bath.

50. If yes, specify how water is heated (v) choolah with fore wood /choolah with Agriculture waste/kerosene stove /LPG/ heater /immersion coil/simultaneous Arrangement with cooking.

51. Specify the type of the vessels used in kitchen (please tick).
Earthen, Aluminum, Hindalium, Bronze, Brass, Copper bottom, Steel.

Section I : Energy Conservation and Improved Technologies

52. State whether you practice the following measures(if not applicable please tick N.A)
(a) Getting items to be cooked ready before setting on flame Yes/No.
(b) Soaking rice and pulses in water before cooking Yes/no.
(c) Drying the vessels before putting them on flame Yes/No.
(d) Covering the vessels while cooking Yes/No.
(e) Cooking vegetable and rice together Yes/No.
(f) Using pressure cooker yes/No.
(g) Not heating dishes immediately out of refrigeration Yes/No/N.A.
(h) Using hay box Yes/No.
(i) Not using plenty of water while cooking Yes/No.
(j) Cooking on blue flame instead of yellow Yes/No.(for LPG, kerosene etc) Yes/No/N.A.
(k) Lowering the flame after boiling (for LPG. Kerosene etc) Yes/No/N.A
(l) Servicing or cleaning stoves from time to time (for LPG, Kerosene etc) Yes/No/N.A.
(m) Using shades for ordinary bulbs (for electrified house) Yes/No/N.A.
(n) Clean the kerosene lamp from time to time (for uncertified houses and houses using kerosene lamp) Yes/No/N.A.

53. Do you have a smoke less choolah : Yes/No.
A. If yes state the reasons for fixing the choolah (if no go to B).
a. to get rid of smoke **b.** to save fuels **c.** Convenience **d.** Faster cooking **e.** Efficient burning **f.** persuasion of officials **g.** persuasion of voluntary agencies **h.** To avail financial assistance **i.**________________.

B. If No why.
a. Unaffordable **b.** No space/provision in the kitchen **c.** Fuel availability is not suitable **d.** Operation is risky **e.** Food will not be tasty **f.** Is not aware of the benefits of choolah **g.** Do not know to install **h.** Not given thought thought at present **i.** ____________________.

54. State whether you are aware of the following energy technologies and whether you have adopted them. Also state if yes why and if no why.

Technology	Yes	No	Adopted Reasons	Aware of, but not adopted reasons
1. Smokeless choolah				
2. Improved kerosene stove (Nuthan, pumping)				
3. Hay box				
4. Pressure cooker				
5. Tube light				
6. CFL				
7. Electronic chock				
8. Electronic regulator				
9. Solar lamp				
10. Solar cooker				
11. Solar water heater				
12. Biogas				
13. Micro wave				
14. Fuel efficient water pumps				
15. Fuel efficient iron boxes				

Codes: I for 'Reasons for adopting', 1 to save energy, 2 to save money / to reduce expenditure on energy, 3 Healthier kitchen environment, 4 Faster cooking / time saving, 5 Non availability of the fuel in use, 6 Received at subsidized rate, 7 Received free of cost 8 Persuasion of NGOs, 9 Low voltage, 10 Better quality of light, 11 Others (specify)

II. Codes for ' Aware of, but not adopted', 1 Unaffordable, 2 Lack of financial assistance, 3 Complicated procedures in getting financial assistance, 4 Present fuel freely available, 5 Present fuel cheaply available, 6 Lack of information about the benefits, 7 Unfamiliar, 8 Operation risky, 9 Have not felt the need, 10 Others (specify).

Section J: FUEL COLLECTION /PURCHASE

55. Do you collect fuel material Yes/No.
    If yes give the following details (if no go to 61).

56. Source of collection : Own land/neighboring private land /public land /forest/ Social forestry scheme.
57. Specify whether male/female/children are engaged in fuel collection.

58. Give the following details like the names of the fuel material collected, quantity Time.etc.

FUELS Particulars.	1	2	3	4	5	6	7
(a) Frequency of collection (codes D-daily, AD-Alternative days OW-Once in a week , TW-Twice a week, O-Occasionally). (b) Distance traveled in each trip to Collect fuel (in K.m). (c) Time spent in each trip(in Hrs) (d) Quantity collected in each trip. (e) Mode of transport(codes HL-head load, C- Cycle, BE-Bullock cart.).							

Codes for fuels (1) Fire wood (2) Coconut residue (3) Tapioca stem
(4) Rubber residue (5) Other agriculture residue (6) Twigs & leaves
(7) Others.

59. Does fuel collection affect your work/education Yes/No.

60. Is there difficulty in getting fuels in different seasons Yes/No.
    If yes, (a) Give details.

    (b) Do you change fuel according to seasons (details).

61. If you purchase fuel, name the fuels, place of purchase etc.

FUELS Particulars	1	2	3	4	5	6	7	8
(a) Place of purchase (Codes : SM-sawmill, WD-wood depot, HD-Home delivery) (b) Mode of transport(if not) home Delivered(codes: HL-head load, BC-bullock cart, HC-hand cart AR-Auto rickshaw, T-tempo) (c) Cost of transportation. (d) Quantity per week/month.								

Codes: 1. Fire wood 2. Coconut residue 3. Rubber residue/Tapioca stem 4.Other agriculture waste 5. Saw dust 86. Kerosene 7. LPG 8. Others.(please specify).

Section K: MISCELANEOUS

(Common to all house holds but some questions may not be applicable to some house holds .In such cases tick N.A).

62. Specify whether you have experienced any of the following in the last 5 years.

(a) Increase in collection time of fuel : Yes/No.

(b) Increase in distance traveled to collect fuel: Yes/No/N.A.

(c) Change in the persons collecting fuel (from adult to children, male to female Etc) Yes/No/N.A (If yes from whom to whom)

(d) Change in the means of transport of fuel from collection site Yes/No/N.A (If yes, from what to what).

(e) Change in collection from dead to green wood :Yes/No/N.A.

(f) Cutting younger tars for fuel : Yes/No/N.A.

(g) using less preferred fuel material: Yes/No/N.A.

(h) Introduction of fuel saving devices: Yes/No/N.A.

(i) Increase in the proportion of purchase bio fuels: Yes/No/N.A.

(j) Increase in the price of purchased bio fuels: Yes/No/N.A.

(k) Increase in the proportion of house hold expenditure devoted to fuel purchase Yes/No/N.A (if yes, How much).

(l) Substitution of bio fuels by modern commercial fuels (LPG, Kerosene etc) Yes/No.

63. Do you sell fuel material from your land: Yes/No.

64. (a) If yes ,why do you sell(if no go to 65) Excess quantity/to earn income

(b)

Fuel	Frequency of sale	Qty(kg/no)	Income(Rs)
1. Fire wood 2. Coconut residue 3. Tapioca stem 4. Rubber residue 5. Other agriculture wastes 6. Others.			

65. If No (go to 59) do you allow excess quantity (if any) to be collected freely by Others Yes/No.

Section L: FUEL FOR VEHICLES

66. Do you own a vehicle Yes/No.
If Yes
(a) Type of vehicle.
(b) Average use per month ________ K.m
(c) Average fuel cost(petrol/diesel) Rs _______________/month.

Code: Energy Consumption For 24 hrs From_______ to ________.

Fuel ,Kg/Numbers	For Cooking			Other Domestic uses.			For Lightning		Remarks
	Collec-ted Qty	Purchased		Collec-ted Qty	Purchased		Kerose-neQty	Price/ Ltr	
		Qty	Price/ Unit		Qty	Price/ Unit			
1.Fire Wood									
2.Coconut Residue									1.Mention qty Of Kerosene Purchased From PDS And private Sources separately 2.1Bundle = ___kg 3.-No :s = ___kg.
(i).Coconut leaf									
(ii).Coconut husk									
(iii).Coconut shell									
(iv) Spathe									
3.Areeanut leaf									
4.Tapioca stem.									
5.Rubber seed									
6.Rubber stem.									
7.Twigs and leaves									
8.Saw Dust									
9.Kerosene									
10.LPG/Month									
11.Electricity/Month									
12.Others(specify)									

ANNEXURE -II

A BRIEF REVIEW OF SOME HOUSEHOLD ENERGY STUDIES BY ORGANISATIONS / AGENCIES

Over the last three decades, several governmental agencies and research organizations have attempted to estimate the energy demand in the rural house hold sector. The Energy Survey of India Committee report[1] used the national council for Applied Economics Research (NCAER) survey conducted in 1962 to aggregate the fuel mix at national level based on the date of approximately 9000 rural house holds Working Group on Energy Policy[2] (WGEP) set up by the government of India in 1977 quoted extensively the results of the 8^{th} and 28^{th} round of the National Sample Survey (NSS) to project the aggregate energy demand .The Advisory Board on Energy (ABE)[3] used the NCAER (1978-79) survey results to project the energy demanded and estimated commercial energy consumption to grow at 7 percent compounded per annum for a GOP growth at 5 percent compound per annum, at prevailing levels of energy utilization. The study also found out that a 20 percent improvement in the efficiency of electricity, coal and oils is possible in India. Planning commission in another study used the published information on energy demand to project energy demand for the years 1999 / 2000 and 2004 / 2005.[4]

1. Government of India, Report of the Energy Survey of India Committee. New Delhi, 1965.
2. Government of India Planning Commission: Report of Working Group on Energy Policy, New Delhi, 1979.
3. Government of India Advisory Board on Energy, Towards a perspective on Energy demand and supply in 2004-05 may, 1985: Years 1999/2000 and2004/2005.
4. Government of India, Planning Commission Report on Sectional Energy Demand for India New Delhi, 1991.

NCAER has conducted extensive surveys on domestic energy consumption. In 1958 NCAER brought out a study on utilization of primary energy in India, which is one of the earliest attempts to analyze primary energy sector in India.[5] The study examined the trends in the production and consumption of primary energy in India and projected the future requirement. Next study by NCAER was done in urban areas of Delhi, Bombay and Calcutta.[6] Assessing the supply of domestic fuels in these cities, the study highlighted the affects of income, family size, fuel preference and purchasing habits on energy consumption. The first study by NCAER that confined to rural areas was published in 1962.7 the study provided quantitative estimates of source-wise effective energy consumption, consumption of collected and purchased fuels and seasonal variation in consumption. During the sixties the NCAER also conducted a series of studies that deal with energy demand in different regions of India.[8]

5.NCAER Utilization of Primary Energy in India, Asia publishing House. Bombay 1958.

6.NCAER, Domestic fuels in India, Asia publishing house, Bombay, 1959.

7.NCAER, Domestic Fuel Consumption in Rural India, NCAER, New Delhi, 1965

8. (i) NCAER . Demand for energy in southern India ,NCAER, New Delhi,1962.

(ii) NCAER , Demand for energy in eastern India ,NCAER, New Delhi,1963

(iii) NCAER . Demand for energy in western India ,NCAER, New Delhi,1965

(iv) NCAER . Demand for energy in northern India ,NCAER, New Delhi,1965

These studies were help full on cross regional comparison of energy demand. NCAER has also brought out a rural energy survey of northern India in 1978.[9] and a Comprehensive study of five northern states of India in 1981.[10] The latest study in the series by NCAER was published in 1985.[11] Covering about 13000 households and 8000 establishments, the study provides comprehensive information on state-wise rural and urban energy consumption for almost all fuels. The study also provides conformation about the relationship between income size of land holding and energy use. Fuel collection methods fuel preferences and various aspects of kerosene consumption are also discussed.

National Sample Survey Organization (NSSO) in its various rounds has addressed the energy consumption pattern. In fact the NSSO survey of 1964 is one of the earliest systematic surveys on energy use in rural India.[12] In 1983 NSS conducted a study on energy use for cooking and lightning.[13]

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9. NCAER. Survey of rural energy consumption in northern India. NCAER New Delhi. 1978

10. NCAER Report on rural energy consumption in northern India. NCAER. 1981

11. NCAER. Domestic fuel survey with special reference to kerosene. Vol. 1 and 2. NCAER. New Delhi. 1985

12 .NSS Table with notes on house hold consumption of fuel and light . 18th round .No. 141. Cabinet secretariat. New Delhi, 1964.

13. NSS Result of survey on source of drinking water and energy used for cooking. and lightning . 38th round , Jan -Dec 1983. *Sarvekshana* , vol. XII. No.2.October.1988.

The study revealed that boring a few exceptions, in rural sector, firewood and chips provide fuel for cooking. However, in some states dung was found to be important as well. The study also found that kerosene followed by electricity is the major source of lightning fuels in India. NSS survey on consumer expenditure also provides Information on fuel use. For instance the 45th round of NSS reveals that for rural India, the average monthly per capita expenditure on fuel and light was Rs.14.44.[14]

ASTRA (Application of Science and Technology to Rural Areas) has also conducted some studies on rural energy consumption pattern. For instance, the 1981 study of ASTRA brought out the significance of house hold energy use for cooking in the rural economic system.[15] It was found that fire wood accounted over 80 percent of the total energy resources in the village and of this 82 percent was used for cooking and 14 percent for water heating. The study has also revealed some interesting facts regarding human time budgeting. Gathering fire wood consumed 0.33, 0.41 and 0.24 hours per day of men, women and children respectively. Cooking consumed 0.02, 2.28 and 0.18 hours per day of men women and children.

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14. NSS, Result of 3[rd] annual survey on consumer expenditure and employment and Unemployment, NSS 45[th] round 1989-90, *Sarvkshana*, Vol. XV, No.1, July-Sep, 1992

15. ASTRA, Rural energy consumption patterns – afield study, ASTRA, Indian Institute of science, Banglore, 1981.

TERI (Tata Energy Research Institute) has contributed much to development of energy database for India. In 1992, TERI prepared a comprehensive rural energy data based on the rural energy surveys conducted between 1985-92 by different agencies.[16] This database is updated regularly with data from energy surveys conducted by TERI. Besides TERI also publishes TEDDY

(TERI Energy Data Directory and Year book) every year, which also provide latest data on house hold energy use.

The other important data source on the rural domestic sector are the IREP(Integrated Rural Energy Program) surveys conducted by various state departments . The results of these surveys were published in the eight five-year plans, in 1992. In 1991,the census of India collected information on the consumption of both commercial and non-commercial fuels at the household, used for cooking. Information was also collected on the households having electricity.

16.TERI. Rural Energy Data base-India. TERI. New Delhi.

BIBLIOGRAPHY

Books

Alam, Manzoor, (1985), Fuel wood in urban markets: A Case Study of Hyderabad, New Delhi, Concept publishing company.

Amman, Fernando and Wilson, Ricard (Ed), (1981), Energy demand and efficient use , plenum press, New York.

Barnett, Andrew, Bell, Martin and Hoffman, Kurt, (1982), Rural energy and the third world – a review of social science research and technology policy problems, pergamon press, Oxford.

Chitale V.P. and Roy , M. (Mrs.), (1975), Energy crisis in India, Economic and Scientific Research Foundation, New Delhi.

Eden, Richard et al ., (1981), Energy Economics - growth, resources and policies, Cambridge University press, Cambridge.

Giriappa, S . (Ed) (1986), Rural Energy Crisis, Himalaya publishing house , Bombay.

Giriappa Somu, (1991), Energy Environment in Agriculture, Ashish publishing house , New Delhi.

Henderson, P.D, (1975), India: The Energy Sector , Oxford University press, New Delhi.

Hall D.O, Burnard G.W, Mass P.A, (1982), Biomass for energy in the developing countries, pergamon press, New York

Jill Gala de villa (ed), (1994), Energy end use – an environmentally sound Development path way, Asian Development Bank, Philippines.

Kashkari, Chaman, (1975), Energy, Resources, Demand and Conservation and Special Reference to India , Tata McGraw Hill Publishing Company Limited, New Delhi.

Knowland, Willaim E. (ed), (1980), Energy in the Developing World: The Real Energy Crisis, Oxford University press.

Mahajan, V.S, (1983), Energy Development in India , Deep & Deep publications, New Delhi.

Mohan Mun Asinghe, (1987), Rural electrification for Development, West vies press, 1987.

Mehetre, M..G, (1990), Energy Crisis in India, Chugh Publications, Allahabad

Nordhaus, William, (1977), International Studies of the Demand for Energy, North Holland Publishing Co., Amsterdam.

Pachauri, R.K, (1977), Energy and Economic Development in India, Praegar Publishers, New York.

Parikh Jyothi, (1997), Energy models for 2000 and beyond, Tata McGraw Hill, New Delhi.

Pachauri R.K, et.al (ed), (1991), Energy Environment, Development, Vihas, New Delhi.

Pillai, P.P, (1982), Dynamics of electricity supply and demand in Kerala : a macro economic study, Agricole Publishing Academy, New Delhi.

Raikhy, P.S. Parminder Singh, (1990), Energy Consumption in India - Pattern and Determinants, Deep & Deep Publications , New Delhi.

Rao Hemalatha, (1990), Rural Energy Crisis: A Digonostic Analysis, Ashish Publishing house, New Delhi.

Robert W Pirog, Stephen C. Stamas Jr, (1990), Energy Economics - Theory and policy, Prentice Hall, New Jersey, USA.

Subramanya , K.N. (ed), (1983), Energy Problem and World Economic Development with Special Reference to India, Deep & Deep Publications , New Delhi.

Simon, Andrew L, (1975), Energy Resources, Pergamon Press, New York.

Slesser, Malcolm, (1978), Energy in the Economy, The Macmillan Press Ltd., London.

Somasekhar N, (1985) Rural Energy, Sterling, New Delhi.

Varshney, A.C, (1990), Rural Waste Management , Associated Publishing Company , New Delhi.

Veena D.R, (1988), Rural Energy Consumption, Problems and Prospects, Ashish publishing house, New Delhi.

World Bank, (1996), Rural energy and Development, World Bank Publication division, Washington Dc.

Journals

Adams John, Tyner Wallance, (1997), Energy in rural India- National policy from the village perspective', Indian journal of Agricultural Economics, vol. XXII.

Balagopalan Unni, (1986), 'Energy Crsis and the Wayout'. Yojana, Vol: No.20, November.

Bartwal, P.S. Thapliyal, A.P, (1987), 'Rural Energy Crisis and Alternatives'. Kurukshethra , Vol. XXXV, March.

Batliwala , Srilatha, (1982),. 'Rural Energy Scarcity and Nutrition: A New Prespective' , Economic and Political Weekly, Vol XVII, No. 9, February 27.

Bhagawan, M.R,. (1986), 'India's Energy policy in ti the Late Eighties', Economic and Political Weekly , November 1-8.

Battacharya D, (1991), 'Energy Demand Management Policy Issues in the Indian Cintext', Urja, Vol. 2, No.4, April.

Barners Douglas F et.al, (1993), 'The design and diffusion of improved cooking stoves', The World Bank Research Observer, vol. 8 No.2.

Bhagavan M.R, Giriappa S, (1987), 'Class character of rural energy crisis', Economic and Political weekly, vol. XXII, No 26.

Bose, Subhas Chandra, (1981), 'Development of Energy Sector', Yojana, Vol. XXV, No.20, November 1-15.

Bowonder B, et.al, (1985), 'Energy use in eight rural communities in India', World development, vol. 13, No.12.

Ching-Yuan Lin, (1984), 'Globel Pattern of Energy Consumption before and after 1974 Oil Crisis' Economic Development and Cultural Change, Vol 32, July.

Coltrane Scott, Archer Dane, Aronson Elliot, (1986), 'The Social- psychological foundations of successful energy conservation programs, Energy policy, April.

Down Sally, (1986), 'Cooking in west Sumatra', Energy policy, December.

Desai Ashok V, (1978), 'India's energy consumption – composition and trends', Energy policy, September.

Dunkerley J.et.al, (1990), 'Consumption of fuel wood and other household cooking fuels in Indian cities', Energy policy, Jan/Feb, 18(1).

Feature on Energy, (1994), The Economist, June 18th

Ghosh, Arun, (1990), 'Energy: Overalll acenario, Rural Energy, Renewable sources and Oil and Natural Gas' , Economic and political Weekly, Vol.. XXVI, No.7, February 8.

Gowen Marcia M, (1989), 'Bio fuel v fossil fuel economics in developing countries', Energy Policy, October.

Government of India, (1995), Ministry of Non – conventional energy sources, Urja Bharati-special report on wind energy, vol.6, No.6, New Delhi.

Government of India, (1994), Ministry of Non – conventional energy sources, Urja Bharati-special issue on solar energy, vol.5, No.1, New Delhi

Harris John, (1980), 'Why poor people stay poor in rural south India', Development and Change, vol. II.

Habubullah, M.I, (1986), Developing Rural Indian through Non-Conventional Energy, Kurukshetra, Vol. XXXV, November, December.

Haque Asraul, (1981), 'Solving Energy Crisis- The Right way' Manthan Journal, Vol. IV, June.

Jain, B.C, (1988), 'Biomass Technology for Rural Development', Kurukshetra, Vol. XXXVII, October.

Jannuzzi De Martino Giberto, (1989), Residential energy demand in Brazil by income classes', Energy policy, June.

Kacktwana, S.C, (1990), 'Gulf Crisis and Oil Scenario' Mainstream, Vol.XXVIII, No. 46, September 8.

Meier P, Munasinghe M, (1987), 'Implementing a practical fuel wood conservation policy', Energy policy, April.

Moorthy, Ravi, C, (1990), 'Indian Energy Scenario' Yojana, Vol. XXXIV, No.21, November 16-30,1990.

Manglik Purnima, Padida Manoranjan, (1991), 'Role of Non-Conventional Energy Technology in Alleviating The Drudgery of Rural Women', Khadi Gramodyog Vol.XXXVII October.

Mishra Durga Shanger, (1991), 'Impact and assessment of integrated rural energy planning Programme in block mohanlalganj of district Luknow', Journal of Rural Development, vol.10 (4).

Micklewright John, (1981), 'Towards a households model of UK domestic energy demand', Energy policy, June.

Oberai K, Sindhu M.K et.al (1992), 'Study on the extent of use of fuel conservation method by the rural families', Journals of Research, Punjab Agricultural University, September.

Oberai K, Sindhu M.K et.al (1992), 'Fuel consumption and thermal efficiency of choolah with cooking vessels of different metal and shapes', Ibid.

Parameswaran, M.P, (1982), 'Energy Perspective of Kerala', Yojana, Vol. 26 (1&2), 26th january.

Pachauri R.K, (1983), 'Third world energy policies', Energy Policy, September.

Pattel, V.J, (1985), 'Rational Approach Towards Fuel wood Crisis in India' , Economic and Political Weekly , August 10.

Parik Jyothi K, (1986), 'From farm gate to food plate', Energy policy, August.

Pillai.P.P, (1983), 'Shortage of Wood fuel for Kerala Home Fires', State and Society, Vol. 4, No. 4, October, December.

Pillai, P.P, (1984), 'Regional Power Scenario in 2001 AD, the case of Kerala', India Journal of Regional Science,. Vol. 1,16, No.1.

Rao, A.R. et al, (1990), 'Vignetties of Rural Energy Options in India', Journal of Rural Development , Vol. 9 November.

Shippee Glenn, (1981), 'Energy conservation and the role of the social sciences', Energy policy, March.

Srilatha Batliwala, (1982), 'Rural energy scarcity and nutrition-A new perspective ', Economic and Political weekly', February 27.

Srilatha Batliwala, (1983), ' Women and cooking energy', Economic and Political weekly, December 24 – 31.

Stanovnik Time, (1986), 'Household energy consumption in Slovenia', Energy policy, June,

Tata Energy Research Institute, 'Pacific and Asian Journal of Energy', Various issue.

Varun Vidyarthi, (1984), 'Energy and the poor in an Indian Village', World Development, Vol. 12, No.8.

Vijayalakshmi and Sharma A.N, (1987), 'Empirical Relationship between Fuel Wood Consumption and Factors affecting its consumption—a case study', Agricultural situation in India Vol. XLI, No.12, March 1987.

World Bank water demand research team, (1993), 'The demand for water in rural areas, Determinants and policy implications', The world Bank Research Observer, vol.8, No.1.

Reports

Anert, (1989), Integrated Rural Energy Planning Programme for Manandavadi Block, Thiruvananthapurm.

CMIE (center for Monitoring Indian Economics Pvt. Ltd.) (1996), India's energy sector, CMIE, Bombay.

Energy Management center, Kerala, (1996), "*Oorja samrakshanam ippol thudangaam, ivide thudangaam*" (Malayalam), Energy management Center, Trivandrum.

FAO Regional Wood Energy Development Programme in Asia, (1991), Report of National Conference conservation and sustainability of wood based energy systems in rural industries and village applications, October, Report No GCP / RAS / 131 / NET, FAO, Bangkok.

--------------, (1989), Wood based energy system in rural industries and village applications in India, Report No. GCP / RAS /111 / NET, Filed document No. 18, FAO, Bangkok.

-----, (1993), Status and development issues of he brick industry in Asia, Report No. GCP / RAS / 131 / NET, Filed document No.35.

--------------, (1992), wood / Biomass based energy systems in rural industriesand village applications, report of the National seminar, Kathmandu, July, FAO, Bangkok

--------------, (1993), wood energy development planning, policies and strategies, report No. GCP / RAS / 131 / NET, Filed document No. 37a, FAO, Bangkok.

-------------, (1991), Wood fuels flows, Report No GCP / RAS / 131 / NET, Filed document No. 26, FAO, Bangkok.

------------, (1990), Trees and fuel wood from non-forest lands, Report No. GCP / RAS / 131 / NET, Filed document No. 23, FAO, Bangkok.

-----------, (1993), Indian improved cook stoves: A compendium, Report No. GCP / RAS / 131 / NET, Filed document No. 41, FAO, Bangkok.

-----------, (1991), Improved cook stove development Programme in south Asian countries, report No. GCP / RAS / 131 / NET, FAO, Bangkok.

Government of India, (1981), Census of India 1981, Series 10 Kerala, Final population Totals, New Delhi, Director of census operation.

Government of India, (1981), Census of India 1981, Series 10 Kerala, paper 2 of provisional population Totals, New Delhi, Director of census operation.

Government of India, (1965), Report of the Energy Survey of Indian Committee, New Delhi.

----------------, (1976), Report of the National Commission on Agriculture, Vol.5, Forestry, New Delhi.

----------------, (1979), Report of the Working Group on Energy Policy , Planning Commission, New Delhi.

------------------: Seventh Five Year Plan , 1985-90, Planning Commission New Delhi.

Government of Kerala, (1978), Report of the Steering Committee on Energy – Proposals – 1978-83, State planning Board, Thiruvananthapuram.

-------------- (1984), Report of the High Level Committee on Industry, Trade and Power, Vol. III. State Planning Board, Thiruvananthapuram.

-------------- (1986), Rural Energy Generation and Use Pattern, Southern Kerala, State Planning Board.

------------- (1989), Eight Five Year Plan 1990-95 – Report of the Task Force on other forms of Energy, State planning Board , Thiruvananthapuram.

------------- (1989), Eight Five Year Plan 1990-95, Report of the Task Force on other forms of Energy, State planning Board , Thiruvananthapuram.

Kerala State Electricity Board, (1987-88), Power System Statistics, Thiruvananthapuram.

Krishnankutty, C.N, (1990), Demand and Supply of Wood in Kerala and their Future Trends, Kerala Forest Research Institute Peechi, Research Report 67, September.

National Sample Survey (1964), Tables with Notes on House hold Consumption of Fuel and Light , 18th round , No.141, Cabinet secretariat, New Delhi.

------------- (1974), Tables with Notes on House hold Consumption of Fuel and Light , 28th round , No.141, Cabinet secretariat, New Delhi.

NSS, (1997), Survey result on housing condition, NSS 28th round, Survekshema, vol. 1, No.2, October.

NCAER (1965), Domestic Fuel Consumption in Rural India, New Delhi.

-------- (1966), Demand for Energy in India , New Delhi.

------- (1978), Survey of Rural Energy Consumption in Northern India, New Delhi.

------- (!981), Report on Rural Energy Consumption in Northern India , New Delhi.

------- (1985), Domestic Fuel Consumption Survey with Special Reference to Kerosene, Vol.I and II, New Delhi.

PCRA (petroleum Conservation Research Association), Fuel saving tips for households, leaflet, PCRA, New Delhi.

The World Bank, (1992), World Development Report 1992, Oxford University press.

--------- (1981), Renewable Energy Resource in Developing Countries, Washington.

World watch Institute, (1992), State of the world 1992, Progress towards a sustainable society, Horizon India Books, New Delhi.

World Bank, World Development report, Various years.

Working papers

Ashok Desai, (1981), Energy Output and Consumption in India – A Methodological Review, Working paper No.97 Center For Development Studies, Thiruvananthapuarm.

Bater Robin W, Moore Edwin A, (1992), 'Commercial energy efficiency and the environment', working paper wps 972, World Bank, Washington D.C.

Borg Brigitte van der, (1989), women's role in forest resources management, Project working paper No.1, FAO, Bangkok.

Campbell John R, (1993), Urban household perceptions and energy use Dar es Salaam – Tanzania memorandum 1993 m 6, Lund center for habitat studies, Lund University Sweden.

Gately Dermat, Streifel Shane S, (1997), The demand for oil products in developing countries. Discussions paper No. 359 World Bank Washington.

Hall David O, (1992), Biomass, work paper wps 968, world Bank, Washington D.C.

Haddad et.al, (1994), Intra-household resources allocation-An over view policy research working paper 1225, World Bank, Washington DC.

Ishiguro Masyaso, Akiyama Takumara, (1995), Energy demand in five major Asian developing countries-structure and prospects, Discussion paper No. 277, World Bank, Washington.

Lund center for habitat studies , (1993), Housing energy and indoor environment, memorandum 1993 m7, Ibid.

Malhotra Anil K it.al, (1994), A survey of Asia's energy prices, Technical paper No. 248, World Bank, Washington D.C.

Nordhaus William D, (1993), Climate and economic development: climates past and climate change future, The world Bank annual conference on development economics, May 3-4, World Bank, Washington DC.

Schipper Lee, (1993), Energy efficiency and human activity : lessons from the past, importance for the future, paper, World Bank's Annual conference on Development Economics may 1993, World Bank, Washington D.C.

Thesis, Dissertations

Bahuleyan, K.D, (1992), Demand of Energy in the Rural Sector of Kerala, Ph.D. Thesis, submitted to Department of Economics, University of Calicut (unpublished).

Nirmala Jayakumar, (1992), Energy Consumption of Urban House holds : A case study of Thiruvananthapuram city, M.Phil. Dissertation, Department of Economics, Kerala University.

Sudhakaran, M.N, (1991), Diffusion of Improved Chulahs - a Study with Reference to Kerala, M.Phil. Thesis, Center for Development Studies Thiruvananthapuram.

Thampi Balachandran, (1983), Pattern of Domestic Energy Consumption in Rural Kerala – A Study of Selected Village . M.Phil. Thesis, Center for Development Studies Thiruvananthapuram.

Sarala Gopalan, (1989), Domestic fuels and devices for cooking-practices, problems, policies and perspectives, Ph.D. Thesis, IIT, Delhi (unpublished).

Web sites

Beijing Energy Efficiency Center www.gcinfo.com/becon/becon.hmtl

Contortion for Energy Efficiency in Rural Wales www.ceerco.org.uk

Center for Excellence for Sustainable development www.sustainable.doe.gov

Food and agricultural organization www.fao.org

National Rural Electric Co-operative association www.nreca.org

Rural Energy and Development at ITC www.itc.nl

Renewable Energy for Rural Economy www.sac.ac.uk

Rural Energy Web www.edr.uct.ac.za

Rural Energy Resources www.ruralernergy.com

Rural Book 1997-1998 www.landcare.gov.au

Rural Energy Enterprises www.servcom.com

The Niger Household Energy Project www.ideas.uqam.ca

United Nations www.un.org

World Bank www.worldbank.org

Winrock International www.winrock.org