DEMAND FOR DOMESTIC FUEL CONSUMPTION

A case study of Rangia Town

By

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It is my great pleasure to certify that Mr. A. Rezzaque has done a commendable job in a relatively new field - Energy Economics. His dissertation on "Demand for Domestic Fuel Consumption - a case study of Rangiya Town", is partly substantiated by published data and mostly by data collected by him. His research findings are of his own and have not been published earlier. He has taken serious interest in the subject and analysis reveals the nature of consumption in a provincial town. I recommend his thesis for the grant of M.Phil degree in Economics.

(Dr. K. Bez)
Supervisor.

Shillong
Dated.20.4...1986

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A C K N O W L E D G E M E N T S

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A. Rezzaque

Shillong, Meghalaya. (A. Rezzaque)

Chapter - I

INTRODUCTION

1.1.Historical background of Rangia :

Every place is named after an old historical episode. Rangia also bears a significant story behind its name. People of this place generally believes that the name 'Rangia' has been derived from the word 'Ron-Dia'. History also tells us that this place was the battle field of ancient Kings. The Ahom, the Koch, the Mughal, the Pathan, the Bhutanese and the British fought around here during Pre-independent period. It is Rangia where farmers revolution took place in 1894. From Geographical point of view Rangia is a strategic place. There is an international boundry between India and Bhutan just near to the northern side of Rangia. In ancient time struggles among the Kingdoms of Bhutanies, Ahoms, Darrangies and Mughals took place in Rangia. As the place was used by every King as battle field hence it was named as 'Ron-Dia' or 'Rangia' (Common battle field).

Some people also believes that it was once the centre for Shakta, Shaiva & Vaisnava cult. Some tools and temples of that time are still found in existence here. In the past days this place was famous for higher agricultural production. It was a surplus area and could supply food grains to the rest of the state. And hence it was called "the grainary of Assam". In this sense the name Rangia bears the meaning of "Rong-Rois".

Rangia is a place full of historical evidence. It was a royal place of ancient Kings like Baidyadev and Arimatta. It was the birth place of Revolutionary public leaders like Hara Dutta and Bira Dutta. A Public Hall constructed in 1951 was named after them. This Hara Dutta-Bira Dutta bhaban is situated in the heart of Rangia Town. It tells us about the past activities of Rangia. It was constructed by the efforts of mass people without any financial help from government. There is a public library inside the Bhaban. People of Rangia used the Hall for any public works till to-day.

The Baralia river which follows through the heart of the town also bears historical evidence of King Arimatta. It is said that King Arimatta committed suicide in this over flooded river in order to get rid of sin for killing his wife and father. King Baidyadeva built a fort in 1142 just one and half mile away from Rangia town. The fort is known as Baidyagarh and can be seen till to-day. Subsequently King Arimatta while fighting with Fingua Konor repaired the fort and occupied it.[1] After rebuilding the fort King

1. Atul Chandra Baruah - "Atitar Rengani", Smritigrantha, 40th Rangia Adhibesan, 1973, Assam Sahitya Sabha.

Arimatta shifted capital from Betna to fort.

1.2. Socio-economic characteristic of Rangia Town

1.2.1. Population Growth since 1971 :

It is worth while to mention that Rangia is a growing town. The newly created Rangia Civil Sub-Division established its head quarter with in the jurisdiction of Rangia Municipal area. People from various places are coming in here. They belong to different caste, creed, tribe and community. The inhabitants are mainly comprised of Hindus and Muslims. Majority of the population is Assamese. Besides Assamese, some Bengali speaking people are living in Rangia town. They earn their livehood mainly from service in the Railway department. Apart from this some Marowaries (Rajasthanies), Biharies and Bodos are also living with in the Rangia Municipal area.

Current population figure of Rangia town can not be given accurately due to the lack of reliable population statistics. Since 1978 Rangia Municipal Authority has not been carried out any population census. It may be mentioned here also that Assam was not figured in population census of India in 1981 due to Foreign National Movement. So we may roughly estimate the population of Rangia town on the basis of previous census records. As per population census of Assam in 1971 the number of population in Rangia town was 9,884. In 1978 another population census was done by the Rangia Municipal Board. According to this census the number of population in Rangia town was 13,346 excluding Railways and Army population.

Absolute increase of population in 1978 was 3,462 as compared with 1971. During this period of 7 years the growth rate was 350 per one thousand. On the basis of this growth rate we can estimate the number of population in Rangia town for another subsequent period of 7 years e.g. upto the end of 1985. Accordingly the estimated population will stand at 18,017 excluding Railway and Army population. Inflow of new comers are still continuing to this area and hence Rangia may be a thickly populated town in near future.

1.2.2. Occupational Pattern :

It is already mentioned in the previous section that Rangia town is characterised by various types of people. They maintain their livelyhood through different kinds of occupation. A majority of them earn their livelyhood from services both in governmental and public sector. Commercial business comes next to service. It plays a dominant role in maintaining their families. Agriculture considers as the third major source of livelyhood. Although Rangia was mainly an agricultural area still its relative share to family income is less because of the fact that urban people are engaged with governmental services and allied sectors. Occupational pattern of the population of Rangia town can be seen from the following tables.

Table - 1 :

Percentage distribution of families by the type of Occupation of the head of a family.

Sl.No.	Main Occupation of the head of the families	No. of Units in the sample	Percentage of the Sample
1.	Administrators, executives, teachers etc.	26	21.67
2.	Clarical and related works	16	13.33
3.	Technical, professional and related workers	17	14.17
4.	Peons, Chowkidars, watermen etc.	-	-
5.	Business men	41	34.16
6.	Farmers and related workers	20	16.67
	Total -	120	100.00

Source : Survey data.

Table - 2 :

Percentage distribution of families by the number of earners in a family.

No. of earners	Sample units	Percentage
1	85	70.83
2	27	22.50
3	7	5.83
4	0	0.00
5 or more	1	0.84
Total -	120	100.00

Source : Survey data.

Table - 3 :

Percentage distribution of families by the number of salary earners in a family.

No. of salary earners in a family	Sample units	Percentage
Nil	64	53.33
1	36	30.00
2	15	12.50
3	4	3.33
4	0	0.00
5	1	0.84
Total -	120	100.00

Source : Survey data.

In Table 1 it is found that almost half of the total sample house-holds earn their livelyhood from services. Percentagewise break through of the sample households shows that 21.67 percent households earn their income from first category service in the table. 13.33 percent and 14.17 percent households income comes from the second and third category service of the table respectively. 34.16 percent maintain their families though income of commercial business. Rest 16.67 percent depend upon Agriculture and related works.

Percentage distribution of families by the number of earners in a family can be seen in table 2. Nearly 71 percent of the sample households has only one earning member in the family. This reveals that rest of the members in a family depend upon the income of one earning member. Able bodied persons in a family are expected to be more active. 22.50 percent and 5.83 percent families of the sample households are maintained by two and three earning members respectively. In our sample data only one household was found having more than three earning members.

Table 3 shows the percentage distribution of families by the number of salary earners in a family. In this table it is found that 53.33 percent of the total sample households is maintained by income other than salary from services. Rest 46.67 percent of the sample units is maintained through the salary income from services, The rest, 30 percent, 12.50 percent and 3.33 percent households of the sample data are maintained by salary earners of one, two and three members in a family respectively. Only one household in our sample data was found having more than three salary earning members in the family.

1.2.3. <u>Educational Status</u> :

Apart from an old proverbial style Sanskrit Tole run by some Pandits, there is anything of the sort in the name of education. This centre is offering training only to a particular caste to perform religeous rites. This centre is maintained by Aryadharma Sangrakshan Committee since 1922.

Rangia in the field of general education is progressive if not upto highly developed stage. A large number of educational institutions are established here right from pre-primary to college level. Some leading educational institutions of Rangia town are as follows :-
One general degree college having both arts and science faculties, one girls' degree college, one general higher secondary school having both arts and science faculties, one girls' higher secondary school, one High Madrassa school, one Hindi high school, one Bengali high school, one Arimatta high school, one basic training school, one

music school, one Arabic college. This Arabic college is one of the leading religious institutions in the country where Post-graduate level of education is being given. Besides these institutions, there are a few numbers of middle and primary schools here. As Rangia town is inhabited by different kinds of people having different language and religion. So we found here various types of educational institutions to suite the cultural heritage of the diverse communities. The status of Education of Rangia town can be observed from our survey data which is given in the following table .

Table - 4 :

Percentage distribution of the families by the educational standard of the head of the family.

Educational standard of the head of the family	Sample units	Percentage
Literate but no formal education	4	3.33
Primary or below	10	8.33
Above primary but below Matric	22	18.33
Matric or equivalent	20	16.67
Higher Secondary	19	15.84
Graduate	16	13.33
Post-graduate	12	10.00
Others, including professional, and technical education	17	14.17
All Classes	120	100.00

Source : Survey data.

In the above table it is seen that barely 12 percent of the sampled households is below or upto primary level and 35 percent above primary and below higher secondary education. Rest more than 50 percent is in the higher education level This clearly indicates that people of Rangia town are advance in the field of general education. A progressive trend is being expècted in future as more and more new educational institutions are going to be established in near future.

1.3. Municipal Administration :

As regards to the general administration of Rangia town it is to be appropriate to mention about Municipal administration here. Rangia Town Committee was formed on 1st January 1956. It was then comprised of four administrative wards. On 21st November 1969, the Town Committee was converted into Municipal Board. Since then Rangia Municipal Board has been working with eight administrative wards. In regard to functional structure of the Board it has 8 (eight) elected representatives from each ward. Out of these representatives one Chairman and one Vice-Chairman are elected by the elected members. The Chairman holds an full fledged office for proper administration.

Among the main functions, the Board takes necessary steps in promoting public health through better sanitation and vaccination. For road development works and water supply one sub-engineer and one pump operator are engaged respectively by the Municipal authority. Besides these functions, the authority also looks after in promoting education, security of property, house construction, setting-up markets , street lighting, drainage etc.

1.4. Brief review of chapters in the dissertation :

The plan of the work is as follows :-

Chapter 1 is the introductory chapter where historical background of Rangia is briefly described. Socio-economic characteristic of Rangia town including population growth, occupational groups, educational status and Municipal administration is described in this chapter.

Chapter 2 is devoted to give an over view of sources of domestic fuel in India. At begining energy sources under heading of commercial and non-commercial sources is discussed. A brief discription of fuel resources in India is given in this chapter. Some important tables in connection with various sources of domestic fuel in India are also presented here.

Chapter 3 contains a short historical survey of the sources and use of domestic fuel in Assam. Sources of Commercial fuel are discussed here in details. In case of non-commercial fuel reliable or recorded data was not found adequately. Hence details could not be given. A few tables in regard to commercial fuel are presented in this chapter.

Chapter 4, deals with the data base. It discussed how primary and secondary data were collected. It entails also the groupism of data and types of fuel taken for consideration in research work.

Chapter 5, contains methodology of study. At the beginning it deals with the theoritical description of consumer behaviour and demand function. Models adopted for empirical analysis of data is given in this chapter. Engel-type demand function equation is shown here. In empirical analysis regression equations both linear and non-linear are used. Seperate calculation for each type of fuel and calculations on N.S.S. data are detailed in this chapter.

Finally in chapter 6, we concluded on the basis of entire findings. The demand as well as supply of fuel is a newly branch of economics. In some countries e.g. West Germany they have separate department of Energy Economics. We have still to go far ahead.

In this essay, we only could begin the problem and for a real analysis of demand for fuel is very difficult to make due to the unavailibility of data. We have mentioned some of these facts in this chapter.

Chapter - II

A BRIEF SURVEY OF INDIAN ENERGY SITUATION

.1. Introduction :

The need for energy in a developing society can hardly be over-emphasised. It is a basic input required to sustain economic growth and to provide basic amenities of life to the entire population of a country. In the Indian context, fulfillment of the national objectives of removing unemployment and poverty are going to require a very significant in put of energy.

It is an undisputed fact that economic progress is crucially dependent on and intimately linked to steady and reliable supply of energy. To a developing nation, the growth process from the low economic base is dependent upon adequate supplies of energy and defficiencies in energy supplies effect the very growth.

The phenomenon of modern society with its computer run factories and sky scraper-studded cities and more confortable facilities for an average citizen to-day could also be explained by the advent of energy as the maker of complex industrial culture. Energy is at the heart of modern industrial society.

While importance of power in the industrial field has long been recognised in our country, it is only recently that its importance in the agricultural field also has become to be acknowledged. Agricultural out-put is the single most important component of the gross domestic product of India. Here the choice must be a balanced, modest but appropriate development model which places greater emphasis on labour intensive, small-scale technologies with rural orientation.

Per capita consumption of power is now universally accepted as one of the major indicators of economic growth. The requirement of power and the position of its availability provide the surest index of a country's over all economic scene as power is the basic input for industrial and agricultural activities. Energy has thus emerged as a strategic factor in the process of economic development. An accelerated development programme is, therefore, needed for increased harnessing of energy resources and, thereby, improve the living standard and quality if life, reduce social inequalities and regional imbalances.

2.2. Progress and Prospects of Fuel Industry in India :

In the present state of scientific and technical knowledge, the main energy sources in India can be listed under five headings which come under commercial and non-commercial sources of energy. These are coal, oil and natural gas, hydroelectric power, nuclear fuels and forests (fire wood and char coal). The former four can be categorised under the general description of "commercial energy" and the later can be included in the category of "non-commercial energy" because much of it is not ordinarily bought and sold at any rate of recorded transactions. Dried cow dung and vegetable wastes are also come under the category of non-commercial sources of energy.

In India the other possible sources of energy such as— solar energy, tidal power, wind power and geothermal energy are yet largely untapped because limitations of existing knowledge and techniques of these possible new sources, solar energy which seems to have greatest potential in India in the long-run. Conversion of solar energy into electricity can be acheived with the present techniques at a very high cost and will remain extremly limited in our country untill further research work is developed in this field. Potentiality with regard to other new possible sources are also limited and to generate electric power from these sources will be a costly method in comparision to other means of generation. Inspite of high costs and limited technology, a great deal of research and development works is now being under taken in many countries including India.[1] (Henderson, 1975).

The present energy system in India is more or less based on non-commercial sources (such as fuel wood, agricultural wastes and animal dung), and on commercial sources (such as coal, oil and electricity). So far as domestic cooking and heating, non-commercial sources of energy play a very significant role. The domestic needs are largely met, by what are referred to as non-commercial sources of energy.

In India before the advent of coal and other commercial fuels all the thermal energy used to come from non-commercial fuels. In the aggregate, India consumes almost 50 percent of its total energy through use of non-commercial fuels. But commercial fuels surpassed non-commercial fuels in energy generation only as late as 1968. As a result the share of non-commercial energy sources is falling rapidly. In 1970 the contribution was around 52 percent (350 m.t.c.r.*) by commercial energy and 34 percent (178 m.t.c.r.*) by non-commercial energy. The ratio of non-commercial to commercial sources has fallen from 2 : 1 in 1953-54 to 0.77 : 1 in 1975-76. The increasing importance of commercial energy is the result of the increase in the aggregate energy consumption and also of the shift of energy consumption away from the non-commercial sources.

Statistics pertaining to non-commercial energy in India is subject to serious limitations. First, figures

* M.T.C.R. = Metric ton coal replacement.

pertain only to household sector and ignore industrial sector. Second, they are essentially estimates and are derived from certain 'assumptions' regarding per capita household consumption. Third, the inter se shares of fire wood, agricultural waste and animal dungs are again assumed to be constant at 65, 15 and 20 percent respectively. Fourth, animate energy is not taken in to account at all.

Among the various commercial sources of energy, coal is losing to both oil and electricity. Electricity will continue to be the most preferred source of energy at least during the next 10 years. The share of electricity is, thus expected to gain further, Coal is also likely to make up a part of what it lost during the last 25 years. In consequence, the share of oil is unlikely to improve further in the next decade or so. Consumption trend in both commercial and non-commercial sources is shown in table 1.

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Table - 1 : Consumption of Energy (Source wise)

MTCR

Category	1953-54	1965-66	1975-76	1978-79	1979-80	1980-81
1. Non-Commercial	125.9 (67.6)	159.6 (52.1)	194.6 (43.5)	NA	NA	NA
Total of which -						
1.a. Firewood	82.2	103.8	126.5	NA	NA	NA
1.b. Agricultural sastes	25.1	31.9	38.9	NA	NA	NA
1.c. Cow-dung	18.6	23.9	29.2	NA	NA	NA
2. Commercial	60.4 (32.4)	147.0 (47.9)	232.7 (56.5)	294.3 -	303.7 -	312.9 -
Total of which -						
2.a. Coal	28.7	51.8	71.0	68.8	71.4	71.3
2.b. Oil	24.1	64.6	115.7	141.1	145.6	150.1
2.c. Electricity	7.6	30.6	66.0	84.4	86.1	91.5
3. Total (1 + 2)	186.3	306.6	447.3	--	--	--

Source : Economic and Political Weekly, March 13, 1984, Vol. XIX No.13.
Dielemmas of Energy Strategies in India.
Implication for Third World by - D.R.Pendse.

The sector wise and the source wise details of consumption of commercial energy are given in table - 2.

Table - 2 :

Sector wise and Source wise consumption of Commercial energy.

Sectors	Percentage share of different sources of energy			
	Coal	Oil	Electricity	Total
Household				
1953-54	17.3	77.2	5.5	100.0
1965-66	15.5	75.6	8.9	100.0
1978-79	10.0	71.2	18.8	100.0
Agriculture				
1953-54	-	89.0	11.0	100.0
1965-66	-	70.0	30.0	100.0
1978-79	-	61.8	38.2	100.0
Industries				
1953-54	61.5	16.2	22.3	100.0
1965-66	49.5	13.3	37.2	100.0
1978-79	44.5	7.9	47.6	100.0
Transport				
1953-54	56.4	40.8	2.8	100.0
1965-66	34.8	62.9	2.3	100.0
1978-79	13.3	83.9	2.8	100.0
Others				
1953-54	35.3	-	64.7	100.0
1965-66	8.2	23.1	68.7	100.0
1978-79	11.9	36.2	51.9	100.0

Source : Economic and Political Weekly, March 13, 1984. Dilemmas of Energy Straligies in India. Implications for Third World by - D.R. Pendse.

In both the tables No. 1 and 2 above it is seen that the consumption of electricity is increasing rapidly. In table No.1 electric power consumption has been increased by 91.5 in matric tonne coal replacement values in 1980-81 as compared with 7.6 m.t.c.r. in 1953-54. In table 2 consumption of electricity in agricultural sector shows a 60 fold increase from 11 percent in 1953-54 to 38.2 percent in 1978-79. Electricity is increasingly prefered in agriculture because of the fact that agriculture has been accorded a high priority in Indias national planning and the government provides inputs including energy at subsidies prices.

*In domestic sector, energy consumption is related to the purchasing power of consumers and partly related to distribution inadequacy. The level of per capita domestic energy requirement was around 3,000 k. coal per day in rural areas and around 10,500 k. coal per day in urban areas in 1977. Although there is no exact assessment of energy consumed by the domestic sector in India, yet the commercial and non-commercial fuel usage per day in the domestic sector may be roughly taken as[2] (Bondopadhya, 1977).

Source : Commerce Annual Number 1977.
Thermal Energy Development in India.
Constraints and corrections - by - S.B.Bondopadhya.

Urban domestic sector : Commercial fuels 30 (m.t.c.r.)
Non-Commercial fuels 70 (m.t.c.r.)

Rural domestic sector : Commercial fuels 10 (m.t.c.r.)
Non-Commercial fuels 130 (m.t.c.r.)

From the above figures it is found that the urban domestic sector consumes 100 m.t.c.r. and rural domestic sector consumes 140 m.t.c.r. of thermal energy. This represents about 68 percent of total thermal energy. Although about four times more people live in rural areas than in urban areas, the energy consumption is only 1.4 times higher which indicates that urban people use about three times more energy for domestic purposes. The domestic needs are largely met by non-commercial sources of energy. But in urban areas, the basic energy consumption of the residential sector, would be expected to change, and grow in proportion to the total population plus any per capita increase due to increasing affluence and changing life styles.

Taking together the data on commercial and non-commercial per capita energy consumption, the changes which occured in the decade 1963-64 to 1973-74 can be seen in table -3.

Table - 3 : Energy Consumption (per capita) Unit; Tonnes of Coal Replacement.

Year	Commercial				Non-Commercial				
	Coal	Oil	Electricity	Total (Comm.)	Fire Wood	Dung Cake	Vegetable waste	Total (Non-Comm.)	Grant Total
1963-64	0.104	0.127	0.054	0.285	0.242	0.036	0.066	0.344	0.629
1973-74	0.097	0.201	0.096	0.394	0.216	0.063	0.063	0.304	0.698

Source : Commerce Annual Number 1977.
Out look. For Energy in the Coming Decade - by - S.T. Satish Chandran.

The above table makes it clear that during the period of 1963-64 — 1973-74 the annual growth rate of per capita consumption was under 1 percent only. But the rate of growth in commercial sources was more than in the non-commercial sources. The share of commercial in the total energy consumption is increasing steadily. During the period of 1963-64 — 1973-74, the total energy consumption recorded an annual growth rate of 3.3 percent. Commercial energy consumption grew faster at 5.6 percent per annum and the annual growth rate of non-commercial energy consumption was around 1 percent only. Over the 10 years, the share of total energy consumption by commercial sources went up from 45.3 percent to 56.5 percent.

The non-commercial energy consumption, which is mostly in the domestic sector, is difficult to assess correctly due to the lack of definitive data various assumption have to be made to estimate in this regard. Fortunately, the 28th round of the National Sample Survey (N.S.S.) give us some insight into the trends of energy consumption in the domestic sector. Table - 4 sets out the comparative picture of 1963-64 and 1973-74.[3]

(Satish Chandran, 1977)

Table - 4 :

Domestic energy consumption.

Fuel	Estimated consumption during the year in Coal Replacement (Million tonnes)			All India per capita consumption in Coal replacement (tonnes)
	Urban	Rural	Total	
1	2	3	4	5
I. Based on 18th round of NSS (1963-64)				
Commercial				
1. Kerosene	5.644	14.185	19.829	0.043
2. Electricity	0.746	0.137	0.883	0.002
3. Coal	1.099	1.372	2.471	0.005
4. Coke	2.162	0.960	3.122	0.007
5. Charcoal	0.373	0.274	0.647	0.001
Total	10.024	16.928	26.952	0.058
Non-Commercial				
1. Fire Wood	13.684	98.986	112.670	0.242
2. Dung Cake	1.133	15.545	16.678	0.036
Total	14.817	114.531	129.348	0.278
Total Consumption of Energy	24.841	131.459	156.300	0.336

(Urban = 0.296)
(Rural = 0.345)

Contd/- next page

1	2	3	4	5
II. Based on 28th round of NSS (1973-74)				
Commercial				
1. Kerosene	11.162	27.633	38.795	0.067
2. Electricity	2.115	1.052	3.167	0.005
3. Coal	2.086	1.605	3.691	0.006
4. Coke	2.784	2.159	4.943	0.009
5. Charcoal	0.288	0.055	0.343	0.001
6. L.P.G.	0.873	0.747	1.620	0.003
Total	19.308	33.251	52.559	0.091
Non-Commercial				
1. Fire Wood	16.690	108.700	125.390	0.216
2. Dung Cake	1.197	13.153	14.350	0.025
Total	17.887	121.853	139.740	0.241
Total Consumption of Energy	37.195	155.104	192.299	0.332

(Urban = 0.314)

(Rural = 0.336)

Note : MTCR equivalent sare as follows -

	Unit	MTCR
Coke	1 m.t.	1.5
Charcoal	1 m.t.	1.0
Fire Wood	1 m.t.	0.95
Dung Cake	1 m.t.	0.40

Source : Commerce Annual Number 1977.
"Out look for Energy in the Coming Decade", by- Satish Chandran.

The above table shows a higher level of per capita consumption in the rural areas than in the urban areas. The share of non-commercial energy in the domestic sector (including vegetable waste) came down from 85.6 percent in 1963-64 to 77.0 percent in 1973-74. While the per capita fire wood consumption in both rural and urban areas has gone down somewhat,[3] there is a sharp increase in Kerosene consumption. In case of the total per capita energy consumption there appears to be no growth which is significant here, with rising per capita income one can expect a corresponding increase in the level of domestic energy consumption.

With the increase in oil prices since 1973 following the oil price hike in the world market, the consumption trend of Kerosene is expected to go down although during 1963-64— 1973-74 it has shown an increasing trend in domestic sector both in rural and urban areas. Kerosene is going to be substituted by electricity in domestic consumption. A probable change in the pattern of household consumption can be illustrated in table - 5 for the period from 1975-76 to 2000-1.[4]

(Indian Institution of Public Opinion 1981-82).

Table - 5 :

Probable or Projected change in the Pattern of Households using Different Fuels : 1975-2000.
(Percentage)

Fuel	1975-76	1982-83	1987-88	1992-93	2000-01
A. RURAL					
Electricity	4.4	12.9	19.3	27.6	45.2
Kerosene	91.4	84.0	78.8	71.4	53.9
Others	4.2	3.1	1.9	1.0	0.9
Total	100.0	100.0	100.0	100.0	100.0
Number of Households (Million)	90.1	100.9	108.6	116.1	128.3
B. URBAN					
Electricity	42.1	53.0	62.3	73.8	89.2
Kerosene	53.6	45.2	36.9	25.5	10.4
Others	4.3	1.8	0.8	0.7	0.6
Total	100.0	100.0	100.0	100.0	100.0
Number of Households (Million)	26.1	32.1	36.9	42.0	51.7

Source : Quarterly Economic Report of the Indian Institute of Public Opinion, December 1981 - March 1982.

Article: "The Future of Rural Electrification, A Power Projection for Agriculture".

It is seen from the above table that a probable sharp change in the domestic electricity consumption both in rural and urban areas would take place in future. As the table shows, the consumption of electricity in domestic sector would increase from 4.4 percent to 45.2 percent during the period of 1975-2000 in rural households and from 42.1 percent to 89.2 percent during the same period in the urban households. But the share of Kerosene and others are expected to go down as the table shows during 1975-2000.

2.2. Brief description of Fuel resources in India

Coal :

Among fossil fuels coal is placed as a primary sources of fuel in view of the vast resources possessed by India. The total coal production of India was 56 million tonnes in 1960-61 and 76 million tonnes in 1970-71. The production figure has been increased to 114 million tonnes in 1980-81. Published estimates of coal reserves have varied appreciably and much exploratory works has still to be done. Estimated figure of Coal reserves is shown in table 6.

Table - 6 :

Estimated Coal Reserves in India (Million Tonnes).

	Proved Reserves	Other Reserves		Total Reserves
		Indicated	Inferred	
Prime Coking Coal	3,650	1,540	460	5,650
Medium Coking Coal	3,850	4,310	1,270	9,430
Semi and Weekly Coking Coal	1,520	2,600	910	5,030
Total Coking Coal	9,020	8,450	2,650	20,120
Non-Coking Coal	12,340	22,310	26,180	60,830
Total Coal Reserves	21,360	30,760	28,830	80,950

Source : India; The Energy Sector,' P.D.Henderson,1975.

From the above table it can be seen that total estimated reserves of all types of coal are put at about 81 billion tonnes. Out of the Proved reserves about 42 percent consists of cooking and 58 percent of non-cooking coal. The share of non-cooking coal in indicated and in inferred reserves exceeds 80 percent. At present level of out put non-cooking coal, a reserve of this size would be adequate for 350 years to 400 years. The reserve position with respect to cooking coal appears less favourable. Above table shows that the total reserves of prime cooking coal are put at some 6 billion tonnes of which 1.6 billion tonnes can be changed to coke ovens. This is because of losses arising from washing process due to the high ash content.

The coal deposits in India have two related characteristics which create problems both in working and in marketing. The first is seems to be very thick, sometimes exceeding 45 meters. The second one is the high ash content. Average ash content was found to be about 14 percent in earlier years but gradually over times the average ash content has gone up and exceeded over 20 percent at present. However, this should not be a problem, the ash content of South African coal is not less than that of Indian coal, Yet their desulpharisation and eventual production of oil from the coal, the union of South Africa is ahead of any nation in the world. She is prepared for prospective oil blocked.

In India coal deposits are distributed unevenly. There are no coal fields in the north west region of the country except for the small fields in Maharastra and non in the South Indian region except for the Singarine fields in Andhra Pradesh and Neyveli in Tamil Nadu. Hence a high transport cost is necessary if coal is to be supplied to different regions of the country.

The total number of coal fields in India is more than 82 excluding few small fields in Assam, of these, the four largest fields are— Raniganj in West Bengal, Jharia and North Karanpura in Bihar and Singrauli in Madhya Pradesh which account for some five-eights of the total coal reserves. Raniganj and Jharia alone produced about 58 percent of the total out put in 1969-70.

To increase the production of coal in the out lying fields, various attempts has been made over the past yearsso as to minimise the transport costs from Bengal/ Bihar to long distances of other parts of the country. In recent past years the rate of increase in coal production has been well under 5 percent per annum and output increased at an average rate of about 5 percent per annum. The sharprise in oil price after 1973 improved the competitive position of coal and strengthened the reliance on indegeneous fuels.

The progressive growth of coal will be apperent from the production figures in table 7 for the period from 1954 to 1973-74 which is given in sector wise. Type of coal and main coal fields are also included in the table.[5] (Henderson 1975).

Table - 7 :

Coal Production by Sector, Type of Coal and Main Coal Fields, (Million tonnes).

Year	Total production	Share in Total production of—					
		Public Sector	Private Sector	Coking Coal	Non-Coking Coal	Bengal/ Bihar	Outlying fields
1954	37.5	4.0	33.5	13.8	23.7	30.2	7.2
1960-61	55.7	10.6	45.1	16.1	39.6	41.3	14.4
1965-66	67.6	13.6	54.1	17.0	50.7	51.2	16.5
1968-69	71.4	16.5	54.9	17.2	54.2	52.3	19.1
1969-70	75.7	17.5	58.2	18.1	57.6	55.7	20.0
1970-71	72.9	17.8	55.1	17.8	55.1	52.4	20.5
1971-72	72.4	25.3	47.1	16.7	55.7	49.9	22.5
1972-73	77.2	41.3	35.9	16.6	60.6	53.1	24.1
1973-74	77.9	75.3	2.6	15.8	62.1	52.6	25.2

Source : P.D. Henderson, India; The Energy Sector, 1975.

Above table shows that total production of coal has been increased double over the period as a whole. Production from 1972 in public sector has shown a rapid increase and a decreasing trend in private sector. This position acheived as a result of the nationalisation measures adopted by the Union Government to the coal industries.

*Coal mining in India started as far back as in 1874. There were more than 800 coal mines by 1971 producing 70 million tonnes per annum. Nationalisation of the mines allowed their amalgamation and reconstruction into a smaller number of viable units and increase the production to touch the 100 million mark by 1976-77. The total number of operating units in public sector is now over 300 whose average out put may be in order of 240,000 tonnes per year. The increase in production from 100 million tonnes to 200 million tonnes in the next decade needs flexible and effective planning on a long term basis and massive investment programme.[6]

(Mahendran, 1977)

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* Commerce Annual Number, 1977.
  Return of King Coal - by -
  R.G. Mahendran.

Oil and Natural Gas

* From its very inception the oil industry has always provided a variety of challenges. In 1859, an American named Edwin L.Drake drilled the first oil well at Titus-ville in the USA heralding the birth of the modern industry. The exploration for oil is a very risk intensive venture. The success ratio in number of wells drilled is 1 : 7.[7] (S.B.Budhiraja, 1977)

In India, proved reserves of oil are not very satisfactory as compared to coal. In the Pre-independence era the oil industry in India was mostly marketing oriented. There was only one refinery at Digboi in the upper Assam with an annual refining capacity of 0.45 million tonnes per annum for processing the crude oil produced in the nearby Digboi oil fields.

\+ By this time, the total sedimentary area of India both onshore and offshore, comprises about more than 27 basins. The basins are grouped into four main categories of promise. Those with high prospects comprise cambay and a large part of Assam-Arakan basins. The area which falls into this category comes about at some 18 percent of the

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* Commerce Annual Number 1977, Challenges in Oil Industry, by - P.H. Dehderson :

\+ India, The Energy Sector, 1975.

total sedimentary area, onshore and offshore upto the 200 metres isobath line.

A second category with medium prospect comprises 15 percent of the total sedimentary area while the remaining two-thirds of the sedimentary area consists of as fair 40 percent or poor about 27 percent of the total area.

Upto 1974, geological and geo-physical studies have been conducted in 14 of the 27 basins. While exploratory drilling has taken place in nine. The oil bearing reservers are still being dis covered in these producing areas which suggest that further useful deposits of oil remain to be found.

Production of crude oil in India is at present concentrated in a small number of fields. It was estimated that in 1973 well over 90 percent of out-put came from the six main producing fields. The prominent two are Ankleshwar in Gujarat which is operated by the public sector oil and Natural Gas Commission (ONGC) and Naharkatiya in upper Assam, which is operated by Oil India Limited, a joint sector enterprise in which 50 percent shares each are held by the Government of India and Burmah Oil Company (Now taken up by Oil India Limited).

The cost of finding, producing and distributing oil depend on variety of fectors including the difficulties of the terrain, the depth and accessibility of oil deposits and the productivity of producing wells. In most of these respects the Gujarat fields are more favourably placed than those of Assam. The Assam fields are relatively inaccessible and distant from markets. The average depth of wells in the onshore cambay basins is just under 1,700 meters (5,500 feet), while the corresponding figure for Assam is over 3,300 meters (10,800 feet). Annual production per well is generally higher in Gujarat than in Assam. For India as a whole, productivity average about 270 barrels per day. This is low compared with big Middle Eastern Fields.[8]

(Henderson , 1975)

* The production of crude oil both from onshore and offshore rose to 14.37 million tonnes in 1981 as against 9.39 million tonnes in 1980. The production during 1979 was 12.84 million tonnes. In 1982, the total production was increased to about 21 million tonnes. The production during 1980 declined as a result of agitation on the foreigners issue in Assam leading to the blockade of oil pipe lines and installations.

* Notable achievements in the onshore operations in 1981 was thediscovery of crude oil in Sisodra in Gujarat, Napamua and Naharkatiya in Assam. In the offshore operation

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* Fresh Momentum in India's Development (1980-82)
* Directorate of advertising and visual publicity, Ministry of Information and Broadcasting, Govt. of India, Printed at Kuldip Press, New Delhi.

oil and gas were discovered in the first well drilled in Northern Palk-strait in the offshore Cauvery basin. Oil was also discovered at a new structure, located about 35 kms. to the east of the Bombay High in field. Further wells are being drilled to assess the production potential of these two new fields.

The indigeneous production of oil during 1982 was expected to meet nearby 60 percent of the demand. The crude oil availability with in the country was expected to be 20.5 million tonnes against the expected demand of 35.3 million tonnes. Petrolium products to be imported during 1982 was expected to be about 4 million tonnes. Fortunately, a rapid development in oil production has taken place during the last two years. Against the target of 20.5 million tonnes in 1982, production figure went to about 21 million tonnes in 1982-83. Refining capacity expanded to about 37.5 million tonnes of through put.

In the Sixth Five Year Plan, the Oil and Natural Gas Commission (ONGC) had a terget of production of 25 million tonnes per year by 1984-85. A 20 year perspective plan is also being prepared for oil exploration and production.[9] (Fresh Momentum, 1980-82).

The refining capacities of different indigeneous locations in India can be seen from the table 8.

Table - 8 :

Capacities of Oil Production indifferent location (in million tonnes)

Location	Capacity of Production per annum
Bombay	9.0
Vizag	2.0
Kayali	4.3
Barauni	2.4
Haldia	2.5
Cochin	3.3
Madras	2.6
Digboi	0.5
Guwahati	0.8
Bongaigaon	1.0

Source : Economic & Political Weekly, July 27, 1974,

Article: The 'Oil Crises', An Economic Analysis and Policy Imperatives, by - Ramesh Bhatia.

The increase in indigeneous refining capacity led us to greater self reliance in oil supplies. The import of oil products has been decreased since 1976 and particularly in 1980-81 our imports in volumetric terms began to decline.

Natural gas

Since oil reserves are very limited and very precious, its conservation for limited usage requires serious consideration. In domestic sector consumption of oil can be replaced by gas tobe used as fuel. Gas can be used for power generation and for industrial use like fertilizer production.

The gas-oil production ratio trends to be low in India but the out put has been increased in the past recent years.[10] (Prasad, 1977).

But production and consumption of gas are at a low rate as given in the following table 9.

Table - 9 :

Gas production and consumption

Year	Production in (billion c.u.m.)	Consumption in (billion c.u.m)	Percentage utilised	Estimated daily rate of production (million c.u.m.)
1970	1424	676	47.4	3.90
1971	1509	763	50.5	4.13
1972	1564	926	59.2	4.28
1973	1674	912	54.4	4.58
1974	1917	1009	52.6	5.25
1975	2300	1252	54.2	6.32
1976	2409	1512	62.7	6.60

Source : Commerce Annual Number 1977, 'Future of the growth of Oil Production industry in India, by - B.N.Prasad.

Above table shows that both production and consumption figures has been increased. But rate of consumption is faster than the rate of production which marked more than two times in 1976 as compared with 1970. It was 62.7 percent utilisation of the total production. But the utilisation figure is not still satisfactory, because about one-third of the gas production are being burntout.

Steps are being taken to utilise gas in the estern region for fertilizer production and power generation. Submarine lines are being laid for brining the offshore gas to the main land. The main achievements in the on-shore operations in 1981 was the discovery of natural gas in Kudara in Ankleshwar (Gujarat), Baramura in Tripura. In the off-shore operation the discovery was of hydrocarbons in two newareas. Oil and gas were discovered in the first well drilled in the Northern Palk Strait in the off-shore Cauvery Basin.

In domestic sector to reduce consumptiom of kerosene which is used for cooking and lighting should replaced by more utilisation of gas. In 1973-75 only 75 percent of the available LPG could be utilised due to a bottleneck in the availability of cylinders for domestic distribution. However LPG marketing would through a challenge before the oil companies during the years 1977-78—1981-82 when its availability was to be increased three fold as per details given in the table 10 below.

Table - 10 :

L.P.G. availability.

Year	Availability
1977-78	365,000 tonnes
1979-80	560,000 tonnes
1980-81	763,000 tonnes
1981-82	931,000 tonnes

Source : Commerce Annual Number, 1977.
Future of the Growth of Oil Production Industry in India, by - B.N. Prasad.

Hydroelectric Power

* Hydroelectric power plays a major role in the field of power development in the country. Its contribution in the total electricity generation to be about more than 40 percent. Electricity is the most preferred from of energy on account of the versality and cleanliness associated with its handling and utilisation. It is the cheapest and continually renewable source as compared to fossil sources of power which are limited. Hydroelectric stations have a relatively long life and quick set-up and rapid response to change in demand.

India has abundant sources of hydroelectric power. According to the report of Central Water and Power Commission (CWPC) there are economically utilisable hydro power potential at 25.26 million K.W.. Corresponding to annual energy generation to 221 TWh. On the basis of CWPC's hydroelectric potential only about 16 percent had so far been developed in the country. It was estimated that by the end of 1983-84 the exploitation of the potential would be increased to over 28 percent. The region wise distribution of assessed hydroelectric potential and its anticipated development at different points indicated in the table-11.[11]

(K.S.Subramanium, 1977).

Table - 11 : Regionwise distribution of assessed hydroelectric potential.

Region	Total potential as per hydro-electric survey (mw cent)	Potential developed at the end of the IVth Plan (mw cent)	Anticipated power development polution		Percentage of anticipated development at the end of VI Plan
			At the end of the V Plan (mw cent)	At the end of the VIth plan (mw cent)	
Northern	6,438.9	903.0	1,675.7	2,170.6	33.71
Western	4,301.3	538.7	678.5	767.5	17.84
Southern	4,858.2	1,541.0	2,234.0	3,448.7	70.99
Eastern	2,180.2	300.6	361.9	651.9	29.90
North-Eastern	7,478.6	22.5	40.2	145.2	1.94
All India	25,257.2	3,305.2	4,990.3	7,183.9	28.44

Source : Commerce Annual Number , 1977.
Hydro-electric development in India,
by - K.S. Subramanium.

It is observed in the table 11 that the main coal producing eastern region is not well endowed with hydro resources. On the other hand the Northern, Southern and North-eastern region which have practically no coal reserves are rich in hydel resources. It is important to note that hydro potential in the North-eastern region remains undeveloped. The primary reason for the slow rate of exploitation is the lack of power requirements.

* There has been all round improvement in the power sector of the country since 1980. During the year 1980-81, a total of 1,11,566 million units of energy was generated as against 1,05,532 million units during the previous year 1979-80. This presented an increase of 5.7 percent in every generation during 1980-81. Thermal generation increased by 8.5 percent, nuclear generation by 4.5 percent and hydro generation by 2.3 percent as compared to the generation in 1979-80.[12]

(Fresh Momentum 1980-82)

Power consumption has also been increased during the last few years. Consumption of electric power is more in domestic sector than in the commercial sector. In 1973-74

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* Fresh Momentum in India's Development (1980-82), Statistical Abstract of Assam, 1978, Directorate of Economics and Statistics, Govt. of Assam.

the figure of total domestic power consumption was 4,645 million K.Wh. and total consumption figure in commercial sector was 2,988 million K.Wh. of the total 63,974 MKH electric power generation of the country. However, per capita electric power in domestic sector did not mark any significant improvement.[13]

(Statistical Abstract, Assam, 1978)

Estimated total electricity consumption in 1963-64 for domestic sector both in urban and rural areas was 0.883 million tonnes in coal replacement values. The figure went upto 3.167 million tonnes (m.t.c.r.) in 1973-74. But all India per capita domestic electricity consumption were 0.002 tonnes c.r. and 0.005 tonnes c.r. in 1963-64 and 1973-74 respectively. The figures show a slow rate of growth in per capita domestic electric power consumption during the decade 1963-64—1973-74. This may be for the low per capita income of the rural households as household in urban areas consums more than the rural households. However, total per capita electric power consumption has been increased and in 1979-80 it was 1304.8 KHW.[14]

(Statistical Hand Book, Assam, 1982)

* Statistical Hand Book, Assam, 1982, Directorate of Economics and Statistics, Govt. of Assam, Guwahati.

Electric power consumption has been increased during the recent past years particularly in rural domestic sectors. Earlier it was restricted to urban centres for domestic lighting and industries. But with the process of modernisation, increase in productivity and agriculture and improvement in the quality of life people demand more electric power both in urban and rural areas. A probable change in the pattern of power consumption by domestic households both in urban and rural areas can be seen from the table 5 mentioned earlier to which shows a rapid increase may take place in electric power consumption shifting away from other commercial powers of energy.

Nuclear Fuels

Source of nuclear fuels in India is uranium and thorium. Uranium is used for generating electric power. It is found mainly in the Singbhum district of Bihar. The latest estimate of the total uranium resource in India is about 52,000 tonnes and about 320,000 tonnes of thorium upto 1976.

For increasing the available resources of nuclear fuels arises from the development of Fast Breeder Reacters. In Fast Breeder system, the conversion of the fertile material is extremely efficient where about 1.2 to 1.5 new fissile atoms are produced from the fertile. This implies that practically all the uranium can be burnt to produce electricity and can extract as much as $7 \times 10.^{6}$ KWH of electricity from 1 Kg. of uranium. In breeder systems, thorium can also be used efficiently as a fertile material to breed U^{233}, which is a good nuclear fuel.

The energy potential from the coal deposits and from the uranium and thorium deposits in India are compared in the table - 12.[15] (R. Ramanna, 1977).

Table - 12 :

Energy potential from Coal and Nuclear fuels.

Fuel	Energy KWH (e)
Coal -	160×10^{12}
Uranium in Thermal Reactors -	7.2×10^{12}
Uranium in Fast Reactor	208×10^{12}
Thorium in Thermal Reactor	0
Therium in Fast Rector	1280×10^{12}

Source : Commerce Annual Number, 1977.
'Article', 'Inevitablity of Atomic Energy in India's Power Programme', by - R. Ramanna.

Although India entered the nuclear age almost at the same time as some of the Western countries, our nuclear power development has been quite slow. To-day we have three reactors at Tarapur in Maharashtra and Kota in Rajasthan giving 600 MW power. When the forth reactor at Rajasthan and power stations at Madras and Naroya in Uttar Pradesh are completed and Commissioned, the total installed nuclear capacity will be 1,400 M.W.

Indias resources of natural uranium are limited and are barely enough to support a power programme of 5,000 to 6,000 M.W. The large thorium resources the country possesses can be utilised only when the fast breeder technology is developed and this is why the Atomic Energy Commission lays emphasis on research on fast breeders.[16] (V.Dagli, 1977)

The basic philosophy behind India's nuclear power programme is to make use of the existing limited quality of natural uranium. Growth of installed nuclear capacity is bound to be relatively slow at the beginning. Nuclear power technology requires a special infra structure since many of the components and requirement have to be manufactured for the first time in India.

At present much importance is given for developing nuclear power and built-up the capability to establish nuclear power plants. Though the share of nuclear power is only 2 percent this sector represents our determination to pursue all alternative paths available to increase energy supply. Progress is going to make in R. & D. Programme to develope the Fast Breeder Reactors technology to make nuclear power programme self-sustaining in India.

Non-Commercial Fuels

In India the domestic needs are largely met by what are referred to as non-commercial sources of energy. The main sources of non-commercial fuel are fire wood, char coal, dried cow dung and vegetable wastes, of these, firewood considers to be the main item of domestic fuel consumption. But there is no precise estimate of the fuel wood reserves in India. The Fuel Policy Committee of the Department of Science and Technology has estimated a demand of 132 million tonnes of fire wood in 1978-79. The total availability from recorded felling of wood in forests is expected to be 35 million tonnes. This leaves a huge gap of 97 million tonnes. That would probably be made up by unauthorised cutting of trees. Such deforestation will lead to very drastic ecological consequences which is undesirable.

The crisis of fire wood led people to look for an alternative source resulting in increasing use of dung for fuel a very dangerous substitute. Between 300 to 400 million tonnes of wet-dung which shrinks to 60 to 80 million tonnes when dried is annually burned in India; robbing farm land of badly needed nutrients and organic matter. The plant nutrients wasted annually in this fashion equal more than a third of the country's Chemical fertiliser use.

There is a need to identify develop and popularise various alternatives for meeting energy needs of domestic sector. Emphasis has to be on local, decentralised and ecologically sound sources of energy. It is important to keep the long term perspective in mind and ensure that renewable sources play the most important role in the domestic sector of India.[17] (N. Amin, 1977)

The non-commercial energy sector has been given less importance in Indian energy planning. To estimate non-commercial energy consumption in the domestic sector, various assumptions have to be made. This is due to non-availability of definitive data. The estimated consumption of non-commercial fuel in India is shown in table 13.

Table - 13 :

Estimated consumption of non-commercial fuels in India in 1970-71.

	Amount Consumed		Relative share of consumption in MTCR (%).
	Original Units	MTCR*	
Firewood and Charcoal	126	120	65
Dried Cow-dung	68	27	15
Vegetable Wastes	39	37	20
Total	233	184	100

Source : Henderson, P.D., India : The Energy Sector, Oxfored University Press, New Delhi, 1975.

* Metric Tons Coal equivalent.

Above table makes it clear that about two-third of the estimated consumption of non-commercial fuels in terms of coal replacement values consists of firewood, Cow-dung accounts for 15 percent and remaining 20 percent consists of vegetable wastes.

In view of the above the prominent alternative sources of energy seem to be quite promising are firewood plantations bio-gas plants. The cooking needs which mostly rely on wood fuel, dung cake and agricultural wastes can be met by the use of bio-gas. The other non-commercial sources of energy such as Solar, Wind, Tidal and Geothermal energy are still in the process of development. Undoubtedly Solar energy holds out high potential as a replenishable source of energy in the long-run.

Chapter - III

SOURCES AND USE OF DOMESTIC FUEL IN ASSAM

3.1. A short Historical Survey :

The North-Eastern States comprising Assam, Meghalaya, Nagaland, Tripura, Mizoram, Manipur and Arunachal Pradesh are among the most backward States in the country. Amongst the States in the North-Eastern Region, Assam is comparatively ahead in economic development mainly due to availability of natural resources like oil, natural gas, and coal and also because of favourable climatic and soil conditions suitable for tea etc.

The State of Assam covers a vast area and the distance between the eastern and the western tips of the state is quite considerable. The power development has, therefore, taken place separately in Upper Assam and in Lower Assam. The Upper Assam system is fed from the Namrup thermal power station based on natural gas and the Lower Assam system draws power from the oil-fired unit at Chandrapur near Guwahati. Bongaigaon Thermal Power Station (Salakati) based on Coal fired and also from the Umium Umtru Hydro-Electric Power system of Meghalaya.[1] (B.Phukan, 1977)

Supply of Commercial energy in Assam is made mainly from hydro, coal, oil and natural gas resources. Development of hydro power in North-Eastern Region started as early as 1922 with an installation of 3 x 100 K.W. water turbines by Shillong Hydro-Electric Company.

After a long gap, Umtru Hydro-Electric Project was Commissioned in 1957 with an installed capacity of 8.4 M.W. Since then a few more Hydro-Projects have been taken up and present installed capacity of Hydro-Power in North-Eastern Region stands at 173 M.W. including Micro-hydel generation.

Assam is rich in abundant sources of energy. The river Brahmaputra flows through the heart of the state and divides it horizontally into two parts. Upper Velleys of Brahmaputra, particularly in Arunachal Pradesh, have vast Hydro-electric potential which has been estimated to be of the order of 12,000 M.W.

A systematic study of Hydro-potential indicates that three storage reservoirs built across Dihang, Subansiri and Barak alone can produce an installed generation capacity of 26,000 M.W., besides providing Flood Control, Irrigation and Navigation benefits. Technical feasibility of the storage dams have been established by the investigating authority. These Hydro-electric Project sites require detailed investigations and this potential has so far remained untapped. Efficient exploitation of these sites require concerted efforts.

In Assam the first drilling for oil began in 1866 near Jaipur, a place about 30 miles south-west of Digboi. Drilling for oil started in 1889 and completed in 1890 at a depth of 662 feet. In 1898 a separate oil company was formed for oil operation and it was named "Assam Oil Company Ltd". A small refinary was installed at Digboi Commissioned in 1901.[2] (Shamsul Islam, Gauhati University ,1980). The Digboi oil field is the world's oldest oil field. The oil was struck on October 19, 1889 at a depth of 178 feet.

Intensification of search for oil and gas field has led to new discoveries in Naharkatia, Moran, Jorajan, Kharsang, Borhola, Lakwa, Geleki, and Rudra-Sagar. As per estimates, these fields have a reserve of 93 million tonns of oil and 71 billion standard M^3 of natural gas. These account for 19.70% and 16.90% of India's total (on shore + off shore) reserve of oil and natural gas respectively. Search for new fields is still continued.

Since oil and gas reserves are very limited and these are very precious fuels, their conservation for limited usage require serious considerations.

3.2. CONVENTIONAL SOURCES OF ENERGY:

Coal :

Commercial coal mining in Assam started about 100 years back for supplying to the tea industries, railways and brick fields. Later the tea industry has suitched over to electric power and the railways have suitched over to diesel. As a result growth in utilisation of coal in this region did not show any encouraging trend. As against 0.20 million tonns production in 1900 A.D., 1981 production stands at 0.64 million tonne only.

From the stand point of conservation aspects this can be treated as a favourable sign. Out of the two coal belts in the N.E. Region, one along south central part of Meghalaya and the other along Assam-Nagaland Border. The second belt alone accounts for a reserve of 356 million tonne upto a depth of 300 meters. Studies made by various expert committees indicate that there is distinct possibility of producing metalurgical cake and synthetic crude, where India is largely dependent on import.

There are large proven coal deposits in the state of Assam and a substantial portion of this is situated in the Makum Coal fields in the Upper Assam. The proven reserves of these fields have been estimated to be about 114 million tonnes and less than 25 million tonnes are reported to have been raised sofar. Despite these large deposits, Assam Coal has not yet been used for generation of power because of the ecological and technological problems. Posed by its high sulphur content and low ash fusion temperature. It may be noted in this regard that coal for the Bongaigaon (Salakati) TPS is obtained from the Bengal/Bihar belt of Coal mines.

However, a working group constituted by the Union Government has made an indepth study of the problem associated with burning of higher sulphur Assam Coal and has recommended that this coal can be satisfactorily used for generation of power utilising indigeneous technology. For Assam, this is of special significance because it means economic exploitation of the large reserves of coal hitherto lying un-utilised and thus convert this apperant liability to a national asset.

Production of Coal, Crud oil and Natural gas in Assam can be seen from the Table 1.

Table - 1 :

Production of Coal, Crud Oil and Natural Gas in Assam.

Year	Coal (000 Tonnes)	Crud Oil (000 Tonnes)	Natural Gas (Utilised) (Million Cubic Meter)
1	2	3	4
1974	507	3735	539
1975	582	4190	621
1976	558	4296	848
1977	610	4475	824
1978	649	4084	591
1979	584	4565	942
1980	579	1055	455
1981 (P)	651	4386	869

Source : Statistical Hand Book, Assam, Directorate of Economics and Statistics, Govt. of Assam, Gauhati.

In spite of her power potential based on hydel, natural gas, oil and coal resources Assam lags behind the rest of the country in respect of generation and consumption of power. At present Assam accounts for a little over 1 percent of the country's total installed power capacity. In 1980-81 the average per capita consumption of power was a meagre 33 units compared to 130 units for the country as a whole. Similarly, in respect of rural electrification only 30 percent of the villages was electrified upto the end of 1981-82.

Installed Capacity :

At the end of 1979-80 Assam had a total installed power capacity of 141.5 M.W. only (111.5 M.W. from Namrup Thermal Project and 30 M.W. from Chandrapur Thermal Project). This increased to 201.5 M.W. at the end of 1980-81 following commissioning of the first unit of Bongaigaon Thermal Power Station (60 M.W.) with effect from 26th February 1981. It was during 1981-82 that the power position in the state improved considerably with the addition of a total installed capacity of 111 M.W. and thus bringing the total installed capacity to 312.5 M.W. at the end of March, 1982. The additional installed capacity of 111 M.W. came from the following projects.

Second unit of Bongaigaon Thermal Power Station (60 M.W.), two units of Lakwa Thermal Power Station(2x15 M.W.), three units of Mobile Gas Turbine Sets (3 x 3 M.W.) at Geleky and four units of Mobile Gas Turbine Sets (3 x 4 M.W.) at Kathalguri in Upper Assam. It is worth mentioning here that the installation of mobile gas turbine sets in Assam is the first of its kind in the country. Total installed capacity of Generating Plants of the state are shown in Table 2.

Table - 2 :

Installed Capacity of Electricity in Assam.

	Total Installed Capacity of Generating Plants in (M.W.)		
Period	Thermal	Diesel/Oil	Total
1	2	3	4
1976-77	141.5	20.2	161.7
1977-78	141.5	10.0	151.5
1978-79	141.5	10.0	151.5
1979-80	141.5	10.0	151.5
1980-81	141.5	10.0	151.5
1981-82 (P)	312.5	10.0 (a)	322.5

Note : (a) Total Diesel capacity of all sets is about 20.2 M.W. but the capacity of sets in operation is about 10.0 M.W.

Source : Statistical Hand Book, Assam, 1982, Directorate of Economics and Statistics, Govt. of Assam, Gauhati.

Even though the installed capacity of power in the state went up considerably over the last two years, the gap between availability and the demand for power is still very wide. As against the estimated load demand of 462 M.W. in 1981-82, the generation capacity during the year was 312.5 M.W. The Sixth Plan terget was to raise the generating installed capacity to 501.5 M.W. and if this terget can be achieved, the average per capita consumption is likely to be around 90 units by the end of the Plan. Some of the on going power schemes in the state are— Expansion of Bongaigaon Thermal Power Station (2 x 60 M.W.), Namrup Waste Heat Power Project, the first of its kind in the country (22 M.W.), extention of Chandrapur Thermal Power Station (30 M.W.), Karbi Longpi Hydro-Electric Project (2 x 50 M.W.) etc. In addition, the Kopili Hydro-Electric Project (250 M.W.) under taken by the NEEPCO (North-Eastern Electric Power Corporation) is nearly its completion and is expected to improve the power supply position in the state to a great extent in the near future.

Power Generation :

The generation of electricity in Assam which showed decline for two successive years i.e. in 1979-80 and 1980-81, however, increased substantially in 1981-82. The total generation was 728 million K.Wh. in 1981-82 as against 465 million K.Wh. in 1980-81 and 513 million K.Wh. in 1979-80. The generation during 1981-82 would have been much higher but for the breakdown of the Chandrapur Thermal Power Station for about a year.

The following table number 3 shows the generation of electricity in Assam over the past few years.

Table - 3 :

Generation of Electricity in Assam.

Total Units Generated (in Million K.Wh.)				
Period	Thermal	Diesel/Oil	Total	Power Purchase
1975-76	-	-	449.37	-
1976-77	581.50	4.50	586.00	124.80
1977-78	586.65	2.00	588.65	172.75
1978-79	656.52	2.00	658.52	154.21
1979-80	512.99	-	512.99	269.43
1980-81	462.20	2.48	464.68	347.17
1981-82(P)	726.05	2.00	728.05	350.32

Source : Statistical Hand Book, Assam, 1982.

During 1981-82, Assam purchased about 350 million units of power as against 347.17 million units in 1980-81 and 269.43 million units in 1979-80. It is potential to note that although the state continued to recieve power from out side sources (Meghalaya), the Assam State Electricity Board also supplied Power to Arunachal Pradesh, Nagaland, Manipur, Tripura and Bhutan.

Power supply position in 1981-82 :

The power supply position in the State during 1981-82 was not much comfortable. Peak load restriction and power cut ranging from 10 percent to 20 percent were in force almost throughout the year. The position detoriorated further during December 1981 when the Assam State Electricity Board had to resort to serve load shedding in the lower Assam area as a result of depletion in supply of power from Meghalaya.[3] (Economic Survey, Assam, 1981-82)

Pattern of Power Consumption :

In Assam the industrial sector (including tea factories) account for the major portion of total consumption of power. During 1981-82 this sector utilised about 61 percent of the States' total power consumption. The pattern of consumption of electricity for the past few years is shown in the following table No.4.

Table - 4 :

Consumption of Electricity in Assam (Percentage)

Sector	1975-76	1979-80	1980-81	1981-82 (P)
1	2	3	4	5
1. Domestic light and Fan	40.54	57.70	65.00	69.00
2. Domestic Heat and Small Power	4.10			
3. Commercial Heat and Small Power	4.30	28.60	30.00	36.00
4. Commercial light and Fan	16.60			
5. Industrial Power at Low & Medium Voltage	53.65	60.20	61.00	67.00
6. Industrial Power at High Voltage	165.31	276.90	245.00	322.29
7. Public Lighting	2.23	7.30	8.00	12.00
8. Irrigation and Agri-culture Watering	5.00	2.90	4.00	8.00
9. Public Water works & Sewage Pumping	10.21	14.40	15.00	20.00
10. Tea Garden etc.	76.86	95.40	99.71	120.00
11. Bulk supply including defence licences and free suplly to Boards' Employees	91.12	105.60	110.60	98.00

Source : Economics Survey, Assam, 1981-82, Directorate of Economics & Statistics, Government of Assam, Guwahati.

The Assam State Electricity Board (ASEB) is adding another 158 M.W. to its installed capacity during the current financial year. This will raise the ASEB's total installed capacity to 486.50 M.W. by next March, 1985 as against 328.5 M.W. in March 1984.

Out of 158 M.W., a total of 120 M.W. will be available from the two units of the Bongaigaon Thermal Power Station. These two units were scheduled for commissioning in September 1984 and March 1985 respectively. The ASEB heat unit now under construction in the Numrup Thermal Power Station will contribute 22 M.W. constructed at a cost of Rs.15 crore the unit was scheduled for commissioning by the end of August, 1984.

The fourth 15 M.W. unit at the Lakuwa Thermal Power Project sanctioned in March 1982, at an estimated cost of Rs.6.21 crore will provide 13 M.W. This unit was expected to be commissioned in January 1985. Two units of the Bordikharu Micro-Hydel Project, of 500 K.W. each, were commissioned in 1983-84. The third unit was commissioned in April 1984. This incidentally happens to be the only Hydel Station of the Board.

The Assam State Electricity Board has shown definit progress during its 26th year ending on March 31, 1984 in different fields of its activities. In fact, it has created records in generation rural electrification and revenue earnings surpassing its achievements during the last three years of the 6th Five Year Plan.

In the field of generation, the ASEB, achieved an all time high in 1983-84 by generating 966.99 million units against a terget of 975 million units. In the earlier three years viz., 1980-81. 1981-82 and 1982-83, achievements in generation were 646.68, 726.12 and 896.24 against terget of 670, 834 and 1177 million units respectively. For the year 1984-85, the ASEB has set a terget of generating 1224 million units and with the expected addition of 158 M.W. installed capacity during this year, achieving the terget seems possible.

The ASEB achieved significant results in expansion of electricity to the villages during 1983-84. Against a revised terget of electrifying 2504 villages during the year, mid way during the year itself the ASEB has so far electrified 2014 villages, an achievement of 80.43 percent.

In revenue earning also 1983-84 created a new record for the ASEB when it earned a total revenue of Rs.55.39 crore against a terget of Rs.54.17 crore. During the earlier three years (1980-81) to (1982-83), the ASEB's revenue receipts were Rs.24.32 crore, Rs.44.11 crore and Rs.49.48 crore against tergets of Rs.28.10 crore, Rs.51.19 crore and Rs.51.78 crore respectively.

Spirited with the earnings rising by about Rs.6 crore during the last financial year, the ASEB has planned to set a still higher terget of Rs.62.73 crore for the current year.

It is expected that with concerned efforts the ASEB would be able to achieve the terget in view of the increase in sale of power.[4] (News Star, - Agust, 1984)

The Oil and Natural Gas Commission (ONGC) has envisaged a gas-grid to fully utilise the natural gas available in the Eastern Region. The scheme involves compression of moderately high pressure at each group gathering station of Rudra-Sagar, Geleki and Lakuwa Central Tank Farm (CTF) for further supply the Assam State Electricity Board and the Hindustan Fertilizer Corporation, Namrup.

The ONGC proposes to probe a few promising structure prospects identified near Nazira depression. These are Bersilla, Laxmijan and Tiru Hills. Besides, the integration of the surface and sub-surface data collected so far from different parts of the Assam-Arakan basin has provided adequate land in formulating programme of further exploration.

The recent exploratory efforts of ONGC have indicated a good potential in Dhansiri Valley in Assam and foot-hills in Nagaland. These structures Marigaon and Khoraghat in Assam and Chumukedima in Nagaland are being taken up for exploratory drilling during financial year 1984-85. Plans are under way to drill a parametric well in the north bank of the Brahmaputra in Assam and an exploratory well in Khasimora in Meghalaya. It also proposes to take up exploratory drilling at Kanchanpur and Masimpur in Cachar in the near future.[5] (The Sentinel, September'84)

The accumulative oil despatches in the eastern region till March 1984 last total about 15.15 million tonnes crude is being despatched to Gauhati, Barauni and Bongaigaon refineries through Oil India's Pipe line. In the eastern region ONGC has seven group gathering station (GGC) and four Central Tank Farms (CTF). Two additional GGS, one each at Lakuwa and Geleki fields are under construction.

ONGC is now operating four of its Oil Pipe lines for transportation of crude to its terminals at Moran and Jorhat for its onward pumping to Gauhati, Barauni and Bongaigaon refineries through OIL's Pipe line. One more pipe line of 43 Km. length and 12 inches diameter from Borholla at Jorhat is also under construction.

From our sad experience in the past it is clear that if Assam and the North Eastern Region are to keep place with rest of the country in economic development, it is absolutely essential to formulate a perspective plan for power. For Assam, the future for power development lies in our capacity to (a) successfully harness the immense hydro-electric potential of the region and (b) efficiently utilise the vast reserves of Assam Coal.

The Oil and Natural Gas Commission has taken up an ambitious plan of raising the production potential of crude oil to 6 million tonnes per year by the end of the 7th Five Year Plan. The Commission plans to drill 1560,000 meters through 525 wells during the plan period. During the 7th Plan Period the ONGC will spend an amount of Rs.563.31 crores in the eastern region for exploratory drilling. Another amount of Rs.366.57 crores has been earmarked for development of probable reserves. A total sum of Rs.1463.37 crores will be spent in the eastern region during the 7th plan under the heads survey, exploratory drilling, development drilling of known reserves and development of probable reserves.

The ONGC had already drilled 450 wells with a total meterage of 1.5 million meters by the end of March 1984. The crude oil production has stipped upto 2.25 million tonnes per year from a meagre 0.03 million tonnes in 1966. At present 22 deep rings are in operation, including two in Cachar. The ring strength is likely to increase to 25 by the end of the 7th Plan.

The quantity of crude oil despatched had registered considerable increase from 0.442 million tonnes in 1980-81 to 2.180 million tonnes in 1983-84. The cumulative oil despatch since inception till March 31st, 1984 stood at 15.15 million tonnes.

It may be mentioned here that the fate of Assam in the distribution of oil is determined by the Union Government. During the Assam movement of foreigners issue, it was a common talk among the Assamese people that Assam produced at least 50 percent oil of total national production. But why they should deprived of their share of minimum requirements. This feeling occupied an important place during movement against Central Government leading to blockade of Oil Pipe lines from Assam to Barauni in Bihar. Things must not be judged by emotion, as oil being the national wealth must be utilised by other states, wherever it may produced within the national boundary. Nevertheless, the movement leaders used oil blockade for political bargains in solving the problem of foreign national. Ofcourse Oil and Natural Gas Commission could not drill oil in Nagaland as there was a contract between Centre and Nagaland Government at the time of Fizo. This contract prevented Central Government from not to utilise oil of Nagaland. This is not equally justified with the Assam because Nagaland is also a state of India and every natural resource of Nagaland must be utilised by the Centre. Keeping in view of insurgency going unabated in Nagaland, the Centre is not likely to take risk in exploiting the oil fields.

With a view to fully utilising the natural gas in this region, a gas grid had been envisaged. The scheme involves compression of low and high pressure gas at each group gathering station of Rudra-Sagar, Geleki and Lakuwa for further supply to ASEB and Hindustan Fertilizer Corporation.

Assam Government had decided to supply Pipe line gas to domestic users from the ONGC Rudra-Sagar oil fields in Sibsagar district where gas wastage amounted to about Rs.60 lakhs per day. It was also thinking of utilising the gas for the proposed fertilizer plant.

3.3. Non-Conventional and other Renewable Sources of Energy :

Renewable sources of energy are still playing a dominant role in supplying energy for domestic consumption. In the rural sector, fire wood, agricultural wastes and cow-dung cakes are still used as a major source of energy. In urban household sector, fire wood is considered to be a major source of energy and used in a larger proportion compared to other fuel by the domestic sector. Before the invent of commercial energy, both rural and urban households used renewable sources of energy for domestic consumption. Since recent past bio-gas plant particularly gobar-gas plants are popularised among the domestic sector both in rural and urban areas. More gobar-gas plants are being set up in rural areas by government effort. This is very essential because availability of fire wood is reducing day by day.

The most urgent problem faced by the households is the inadequacy of fuel. Fire wood is becoming very scarce and where ever it is available the price is very high. Kerosene is also not available to the require extent. Apart from its scarcity, it is becoming costlier day by day. In this context dried cow-dung becomes the main source of fuel in rural house-holds for domestic use. In urban households sector although use of dried cow-dung is not found sufficiently yet it uses as input in the gobar-gas plant.

Cattle-dung contains a rich source of energy which can be extracted and used as fuel. To extract this , it should pass through what is popularly called "The Gobar-Gas Plant". The gobar-gas plant takes away from the cow-dung the mathane which can be stored in a gas holder and leave ramnants as a sturry very rich in nitrogen and humas. So it is possible to get both fuel and organic manure from the cow-dung by which household miseries can be solved to some extent.

Among the other benefits, the expenditure on fire wood and kerosine can be saved by using gobar-gas. It is easy to handle and ensures less chance of accident. Gobar-gas is preferable due to its cleanness and time saving also. Besides individual household benefits, it renders social benefits also. By installing gobar-gas plants social environment can also be developed. Moreover it helps to conservation of forest. Therefore social need for bio-gas-plants can not be less emphasised.

According to 1976-77 accounts, Assam has only 21 percent reserved forests out of total land area which is not sufficient for maintaining healthy climate. In such a situation felling trees is not desireable as it leads ecological imbalance. So the need for bio-gas-plants has been felt like other states of India. According to 1972 Census, the number of bullock and buffalo population in Assam was 56.10 lakh and 4.88 lakh respectively. Green gobar from this cattle population was estimated to be 33.500 tonne daily from which about 12.35 lakh cubic meter bio-gas can be produced per day.

In view of this potentialities, government of Assam prepared a scheme to utilize gobar-gas properly. In the year 1983-84, Rural Development department, Government of Assam prepared a scheme to install bio-gas plants with the co-operation of registered farms and institutions of respective districts in Assam.

Table - 5 :

These are given district wise below in the table -5.

	Districts	No. of plants
1.	Kamrup	50
2.	Goalpara	30
3.	Nowgaon	30
4.	Darrang	200
5.	Sibsagar	200
6.	Dibrugarh	30
7.	Lakhimpur	40
8.	Cachar	30
9.	Karbi-Anglong	5
10.	North Cachar	5
	Total	= 620

Source :Bio-gas scheme in Assam, Rural Development Department, Assam, Guwahati-7, 1983.

Table -6

An outline shape of a bio-gas plant for domestic use according to size of family is given below in table-6.

No.of members	Size of gas plants	Amt. of green gobar per day	Estimated cost of a plants (Rs)
4 - 6	2 c.mt.	48 Kg. (2½ tins)	6,461.00
6 -10	3 c.mt.	70 Kg. (3½ tins)	7,685.00
10-15	4 c.mt.	100 Kg. (5 tins)	8,618.00
15-18	6 c.mt.	140 Kg. (7tins)	11,157.00

Source : Bio-gas Scheme in Assam, Rural Development Department, Assam, Guwahati-7, 1983.

In Assam besides individual family owned bio-gas plants, community and institutional plants are being tried to set up. Special grants in this regard are being given by the Central Government. The Directorate, Rural Development Department, Government of Assam has been taken initiative in promoting rapid progress in this field.

In Rangia town one gobar-gas plant has been set up by Anath Ashram authority with in the Ashram campus. Capital expenditure for this plant is incurred Rs.10,000.00. As the plant is set up for demonestration purpose so all practical help including equipments were given by the Directorate, Rural Development, Government of Assam. Output capacity of the plant is expected to be 6 c.meter gas. Utilization of produced gas is yet to be started. Another new mini gobar-gas plant owned by a household is informed under construction at the time of collecting primary data.

Chapter - IV -

Data Base

4.1. INTRODUCTION :

This chapter is devoted to data source. There is no available recorded data on fuel consumption by the house-holds according to income and size of the family in which we are primarily interested. Data which are found from the ~~National Sample~~ Survey (N.S.S.) are not suitable for classified fuels. These are given in aggregate under the heading fuel and lighting for the whole state. The present work is a case study of Rangia town on demand for domestic fuel consumption. The study requires data on different types of fuel used by the households and their monthly income. As the published data are not available in government offices including Municipality office of Rangia town hence collection of primary data becomes imperative.

In our study we have considered the following types of fuel.

(1) Electricity,

(2) Coke and Coal,

(3) Kerosine,

(4) L.P.G. (Liquidified Petroleum Gas)

(5) Fire Wood,

(6) Cow-dung.

However we feel that not all the households are capable of giving exact amount of expenditure involved. This is so when the number of income earners in a family are more than one.

Also woods as fuel, people with reasonable income buy in bulk which lasts for months, only those people specially the lower-middle income group and the poor they buy in small quantity. Their accounts for expenditure for fuel could not be considered so reliable, specially of the upper income group within the lower middle class.

From our survey work, i.e., the households visited, none of them have reported the use of Coal or Cow-dung as fuel. It may be so that Fire wood is easily available and Kerosine is not so scarce a commodity in the urban areas, therefore, people prefer to use other types of fuel other than Cow-dung and Coal. In urban set-up, people generally do not have more cattle for which the use of dung cake was not found in time of data collection.

4.2. Sampling Frame :-

For the collection of Primary data stratified random sampling design has been adopted. For this purpose we have taken each ward as a stratum. In Rangia town there are eight administrative wards. For each of the wards the number of the households with house numbers were made available to us by the Town Municipality. We have used this list of households as a primary sampling frame. Due to the financial and time constraints we have decided to take 6 percent of the household units into the sample. The sampling fraction is '60. So the sampling interval between any two chosen sample units i.e., households is 16.

Actually while we were collecting data we had resorted to systematic sampling. According to the procedure of systematic sampling is to select the random number between 1 and 16 and if the first unit happens to be 8 then the successive households to be taken to samples will be 24, 40, etc. etc. Although we have faced a great deal of troubles in collecting data for the consumption of fuel and income, we could cover 120 households.

4.3. Questionnaire for the Survey :-

In time of collecting primary data, a comprehensive questionnaire was used in the field. Types of questions that we have asked the respondents is given in the appendix. The survey was conducted during the summer month of 1984. Any estimate of consumption should therefore be taken to reflect the pattern of fuel consumption during summer only. In summer, consumption of electricity is probably move on account of increasing use of fans, air-conditioners etc. while the consumption of other fuels such as gas, kerosine, coal and fire wood decreases as compared to winter season.

4.4. Secondary data :

4.4.1. National Sample Survey data :-

In the collection of Secondary data we have visited the National Sample Survey office at Shillong and requested the officials to help us by supplying published data from their records. In comply with our request they facilitate us in getting necessary data. In the National Sample Survey office, Shillong, we have collected published data of 25th round and 28th round for the years 1970-71 and 1973-74 respectively. Published data on National Sample Survey tables were on consumer expenditure (Rs.0.00) per person for a period of 30 days by broad groups of items and by monthly per capita expenditure classes for the urban areas of Assam. Number of sample blocks was 144 and number of sample households was 338 in 25th round. Number of sample blocks and sample households in 28th round was 143 and 229 respectively.

4.4.2. Other Sources of data :-

In regard to other published data we visited the office of the Director of Economics and Statistics, Government of Assam, Guwahati. At our request the office supplied us statistical Abstract, Assam, 1978 and other reference books. Concerning data for research work, we also visited Book Depot Section, Government Press, Assam and collected hand books and journals namely Statistical Hand Book, Assam, 1982 and Economic Survey, Assam, 1981-82. A few published data regarding consumption of electricity both in domestic sector and commercial sector of Rangia town are taken from the office of the Sub-Divisional Officer, Electricity, Rangia of Assam State Electricity Board (ASEB). We also visited the Noonmati Oil Refinery, Guwahati and collected published data regarding Oil and Gas.

Some other published data are collected from books, magazines, journals, papers etc. in the Libraries of North-Eastern Hill University, Shillong and Gauhati University, Guwahati.

4.5. Data Arrangement :

4.5.1. Survey Data :-

From our survey we have tabulated primary data of the households according to the number of families and their monthly income distribution, number of families and their distribution of expenditure. Per capita income and the number of household units taking 50 as class interval with Rs.50.00 as minimum income and Rs.500.00 as maximum value. Per capita expenditure and the number of household units taking 25 as class interval and Rs.50.00 and Rs.400.00 as minimum and maximum value respectively. Monthly total income and the size of the family taking Rs.400.00 as minimum value with class interval 200 in each class, electricity consumption and size of the family, monthly Kerosine consumption and size of the family, monthly Gas consumption and size of the family, monthly Firewood consumption and size of the family, monthly combined fuel consumption and the size of the family.

In our survey there are 120 observations. Therefore, certain groupings are necessary in order to have a manageable set of data for the purpose of analysis. We have used the following methods to modify the data according to the following manner.

It is permissible to rearrange only the exogeneous variables and not the endogeneous variables. Therefore we rearranged monthly income in this manner.

First we took at the minimum income and the maximum income so that minimum is succeded by the maximum. Suppose we have in our 120 observations there are 6 families with the minimum income of Rs.400.00. For the purpose of analysis we took Rs.400.00 as minimum income as such. But so far endegeneous variables i.e., fuel expenditure is concerned we have different values for different families as given by the master table. In order to get a single figure for this endegeneous variables we added all the fuel expenditures of the 6 families and took the average of it as the representation of fuel expenditure relating to a family with minimum income of Rs.400.00. This procedure is followed also for other incomes. A summery table containing different income and different types of fuel consumption with total and average consumption of different types of fuel in different income groups is given in the appendix.

4.5.2. National Sample Survey data :-

We have also tabulated National Sample Survey (N.S.S.) data of 25th and 28th round for urban areas of Assam. In the N.S.S. tables data are given on consumer expenditure (Rs.0.00) per person for a period of 30 days by broad groups of items and by monthly per capita expenditure classes in urban areas. In both rounds total numbers of item are 21. Data are given under monthly per capita expenditure class starting from Rs.8.00 to Rs.75.00 at the minimum and maximum value in 25th round table. As the expenditure of different items under class intervals from 0-8 to 18-21 are found almost blank so we have taken data from the class interval Rs.18-21 to Rs.75 and above for the purpose of analysis. In the list of 28th round monthly per capita expenditure classes are given from Rs.0-13 to Rs.200 and above at the minimum and maximum. In this list also per capita expenditure for all items in class intervals from 0-13 to 21-24 are found almost blank. Hence data are taken from class intervals Rs.24-28 to Rs.200 and above for the purpose of analysis.

In order to do the empirical analysis separately. We have categorised all the items into five sub-groups. Items fallen in each sub-group are given below :

(1) <u>Essential Items</u> :-

(a) Cereels
(b) Grams
(c) Cereel substitutes
(d) Edible oil
(e) Vegetables
(f) Salt
(g) Pulse

(II) <u>Near Essential</u> :-

(a) Milk and Products
(b) Meat, Fish & Eggs

(c) Fruits and Nuts

(d) Sugar.

(III) <u>Others</u> :-

(a) Species

(b) Beverages

(c) Pan and Tabacco

(IV) <u>Durable & Other Items</u> :-

(a) Clothing

(b) Foot wear

(c) Rents

(d) Taxes

(e) Durable Goods

(f) Misc. Goods and Services.

(V) <u>Fuel</u> :-

(a) Fuel and Light.

The tables for each group of items are given in the appendix. Tabulated data of National Sample Survey of 25th and 28th round according to per capita fuel expenditure and total expenditure of monthly per capira expenditure class are also given in the appendix.

Chapter - V

METHODOLOGY & EMPIRICAL ANALYSIS

5.1. Introduction :-

In this chapter we shall briefly describe the nature of consumer behaviour and the demand function of the consumer with respect to their income and prices of the commodities. The chapter will be devoted to illustrate in details the empirical analysis of different types of fuel from our survey data as well as National Sample Survey data. Methodology adopted for empirical analysis will also be shown in the chapter.

5.2. Nature of Consumer Behaviour :-

Consumer behaviour is made up out of a variety of decisions and choices. A consumer's decision in respect of any commodity is based on three important factors. These are firstly habit formation which means a consumer whether or not to consume a given commodity at all. Secondly, he must decide on the quality that he will buy. And thirdly the prices he afford to pay for the commodity. These three things taken together can be ascribed as an utility function of the individual consumer. Since price in this context is an operation variable one may think of it as one of the units of disposable income. Hence the earlier two factors are governed by income which is nothing but a multiple of prices.

Habit formation is governed by certain factors like cultural, social, ethical, environmental and economical which are considered to be more influencial in consumer behaviour. A consumer would like to buy certain types commodities which make him comfortable to adjust himself among the so called homogeneous consumers. Climatic conditions also lead a consumer to change his consumption pattern.

The bare outline of Marshall's theory of Consumers demand is that a consumer with a given money income confronted with a market for consumption goods, on which the prices of those goods are already determined. The question is how he divides his expenditure among the different goods. It is assumed that the consumer derives from the goods he purchases so much utility; the amount of utility being a function of the qualities of goods acquired; and that he will spend his income in such a way as to bring maximum possible amount of utility. But utility will be maximised when the marginal unit of expenditure in each direction brings in the same increament of utility. From the principle of diminishing marginal utility, a transference of expenditure from one direction to another will involve a greater loss of utility in the direction where expenditure is reduced than will be compensated by the gain in utility in the direction where expenditure is increased. Total utility must therefore be diminished, whatever transfer is made.

Marshall's argument therefore, proceeds from the notion of maximizing total utility by way of the law of diminishing marginal utility, to the conclusion that the marginal utilities of commodities bought must be proportional to their prices.

Consumer's utility can be measured by new name and call it the Marginal Rate of Substitution between the two commodities. We may define the marginal rate of substitution of X for Y as the quantity of Y which would just compensate the consumer for the loss of a marginal unit of X. If an individual is to be in equilibrium with respect to a system of market prices, it is directly evident that his marginal rate of substitution between any two goods must equal the ratio of their prices.

Consumer's demand changes with the change of income if the prices of X and Y are given. In such a situation as income continues to increase, the income-consumption curve continues to move to the right. It shows the way in which consumption varies, when income increases and prices remained unchanged.

Consumer's demand changes with the effects of a change in prices, income being unchanged. If it is the case of two goods, income is now to be taken as fixed and the price of Y as fixed; but the price of X is variable. In such a case the price-consumption curve varies when the price of X varies and other things remain equal.

5.3. <u>The Consumer's Optimum</u> :-

The consumer purchased optimum amounts of several commodities if he has maximized his utility out of his limited income. The assumption is that the given the prices of P_1, P_2 etc. commodity and the consumer income M are given, he would maximize his utility subject to the budget constraint. Consider the case that a consumer is faced with a utility function with just 2 commodities X_1 and X_2 with P_1 and P_2 their prices respectively, hence

$$U = U(x_1, x_2) \ldots\ldots\ldots\ldots (1)$$

Subject to the budget constraint

$$P_1x_1 + P_2x_2 = M \ldots\ldots\ldots\ldots (2)$$

Equation (2) has been called the budget equation. In order to find the optimality condition, we shall apply the classical theory of optimization. For this we shall construct the Lagrangean function -

$$L = u(x_1x_2) + \lambda(M - P_1x_1 - P_2x_2) \ldots\ldots (3)$$

We differentiate (3) with respect to the independent variables x_1, x_2 and λ, and sets the partial derivatives equal to zero, obtaining—

$$\frac{dL}{dx_1} = U_{x_1} - \lambda P_1 \quad = 0 \quad \ldots\ldots\ldots \quad (4)$$

$$\frac{dL}{dx_2} = Ux_2 - \lambda P_2 \quad = \quad 0 \quad \ldots\ldots\ldots \quad (5)$$

$$\frac{dL}{d\lambda} = M - P_1x_1 - P_2x_2 = 0 \ldots\ldots\ldots \quad (6)$$

from (4). (5) and (6) we obtain

$$U_1 = \lambda P_1 \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$U_2 = \lambda P_2 \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$M = P_1x_1 + P_2x_2 \ldots\ldots\ldots\ldots (9)$$

Where $Ux_1 = U_1$ and $Ux_2 = U_2$.

The three equations can be solved for the three unknowns x_1, x_2 and λ in terms of P_1, P_2 and M provided the condition of the implicit function theorem is satisfied. The nation of equations (7) and (8) gives

$$\frac{U_1}{U_2} = \frac{P_1}{P_2} \ldots\ldots\ldots\ldots\ldots (10$$

Let $\bar{\lambda}$ be the solution value of λ for (7)-(9).

from Equations (7) and (8) it can be shown that,

$$\frac{U_1}{P_1} = \frac{U_2}{P_2} = \bar{\lambda} \ldots\ldots\ldots\ldots (11)$$

Therefore, the condition for the consumer's optimum is that the ratio of a commodity's merginal utility to its prices is equal for all commodities. This theoram has been called the law of equi-marginal utility. And λ is the marginal utility of money. The relation (10) describes the condition of rate of change of marginal utility with respect to the prices of the commodities concerned.

5.4. Demand Function : -

The usual approach in demand analysis is to set out a relationship between quantity consumed and prices with disposable income as the relevant budget variable.[1] The law of demand states that the amount of good demanded by a consumer increases with a fall in price and diminishes with a rise in price. The law of proportionately is supposed to prevail.

The law of demand is based on the Law of Diminishing marginal utility which states that when a consumer buys more

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1. H.S. Houthekker & Lester D.Tylor, Consumer Demand in the United States, Analysis and Projection.

units of a commodity the marginal utility of that commodity continues to decline. Therefore a consumer will buy more units of that commodity only when its price falls. Thus demand will be more at a lower price and less at a higher price.

An individual consumer's demand refers to the quantities of a commodity demanded by him at various prices, other things remaining equal. An individual demand curve shows the effects of a fall or rise in the price of a commodity on the consumer's behaviour. These are income effect and substitution effect.

The market demand is the summation of the individual consumer's demands for a homogeneous commodity. If we sum up different quantities of a commodity demanded by a number of individuals at various prices we have a market demand schedule and their price-quantity relations show a market demand curve or it is the summation of all the individual demand curves.

The most obvious piece of information of a demand function is an indication of the effect on the "dependent" variable of a change in the value of one of the other variables. In the case of the demand curve this involves measurement of the response to quantity demanded which can be explained to result from a given change in the price of the commodity. A shift in a demand curve is normally accounted for by a change in the value of some other variables which affect demand.

For example, a rise in consumer's income lead to an upward shift in the demand curve. This means at any given price consumers will demand more than before. It should be noted however that if price happens to rise sufficiently at the same time, consumer may end up buying less despite an upward shift in the demand curve. In such a case, the shift in demand curve is accompanied by an off setting movement along the curve.[2]

Demand is a function of price, income, prices of related goods and tastes. It is expressed as—

$$D = f(P, Y, pr, t).$$

When income, prices of related goods and taste are given, the demand function is expressed as[3] —

$$D = f(p)$$

To summurize, besides income, demand is a function of many variables such as price, advertizing and decisions relating to competing and complementary products. The relationship which describes this many variables intra-connection is called the demand function.

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2. Willium J. Baumol, Department of Economics, Prineeton & New York University.
3. M.L. Jhingan "Advanced Economic Theory", (Micro and Macro-economics) Vani Educational Books, 1975, New Delhi.

The price effect indicates a consumer's change in the purchase of a commodity when its price changes, given his income, tastes and preferences and price of other related goods. The price-consumption curve shows the price effect of a change in the price of a commodity on the consumer's purchase other things remaining equal.

The price effect has twice effects. Firstly it changes the real income of the consumer. Secondly, it affords him the opportunity to substitute one good for the other. A fall in the price of a commodity raises the real income of the consumer. When a commodity becomes cheaper to a consumer, he can buy more units of it as if his income had increased. On the other hand a rise in its price causes adecline in consumer's real income by making the good dearer than before. This is the income effect via price effect. Again there is a tendency on the part of a consumer to substitute a commodity say X for Y if the price of x falls. It is as if the increased income is taken away from the consumer so that he remain at the same level of satisfaction. This is the substitution effect.

If the income of a consumer changes, given the price, tastes and preferences, the effects it will have on consumer's purchases is known as the income effect. The real income of a consumer increases at the lower price because he has to spend less in buying the same quantity of good. On the other hand, when the price of a commodity raises, the real income of the consumer falls. Under the influence of this effect with the fall in price of a commodity the consumer buys more of it and also spends a portion of the increased income in buying other commodities.

There are persons in different income groups in every society; but majority of them is in low income group. Ordinarily people buy more when price of commodity falls and buy less when price rises. Price is a sensetive factor in case of commodities and services which have different uses. An increase in price of such products will reduce demand leading only for important uses. On the contrary, with the fall in price, they will be put to various uses and their demand will rise. For example, with the increase in the electricity charges, power will be used primarily for domestic lighting but if the charges are reduced, people will use power for cooking , fans, heats etc.

In view of the above,, it is considered to be more appropriate that demand is affected not only by income but by price also which some economists called a twine effect of price and income over consumption.

Algebrically, consumer's demand for each commodity as a function of price and income,

$$x_1 = f_1 \, (p^1, p^2, M)$$
$$x_2 = f^2 \, (P_1, p^2, M).$$

Another problem that we face is the price of fuels. Specially, the price of firewood is fluid. Even kerosine oil at the time of scarcity, when bought from small dealers changes from time to time.

The most important problem is the reliability of data regarding the quantum of money spent for fuel.

(1) Now we shall turn to demand for fuels by the households. The nature of demand for fuel unlike the demand for other commodities is consequent to heterogeneous levels of development or no development atall. The affluents uses the sophisticated fuels like gas or electricity for cooking which is the major use throughout the year irrespective of the seasons. The affluents also can afford to use electric heating while the middle level income group in urban setup use firewood or coal for room heating. The poor has to forego this type of comfort for whom even the fuel for cooking is strictly self-rationed. Under these, heterogeneous economic.

(2) Conditions, we have to decide for a demand function that may not be suitable. Do we have an alternative ? The genesis of demand compel as to use the well established demand models that are, no doubt, globally suitable .

Another aspect of the problem that energy economists often like to study is substitution of one fuel by another.

The pure reason for substitution of one fuel by another is not so much due to the differential price but for the efficiency of one fuel is superior to another. The other reason may be availability. The people who could afford to change over from firewood to Liquidified Petroleum Gas(LPG) for cooking have bizare experience in getting continuous supply. Although, there is enough production of LPG but due to scarcity of gas cylinders, the users of gas have often keep stock of kerosine oil or firewood. Therefore, technically speaking there is hardly a case for substitution.

We also found that almost all the families in an urban setup like Rangiya use electricity only for lighting and other fuels e.g., Kerosine oil, Gas and Firewood are used for cooking and heating.

5.5. Models adopted for Empirical Analysis of data :-

We have in the previous sections discussed in details the economic principles based on consumer demand and the utility theory we could have obtained as per dictation of economic theory a demand function or a consumption function for any item as follows :-

$$Q = f(Y, P)$$

Where, Q is the coomodity demanded, Y is the income and P is the price of the commodity.

The problem here is that we do not have a time series data where the price would have vary over the time periods. But at any point of time and space as the case with us price will remain constant. Therefore the effect of price can not be studied with cross-section data. Hence we have taken income of the households as the only regression for the demand for fuel. Hence the equation—

$$* \quad Q = a + by + u$$

is the only equation we have adopted for the purpose of analysis. In order to see whether there could be any variation in income elasticity given by the linear equation which is more appropriate than the constant elasticity given by log linear Regression. Here of course, problem is not as serious as in the case of analysis involving time series data.

Whereas the nature of data involving in National Sample Survey (NSS) are of special type. There the families are grouped according to size of income and the data are given for different type of expenditure on items. Here we could have only thought of using Engel type of demand function of total expenditure inter-alia income. Hence the

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* Where, Q = Expenditure for the specific commodity.
Y = Total income, U = Disturbing terms
a,b=parameters.

equation for this purpose is adopted as—

$$Q = a + bE + U$$

Where ,

Q = expenditure for the specific commodity,

E = total expenditure

U = disturbance terms

a,b = parameters.

This Engel type of equation differs from the demand function already mentioned. Since we have already accepted that income is the most influencing variable in consumption of any item and we have never assumed here that all disposable income of the family are exhausted by spending whereas in Engel type of functions we have tried to substitute total expenditure as the disposable income of the family. Hence in the truest sense Engel function could be described as market share equations showing the proportion of expenditure on different commodities of consumption of the respective households.

In order to compare the analysis given by empirical equations we have to be cautions in retaining a distinction between the demand function and the Engel function. We probably should not assume income elasticity given by the demand function as similar to or as substitute of expenditure elasticity.

The equations that are considered for empirical analysis are — (Survey data)

Macro :- $F = a + bY + u$

Micro :- $E = a + bY + u$

$K = a + bY + u$

$G = a + bY + u$

$W = a + bY + u$

and their log versions.

where,

F = total expenditure on fuels

Y = family income

E, K, G, W. - stand for expenditure on electricity, kerosine, gas and wood respectively.

u = disturbance terms.

The type of equations considered for analysing N.S.S. data are,

$E = a + bY + u$

where,

E = expenditure of the specific class of goods,

Y = total expenditure

u = disturbance terms.

Here also, we adopted log-linear version of the above model.

5.6. Treatment of Data :-

We have already mentioned about how data have been organized for analysis. Since, we have cross-sectional house to house survey data, there is bound to be discontinuity in some way or other. We, for that reason, make tabulations of data so that analysis of demand for respective fuels come out nicely.

We have given the tables in the appendices.

5.7. Empirical Analysis :-

In this section we shall give the empirical findings for each type of fuel demand function. We have one global equation where we have combined the expenditure on fuel by all sample families on different types of fuel irrespective of their variability either in efficiency or in appearance. These equations are given below :

5.7.1. A. Global Equation, Linear :-

$$(1)\quad F = a + bY$$

$$= 77 + \underset{('004)}{0'032}Y$$

$$R^2 = 0.84, \quad \eta_{(Y)} = 0.45.$$

Loglinear :-

$$(2) \text{ Log } F = \log a + b \log Y$$

$$= 0.62 + 0.47 \underset{(.048)}{} \log Y$$

$$R^2 = 0.92, \ \eta_{(Y)} = 0.47.$$

Where,

F = total expenditure on fuel,

Y = family income.

It appears that equation number (1) from the magnitude of R^2 has a good fit. Also the parameter of income is though not of considerable magnitude as one expected keeping in mind that the fuel is very essential item for cooking, lighting as well as heating. It is also true that fuel is not necessarily comprising a very high proportion item of consumption compared to all other items specially in an urban setting where nearly 25% of the monthly income is spent alone on house rent.

One can also think of fuel for heating purposes is almost negligible in tropical climate as most people use fuel only for lighting and cooking which is definitely on item involving considerable less expenditure as compared to other items. Therefore, we are not least surprise for the income parameter to be just 0.032. So far the constant the parameter a is of such a high magnitude we have to wonder how in an urban setting this automatic consumption could play such a great role. Although statistically speaking this parameter a is of less consequence. We also found that standard error of parameter Y is comparatively less than half of the estimate of the parameter itself. This makes parameter Y highly significant.

We also found that income elasticity of fuel consumption is .45 making theoretically speaking inelastic even though fuel is an essential item. Probably this could be explained off as we have mentioned here in the earlier section that fuel is not a major item of expenditure. In general we conclude that this equation is statistically adequate in all respects.

Whereas the log-linear equation no.(2) gives some what a different picture compared to the linear equation no.(1). However, it has very high value of R^2 which is equal to .92 and the parameter of income is considerably greater than that we obtained in linear equation. The parameter of Y has a very small standard error making the parameter statistically highly significant. Never,the less, it is beyond the scope of statistical interpretation. Surprisingly one can see that the elasticity of income is nearly the same as that in the case of linear equation. Often the economists report such equations without serious comment on hypothesistesting aspect but we have some doubt about the viability of the empirical findings.

5.7.2. Micro Equations :-

In this section we shall present some micro equations both linear and log-linear which worked out from our survey data as well as National Sample Survey data for the consumption of different types of fuel. These equations are given and described below :

B, Electricity, Linear equation (Survey Data)

(3) $$E = a + bY$$

$$= 13.6 + \underset{(.001)}{.0072}\, Y$$

$$R^2 = .76$$

$$\eta_{(Y)} = .41$$

where,

E = Expenditure on electricity

Y = income of the family

a, b = parameters.

(4) Log-linear Equation

$$\text{Log } E = \log a + b \log Y$$

$$= .187 + \underset{(.077)}{.378} \log Y$$

$$R^2 = .64$$

$$\eta_{(Y)} = .38$$

Where,

E = expenditure on electricity

Y = income of the family

a,b = parameters.

In equation no.(3) above, the magnitude of R^2 is considerably high which shows that it has a good fit. But the parameter of income which is equal to .0072 shows a low magnitude. This may be explained away that electricity is used in small proportion only for lighting purpose and very few households use for cooking and heating in urban set up. We also found from our survey that no body uses electricity for cooking. Besides, compared to other items of expenditure, electricity is cheaper. For example, the unit price of electricity is .60 paise. A 60 watt lamp could be burnt for 4 hours on the average with one unit. (1000 units = 1 KWT.) The standard error of parameter Y is comparatively less than one seventh of the estimate of the parameter of income. This makes parameter of Y highly statistically significant. Income elasticity of equation no.(3) which is worked out at .41 shows that consumption of electricity is inclastic. This indicates that proportionate change in electricity expenditure with respect to the proportionate change in income is only '41.

We, of course know that electricity as such can be considered as dispensable and yet a very important complement.

Its use is confined to the limited few. Also many people are not in a position to buy household electric gadgets such as refrigerators, electrical appliances, mixture etc. Therefore its consumption only appears to be confined to mostly for lighting purposes. Even in the town like Rangia, this author has experienced while collecting data. On the whole we may have the reason to believe that the equation is giving satisfactory result, inspite of the fact that there is a probability that this particular equation may not be so accurate from prognostic point of view. The estimates of the parameters are not reliable and also the data are not sufficient to make decisive judgement.

The log-linear equation no.(4) shows a different picture in case of R^2 which is found to be .64. This is comparatively low as compared to the value of R^2 in equation no.(3) above. Never the less, the equation is belived to be a good fit. Parameter of income in this equation is of higher magnitude than that of the value in equation no.(3). This is of course not undesireable. The standard error of parameter Y has shown a very small value which is less than one fourth of the estimate of the parameter. This makes the parameter of Y very highly significant. This equation in no way is different from the equation (3) in respect of elasticity of income which shows that consumption of electricity is inelastic in respect of income of the household.

This should be so since in both the cases we use cross-section data. Therefore the trend component of variables that is income and the electricity expenditure is invariant. If we have here time series data compatibility and comparability of the value of elasticity could have been meaningful. Whereas the trend factor is nill in cross-section studies hence the effect of the variable namely income is more pronounced than that would have been in a time series equation.

Kerosene-linear Equation :

(5) $K = a + bY$

$= 14 + .0043\ Y$
$\quad\quad (.0022)$

$R^2 = .21$

$\eta_{(Y)} = .27.$

Kerosene-log linear Equation :

(6) $\text{Log } K = \log a + b \log Y$

$= .261 + .364 \log$
$\quad\quad (.181)$

$R^2 = .102$

$\eta_{(Y)} = .36.$

where,

K = Expenditure on Kerosene

Y = income of the family

a,b = parameters.

From the magnitude of R^2, it appears that the equation no.(5) does not have a good fit. Parameter of income in the equation is .0043. This is also a small value. This may be due to the fact that in urban set up people use Kerosene to a limited extent only for lighting purposes. Some time Kerosene is used for cooking purpose in a family of small size. Income elasticity in the equation shows a small variation of expenditure on Kerosene. Kerosene is considered to be essential items particularly for the purpose of lighting in houses where there is no electrical connection. Compared to other expenditures, expenditure in kerosene is negligible. Hence, the coefficient of income is so small and the usual interpretation about the concept of elasticity has to be made cautiously. Standard error of the parameter is less than half of the estimate of the parameter itself which makes the parameter of Y statistically significant.

The log-linear equation no.(6) shows a different picture in case of R^2 which bears a small value in comparision to the equation no.(5). Parameter of income in this equation in seen some what satisfactory compared to given by (5) which is just equal to '364. The equation also bears a low magnitude of standard error which is less than half of the estimate of the parameter of income. This is, ofcourse, a good result, as the equation proved to be statistically significant.

Income elasticity in this equation has been calculated at .36. Although it is a little higher than that given by equation (5). And people do not like to spend more on kerosene beyond what they need actually. Hence it is income inelastic. From all aspects, we can conclude that the equation has vice as well as virtue probably, those who give more importance in the consistency of the estimates than in R^2 would not hesitate to say that these equations are adequate.

Liquidefied Petroleum Gas (LPG):

(7) Linear Equation :-

$$G = a + bY$$
$$= 56.93 - .00070\ Y$$
$$(.004)$$

$R^2 = .0051,$

$\eta_{(Y)} = 0.026$

(8) L.P.G. log-linear Equation :-

$$\log G = \log a + b \log Y$$
$$= 4.61 + .079 \log Y$$
$$(.1288)$$

$R^2 = .0600,$

$\eta_{(Y)} = .079.$

Where,

G = Expenditure on Gas.

Y = Family income.

a,b = Parameters.

In the equation no.(7) above we observe very small magnitude of R^2 and parameter of income which is calculated at - .0007 can be considered as very low. This could be, perhaps , due to the fact that a fixed and small proportion of family income is spent on Gas consumption per month. It is used only by 14 families out of sampled 120 families. Income elasticity of this equation is also found very small. Standard error of parameter Y calculated at .004 is comparatively higher than the estimate of the parameter itself. This may be that variation of income has no major influence over the consumption of gas. People use gas only upto the required quantity in respective of their income variation. on the whole we can conclude that the equation is not good fit for obtaining good result.

The log linear equation gives us a different picture in case of R^2 which is found at '0600 and is also greater than that of the value of equation no.(7). But this is not enough as one can expect. The value of the parameter of income of this equation is not found so satisfactorily. Again, as in other equations gas is found to be inelastic. Due to the limited use people spent only a very small proportion of their income on gas in comparision to the expenditure on other items. Also people using gas reported for using firewood too. Here variation of income does not lead to any change of Gas consumption and makes it inelastic. Standard error of the parameter shows small magnitude which is less than the value of the estimate of the parameter. This makes the income parameter significant and the equation statistically adequate.

<u>Fire Wood</u> : <u>Linear Equation</u> :

(9) $W = a + bY$

$= 51 + .021\ Y$
$\quad (.0028)$

$R^2 = 0.75,$

$\eta_{(Y)} = 0.39.$

(10) <u>Log-linear Equation</u> :

$\log W = \log a + b \log Y$

$= 0.679 + .39\ Y$ log
$\quad (.056)$

$R^2 = .76,$

$\eta_{(Y)} = 0.39.$

Where,

W = Expenditure on Firewood

Y = Family income

a,b = parameters.

In linear equation (7) R^2 shows a higher magnitude and makes it a good fit. But the parameter of income bears small value in the equation. This is perhaps, wood is available to the households at a minimum cost in comparision to other expenditure of items. People also spent a little portion of their income on fire wood consumption. Elasticity of income which is calculated at .39 indicates that fire wood being the essential item does not make any consderable change of expenditure in proportion to the change in income. Hence it is income inelastic. The equation can claim its significance on the basis of the value of standard error which is just equal to '0028 and is less than one seventh of the estimate of the parameter.

Log linear equation has a good fit from the magnitude of R^2. It is almost same with the value of R^2 in previous equation no.(9). In statistical sense i.e., according to theory of estimation, the empirical results of both the equations are similar . It is significantly greater than that we obtained in the linear equation. But the standard error of the parameter of income is comparatively higher than the linear equation. Never the less, it is less than one sixth of the value of estimate. This makes the parameter statistically significant. There is no difference between the value of income elasticity in both the equations. Here we also found that people considere fire wood as essential item of expenditure which is required for cooking purpose only. But the amount spend on fire wood consumption is comparatively lower than the expenditure on other items. Hence income variation can influence a little over the consumption of fire wood. In general we may conclude that both the equations have good fit and the parameters are statistically significant.

In this sub-section we shall present empirical analysis in the form of micro equations both linear and log-linear. The equations are calculated from the data obtained from the Table of National Sample Survey of 25th and 28th Round. Here we categorized data in five groups and calculations have been done for each group of items. These equations are given below :

In the following empirical equations for analysing the N.S.S. data. We use the following variables,

E = Total expenditure of ith group of items

Y = Total expenditure of the family

a,b = parameters.

5.7.3. C Micro-Equations (N.S.S.) data: (25th Round)

Fuel : Linear equation :-

(11) $E = a + bY$

$= 0.71 + .054\,Y$
$\quad\quad\quad\quad(.0031)$

$R^2 = 0.97,$

$\eta_{(Y)} = 0.80.$

(12) Fuel : Log-linear equation : -

$\log E = \log a + b \log Y$

$= 0.85 + 0.82 \log Y$
$\quad\quad\quad\quad(.089)$

$R^2 = 0.92,$

$\eta_{(Y)} = 0.82.$

Where,

E = Total expenditure on fuel.

Y = Family expenditure inclusive of all items.

a, b = Parameters.

Micro-equations based on National Sample Survey data have good fit in comparision to our survey data. In the above equation we found R^2 is very high which makes the equation good fit. But parameter of income Y shows small magnitude which is due to the fact that people usually spend a smaller proportion of their income on fuel consumption. Standard error of parameter is very small which makes the parameters statistically significant. Although people spend a low portion of their income on fuel, yet it is quite essential for cooking and lighting purposes. Hence demand for fuel is inelastic irrespective of income.

Log-linear equation is considered to be good fit from all respects. The equation contains R^2 value which is almost the same with linear equation. The same value is found in case of income elasticity for both the equations. The parameter of income is high in comparision to linear equation.

Essential Items : Linear Equation :

(13) $E = a + bY$

$$= 15.10 + \underset{(.026)}{0.15}\,Y$$

$R^2 = 0.80,$

$\eta_{(Y)} = 0.33.$

(14) Log-linear Equation :

$$\log E = \log a + b \log Y$$

$$= 0.72 + \underset{(.063)}{0.38} \log Y$$

$R^2 = 0.94,$

$\eta_{(Y)} = 0.38.$

Where,

E = Total expenditure on essential items.

Y = Total family expenditure.

a,b = Parameters.

The above linear equation from the magnitude of R^2 has a good fit. The equation also contains higher value of income parameter compared to fuel consumption equation, which is equal to .15. This indicates that a major portion of family income is spent on the items which are considered as essential other than fuel. The proportionate change of expenditure on essential items with respect to income is found to be 0.33. In real life situation, theoretical norms either statistical or econometrical are easily vulnerable, we can not lay down the limit of so called elasticity of income with respect to consumption expenditure of this or that item. We can not find a situation where essential items either all cheap or they are too expensive. It is the price factor which is crucial for judgement. The most common yet essential item water can be highly elastic but petrol may be inelastic. It was so, before 1973, and completely opposite after oil embargo imposed by oil exporting countries.[1] (Bez, 1978).

The log linear equation of essential items shows better result than the linear equation. Here R^2 is equal to .94 which proves that the equation has good fit. The value of income parameter is also higher compared to other equation.

Income elasticity is almost same in both the equations. In both the equations we found the effect of income is in elastic. Here also the standard error of income parameter is very small as compared to the value of the estimate of parameter Y. This shows that the income parameter is highly significant. Both the equations can be used for prognosis purposes as these equations could be considered statistically satisfactory.

Near Essential Items : Linear Equation :

$$(15) \quad E = a + bY$$

$$= 1.73 + \underset{(.016)}{0.20}\, Y$$

$$R^2\ 0.95,$$

$$\eta_{(Y)} = 1.20$$

Log-linear Equation :

$$(16) \quad \text{Log } E = \log a + b \log Y$$

$$= -1.98 + \underset{(.313)}{1.68}\, \hat{Y}$$

$$R^2 = 0.78,$$

$$\eta_{(Y)} = 1.68.$$

Where,

E = Total expenditure on near essential items

Y = Total family expenditure

a,b = Parameters.

Linear equation for near essential items gives a higher magnitude of R^2 and makes it good fit. Value of income parameter which is just 0.20 is also considered to be satisfactory. Strangely, the near-essential items are highly income elastic compared to other items. If one looks at the range of items covered under this heading almost all the daily required items. This is, on the other hand, giving the impression that economic theory differs from the real life situation. The very mechanism of calculating elasticity confirms that we can not make rigid rules in classifying an item inelastic because it is not essential. Here standard error of income parameter is less than one tenth of the value of estimate which makes the parameter is highly significant.

Log linear equation gives a different picture in case of R^2 which is less than in the linear equation. But the equation shows a higher magnitude of income parameter. This is due to influence of income variation on the expenditure of near essential items. As peoples income rise, they like to buy more of such items which are not essentially required by them. Income elasticity also tells us the the same thing. House-hold consumers demand for these items is perfectly income elastic. Income parameter is found statistically significant as standard error is less than one fifth of the estimate itself. Hence the equation is adequate and satisfactory in all respect.

Other Items: Linear equation :

(17) $E = a + bY$

$= 2.51 + 0.17\ Y$
$(.026)$

$R^2 = 0.89,$

$\eta_{(Y)} = 1.41.$

(18) Log-linear equation :

$\text{Log } E = \log a + b \log Y$

$= -2.31 + 1.77 \log Y$
$(.089)$

$R^2 = 0.89,$

$\eta_{(Y)} = 1.77.$

Where,

E = Total expenditure on other items

Y = Total family expenditure

a,b = Parameters.

From the magnitude of R^2, the above linear equation has good fit. The income parameter which is equal to '17 shows that expenditure on such other items changes with the change of income. Income elasticity is also higher as proportionate change in income leads to the change of expenditure. Items fallen in this group are not considered to be essential and hence expenditure on such items is income elastic. Standard error of the parameter in this equation is less than one sixth of the estimate. This makes the parameter significant.

In log linear equation we find higher magnitude of R^2 and the parameter of income is significantly greater which is equal to 1.77. The log linear equation gives very high value nearly equal to 2, the value of income elasticity.

<u>Durable Goods : Linear equation</u> :

(19) $E = a + bY$

$= -4.70 + \underset{(.596)}{0.29Y}$

$R^2 = 0.92,$

$\eta_{(Y)} = 1.47.$

<u>Log-linear equation</u> :

(20) $\text{Log } E = \log a + b \log Y$

$= -2.88 + \underset{(.0387)}{2.21} \log Y$

$R^2 = 0.95,$

$\eta_{(Y)} = 2.21.$

Where,

E = Total expenditure on durable goods.

Y = Total family expenditure.

a,b = Parameters.

In both the equations above we found that the value of R^2 is high which makes the equations good fit. But income parameter in linear equation is less than that in the log linear equation. In log linear equation it is 2.21. This tells us that expenditure on durable goods depends upon the income of the households. A household consumer can spend more on such items if his income increases. Both the equations show higher elasticity of income as these goods bear high prices. Only the higher income group can afford to pay for such items. The log linear equation shows a good result in case of standard error which is a very small fraction of the estimate of income parameter. In view of the above results, we may condlude that both the equations have good fit and the parameters of income are considerably significant.

5.7.4. D : Micro equations of National Sample Survey (N.S.S.) data, 28th Round (1973-74).

Fuel : Linear equation :

$$(21)\quad E = a + bY$$

$$= 2.25 + 0.027\,Y$$
$$(.0036)$$

$$R^2 = 0.85,$$

$$\eta_{(Y)} = 0.53.$$

Log-linear equation :

$$(22) \quad \log E = \log a + b \log Y$$

$$= -0.49 + 0.61 \,\text{Log}\, \underset{(.044)}{Y}$$

$$R^2 = 0.95,$$

$$\eta_{(Y)} = 0.61.$$

Where,

E = Total expenditure on fuel.

Y = Total family expenditure.

a,b = Parameters.

Both the equations give almost same results in case of R^2 and income elasticity. But income parameter in linear equation shows small magnitude which may be due to the fact that a small proportion of income is spent on fuel consumption as compared to other expenditure. People in urban setting can not spend more on fuel though it is essential for cooking. Hence income variation does not influence more on fuel expenditure. Here we have seen income inelasticity in both the equations. People can not ignor the consumption of fuel which is highly required for cooking and lighting purposes. The log linear equation gives us small value of standard error as compared to the value in linear equation. Still both the equations have good fit as the standard errors of income parameter are highly significant.

Essential Items : Linear equation :

$$(23) \quad E = a + bY$$
$$= 25.52 + 0.077\,Y$$
$$(.025)$$
$$R^2 = 0.48,$$
$$\eta_{(Y)} = 0.22.$$

Log-linear equation :

$$(24) \quad \text{Log } E = \log a + b \log Y$$
$$= 0.85 + 0.35\,Y$$
$$R^2 = 0.75,$$
$$\eta_{(Y)} = 0.35.$$

Where,

E = Total expenditure on essential items.

Y = Total Family expenditure.

a,b = Parameters.

Log linear equation for essential items shows higher magnitude of R^2 than in the linear equation. In case of income parameter we see that income variation is less effective in linear equation. Both the equations show income inelasticity in the consumption of essential items. These items are highly required by households, and hence expenditure on such goods can not avoid even at low income level. However, as we said earlier, elasticity is not the only true indicator. Standard error of income parameter in both the equations are less than one third of the estimate. This makes the parameters statistically significant.

Near-Essential Items : Linear equation :

$$(25) \quad E = a + bY$$
$$= 2.45 + 0.11\ Y$$
$$(.0109)$$
$$R^2 = 0.91,$$
$$\eta_{(Y)} = 0.80.$$

Log-liner equation :

$$(26) \quad \log E = \log a + b \log Y$$
$$= -0.93 + 1.04\ Y$$
$$(.077)$$
$$R^2 = 0.94,$$
$$\eta_{(Y)} = 1.04.$$

Where,

E = Total expenditure on near essential items

Y = Total family expenditure

a, b = Parameters.

Equation nos. 25 and 26 above give us higher magnitude of R^2 which makes both the equation good fit. But in case of income parameter, the log linear equation shows higher value than linear equation. We have also found income elastic in both the equation. As the items fallen in this category are not so essential to the households, hence they make change in buying these goods when their income permitted . Standard error of income parameter in both the equations are small which make the parameter highly significant.

Other Items : Linear equation :

$$(27)\quad E = a + bY$$
$$= 7.60 + 0.24\ Y$$
$$(.0094)$$
$$R^2 = 0.98,$$
$$\eta_{(Y)} = 1.50.$$

Log-linear equation :

$$(28)\quad \log E = \log a + b \log Y$$
$$= 2.08 + 1.60\ Y$$
$$(.282)$$
$$R^2 = 0.97,$$
$$\eta_{(Y)} = 1.60.$$

Where,

E = Total expenditure on other items

Y = Total family expenditure

a,b = Parameters.

From the magnitude of R^2 which is very high in both the equation, we may say that the equations are good fit. Elasticity of income is also high in these equations as the items are not essential. Hence a proportionate change of income leads to proportionate change in consumption. Income parameter in log-linear equation reflects variation of income on expenditure of such items. But the parameter of income are found significant statistically as the standard error of parameter Y in both the equations are found to be very low.

Durable Goods linear equation :

$$(29) \quad E = a + bY$$
$$= -22.90 + 0.55\,Y$$
$$(.04)$$
$$R^2 = 0.85,$$
$$\eta_{(Y)} = 1.79.$$

Log-linear equation :

$$(30) \quad \log E = \log a + b \log Y$$
$$= -2.61 + 1.97 \log Y$$
$$(.070)$$
$$R^2 = 0.99,$$
$$\eta_{(Y)} = 1.97.$$

Where,

E = Total expenditure on durable goods.

Y = Total family expenditure.

a,b = Parameters..

Although log linear equation contains higher magnitude of R^2. Yet both the equations are good fit. Elasticity of income is also greater in both the equations. People generally spend less on durable goods if their income decrease. But expenditure on such items increases with the increase of income. Moreover these goods are purchased less frequently as they last long time. Log linear equation shows high income parameter. This is because of the same reason as people reduce buying when income reduces. In both linear and log-linear equations we found standard error of income parameter is very low and this makes the parameters highly significant.

Chapter - VI

CONCLUSION

Energy since 1973 becomes crucial issue in international economics. The nations that produced the bulk of the world production of Petroleum when resorted cartel as well as many fold increases in price per barrel of crude oil, the industrial nations felt threatened.

Although the depression has reduced considerably, but the right thinking people are worrying over depletion of non-renewable sources of energy. Due to pressure of population in country like India more and more woodlands are cleared for agriculture and hence the fire woods are also becoming costlier. The much talked geothermal, wind and sun energy are yet to be commercially exploited.

This study is a micro-study relating to domestic fuel consumption may be considered as exploratory. The author has tried to the best of his ability and effort to focus the pattern of consumption.

Due to the nature of cross-section data, energy wise consumption is not reflected by variation of price of different fuels. Our approach is more or less dogmatic in the sense that we make use of income as the principal and only independent variable. The energy as a very essential item should have been income elastic but we could not find support to that end from empirical analysis. It may be so that almost every household in the sample uses firewood, kerosene and electricity. Another reason for less electric consumption is that still nearly no households possess electric kitchen wares, washing machines etc.

The analysis of National Sample Survey data and the analysis of survey data do not differ, so far fuel is concerned. However, the fuel expenditure in National Sample Survey data is aggregate whereas, in survey data it is specific i.e. according to type of energy.

The author finds it a very interesting subject, he would, in future like to continue further research into the field of energy. For any lapse or omission due to the time limit set for completing the research are alone borne conscientiously by the author.

List of Tables
(Survey Data)

APPENDIX -A.

Table - 1: Income Distribution of Households with average family size.

Family income (Rs)	No. of Families	Average Family size	Total No. of family member
Class interval	F	A.F.S.	N.F.M.
400 - 600	19	5.2	98
600 - 800	9	5.5	50
800 - 1000	16	6.6	106
1000- 1200	14	8.1	114
1200- 1400	1	6.0	6
1400- 1600	9	6.7	61
1600- 1800	11	6.3	70
1800-2000	13	7.4	96
2000- 2200	7	8.0	56
2200- 2400	2	6.0	12
2400- 2600	5	12.2	61
2600- 2800	0	0.0	0
2800- 300	8	10.9	87
300- 3200	1	9.0	9
32- 3400	0	0.0	0
3400- 3600	5	10.2	51
Total	120		877

Table - 2: Expenditure Distribution of Households with average family size.

Family exp. (Rs.) Class interval	No.of family F	Total no.of family member	Average family size
400-600	30	156	5.2
600-800	15	108	7.2
800-1000	16	115	7.2
1000-1200	17	124	7.3
1200-1400	1	7	7.0
1400-1600	14	102	7.3
1600-1800	8	69	8.6
1800-2000	10	112	11.2
2000-2200	0	0	0.0
2200-2400	1	10	10.0
2400-2600	2	16	8.0
2600-2800	2	20	10.0
2800-300	2	17	8.5
3000 and above	2	21	10.5
Total	120	877	7.3

Table - 3 : Monthly per capita Income and number of Family.

P.C. 1	No. of family
Class interval (Rs.)	F
50 - 100	19
100- 150	22
150- 200	20
200- 250	18
250- 300	15
300- 350	3
350- 400	15
400- 450	2
450- 500	3
Above 500	3
Total	120

Table -4 : Monthly per capita Expenditure and numbers of Families.

P.C.C. Class interval (Rs.)	No. of Family F
50 - 75	6
75 - 100	25
100- 125	14
125- 150	12
150- 175	10
175- 200	13
200- 225	4
225- 250	12
250- 275	7
275- 300	7
300-325	3
325- 350	2
350- 375	0
375- 400	3
Above 400	2
Total -	120

Table - 5 : Number of Households with family size in different income groups
(Cell frequencies represent the no. of households)

Family Size → / Income ↓	0-2,	2-4,	4-6,	6-8,	8-10,	10-12,	12-14,	14-16,	above 16	Total
400 -600	2	4	8	3	2					=19
600- 800	1	1	5	1	1					= 9
800 -1000		1	7	5	2	1				=16
1000-1200			5	4	2		3			=14
1200-1400			1							= 1
1400-1600		3	2	2	1		1			= 9
1600-1800	1		4	6						=11
1800-2000			5	5	2		1			=13
2000-2200		1	2	2	1			1		= 7
2200-2400			1	1						= 2
2400-2600			1		2	1			1	= 5
Above 2600			1	6	2	2	1	1	1	=14
Total	4	10	42	35	15	4	6	2	2	=120

Table 6 : Electricity Consumption and Family Size,
(The Cell frequencies are the number of households)

Size of Family → Consumption, (Rs.) ↓	0-2,	2-4,	4-6,	6-8,	8-10,	10-12,	12-14,	14-16,	Above 16	Total No. of F.	Average Size of F.
0 - 5					1					= 1	10.0
5 - 10	1				1		1			= 3	8.0
10- 15		3	9	2						=14	5.2
15- 20		2	8	7	5					=22	6.7
20- 25		1	5	14			2			=22	7.4
25- 30		2	5	1	3			1	1	=13	8.5
30- 35			1		1	1		1		= 4	10.2
35- 40				3	1	1				= 5	8.6
40- 45						4				= 4	10.7
45- 50				1					1	= 2	16.0
Above 50		1	1	1			1			= 4	7.5
Total	1	9	29	29	12	6	4	2	2	=94	

Table -7: Kerosene Consumption and family size
(Cell frequencies are the no. of households)

Size of Family → / Kerosine cons. (Rs.) ↓	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	Above 16	Total no. of family
0 - 4		2	8	6	2	1	2		1	=22
4 - 8	1	2				1				= 4
8 -12	1	2	13	5	4		1		1	=27
12-16	1	2	2		1					= 6
16-20		1	11	6	6	2		1		=27
20-24			1	6	1					= 8
24-28		0								= 0
28-32			4	7			1			=12
Above 32		1	3	5	1		2	1		=13
Total	3	10	42	35	15	4	6	2	2	=119

Table -8 : Gas Consumption and family size.
(Cell frequencies are the no. of households)

Family Size → / Gas Cons. (Rs.) ↓	0-2,	2-4,	4-6,	6-8,	8-10,	10-12,	12-14,	14-16,	Total
40 - 60	1		4	6					=11
60 - 80				1		1			= 2
80 - 100							1		= 1
Total	1		4	7		1	1		=14

Table - 9 : Firewood consumption and family size.
(Cell frequencies represent the no. of households)

Family size → / Firewood cons. (Rs) ↓	0-2,	2-4,	4-6,	6-8,	8-10,	10-12,	12-14,	14-16,	Above 16,	Total No. of families
0-20	1		4	1		1				= 7
20-40	1	4	10							=15
40-60		4	5	6						=15
60-80	1		13	10	6		2		1	=33
80-100		1	4	9	1		1			=16
100-120			1	2	6	1	1			=11
120-140				1			2			= 3
140-160		1	1	1	2		1			= 6
Above 160						1		2	1	= 4
Total	3	10	38	30	15	3	7	2	2	=110

Table -10 : Combined fuel consumption and Family size.
(Cell frequencies are the no. of households)

Family size → / Combined Fuel Consumption (Rs.) ↓	0-2,	2-4,	4-6,	6-8,	8-10,	10-12,	12-14,	14-16,	above 16,	Total no. of family
0 - 20			1							= 1
20 -40	1									= 1
40- 60	1	2	5							= 8
60- 80		4	6	3	1		1			=15
80-100	2	1	14	3						=20
100-120		1	8	13	5				1	=28
120-140			5	5	3		1			=14
140-160		1	2	7	1	1				=12
160-180					3	1	1			= 5
180-200				2	1	1	2			= 6
Above 200		1	1	2	1	1	1	2	1	=10
Total	4	10	42	35	15	4	6	2	2	=120

N.S.S. Data (25th Round)

Table -1. Per capita Fuel expenditure and Total expenditure of monthly per capita expenditure class.

P.C.Exp. Class (Rs.)	Fuel expenditure (Rs.)	Total expenditure of P.C. exp. Class. (Rs.)
21-24	2.08	22.73
24-28	1.60	26.59
28-34	2.40	30.88
34-43	3.01	39.17
43-55	3.43	49.35
55-75	4.37	63.46
75 above	6.39	~~108.75~~ 108.75
All classes	4.22	64.24

Table -2: Per capita Fuel Expenditure and Montly P.C. expenditure on different category of consumption goods.

P.C.Exp. Class	Fuel Exp.	Total exp. of P.C. monthly exp. class for the items of—				Total Exp.
		Essential	Near essential	Others	Durable & others	
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
21-24	2.08	18.08	0.76	1.06	0.75	22.73
24-28	1.60	15.99	4.41	1.97	2.62	26.59
28-34	2.40	19.52	3.75	2.20	3.01	30.88
34-43	3.01	21-49	6.60	3.38	4.69	39.17
43-55	3.43	24.68	8,86	4.60	7.78	49.35
55-75	4.37	27.74	12.84	6.09	12.49	63.46
75 above	6.39	28.98	18.39	20.82	34.17	108.75
All classes	4.22	25.40	11.37	8.62	14.63	64.24

APPENDIX - C.

N.S.S. Data (28th Round)

Table - 1 : Per capita Fuel Expenditure and Total Expenditure of monthly P.C. Exp. class.

P.C. Exp.Class (Rs)	Fuel Exp. (Rs)	Total exp. of P.C. Exp. Class (Rs)
24-28	2.10	25.60
28-34	2.76	32.32
34-43	2.80	37.60
43-55	3.40	48.50
55-75	4.35	64.41
75-100	5.26	86.07
100-150	6.27	118.58
150-200	8.68	176.30
200 above	8.41	284.05
All classes	4.37	72.75

Table -2 : Per capita Fuel Expenditure and Monthly P.C. Exp. on different category of consumption goods.

P.C. Exp.Class	Fuel Exp.	Total Exp. of monthly p.c. exp. for the items of-				Total Exp.
		Essential	Near Essential	Others	Durable & Others	
Rs	Rs	Rs	Rs	Rs	Rs	Rs
24-28	2.10	17.90	2.60	1.90	1.10	25.60
28-34	2.76	21.40	3.55	2.17	2.44	32.32
34-43	2.80	25.32	4.59	2.07	2.85	37.63
43-55	3.40	29.33	6.99	3.27	5.51	48.50
55-75	4.35	34.43	10.72	5.00	9.91	64.41
75-100	5.26	41.99	14.48	9.65	14.69	86.07
100-150	6.27	42.60	19.94	25.00	24.77	118.58
150-200	8.68	41.20	24.86	31.58	69.98	176.30
200 above	8.41	40.36	29.72	61.14	144.42	284.05
All classes	4.37	33.24	11.00	9.02	15.12	72.75

APPENDIX - D.

SUMMERY TABLES

Survey Data :-

Table -1 : Monthly expenditure on different types of fuels by households in different incomee groups

(in Rs.)

Income group	Fuels					No. of Households
	Electricity	Kerosene	Gas	Fire-Wood	Total of all Fuels	
400 - 600	204.00	274.00	-	1060/-	1538.00	19
600 - 800	45.00	203.00	-	480/-	728 .00	9
800 - 1000	192.00	172.00	126.50	1148/-	1638.50	16
1000-1200	234.00	260.00	-	1200/-	1694.00	14
1200-1400	18.00	4.00	-	80/-	102.00	1
1400-1600	222.00	220.00	--	815/-	1257.00	9
1600-1800	279.00	270.00	175.50	740/-	1464.50	11
1800-2000	283.00	180.00	203.10	1001/-	1667.10	13
2000-2200	221.00	158.00	49.00	610/-	1038.00	7
2200-2400	43.00	38.00	-	160/-	241.00	2
2400-2600	193.00	97.00	-	635/-	925.00	5
2600 above	453.20	292.00	249.00	1265/-	2251.20	14
Total	2387.20	2168.00	803.10	9194/-	14552.30	120

N.S.S Data (25th Round)

Table - 2. Monthly consumer exp. per person by Broad groups of items in urban areas of Assam.

Items	Monthly per capita exp. class (in Rs.)							
	21-24	24-28	28-34	34-43	43-55	55-75	75 above	All classes
	14.40	12.76	14.89	15.74	18.21	18.92	18.55	17.68
ESSEN-TIAL	0.86	0.78	1.28	1.35	0.01	1.88	0.01	0.00
ITEMS	0.60	1.20	1.54	2.10	1.56	3.45	2.23	1.74
	2.04	1.20	1.73	2.20	2.54	3.37	3.87	2.92
	0.18	0.05	0.08	0.10	2.25	0.12	4.18	2.94
					0.11		0.14	0.12
Total	18.08	15.99	19.52	21.49	24.68	27.74	28.98	25.40
NEAR ESSEN-	0.50	1.08	1.84	2.13	2.86	4.18	5.87	3.64
TIAL	0.26	1.99	0.10	2.94	4.05	6.11	9.02	5.41
		0.24	1.01	0.24	0.29	0.43	1.00	0.48
		1.10	0.80	1.29	1.66	2.12	2.50	1.84
Total	0.76	4.41	3.75	6.60	8.86	12.84	18.39	11.37
	0.51	0.71	0.73	0.83	0.91	1.16	1.28	1.03
OTHERS	0.25	0.43	0.57	0.94	1.57	2.23	13.92	4.65
	0.30	0.83	0.90	1.61	2.12	2.70	5.62	2.94
Total	1.06	1.97	2.20	3.38	4.60	6.09	20.82	8.62
	0.75	0.23	0.44	0.65	1.77	2.97	11.72	4.26
DURABLE		2.10	0.01	0.23	0.23	0.38	0.98	0.43
& OTHER		0.29	1.58	2.77	4.29	5.60	14.69	6.73
ITEMS			0.98	1.03	1.42	3.03	6.15	2.89
				0.01	0.07	0.02	0.19	0.07
					0.00	0.42	0.54	0.25
Total	0.75	2.62	3.01	4.69	7.78	12.42	34.17	14.63
FUEL & LIGHTING	2.08	1.60	2.40	3.01	3.43	4.37	6.39	4.22
Total Consumer Exp.	22.73	26.59	30.89	39.17	49.35	63.46	108.75	64.24

N.S.S Data (28th Round)

Table - 3. Monthly consumer expenditure per person by Broad Groups of Items in urban areas of Assam.

Items	Monthly per capita Expenditure class (in Rs.)									
	24-28	28-34	34-43	43-55	55-75	75-100	100-150	150-200	200 above	All Classes
ESSENTIEAL ITEMS	14.00 1.20 1.00 1.50 0.20	16.11 1.37 1.98 1.71 0.13	19.71 1.61 2.10 1.77 0.13	22.32 1.85 2.54 2.47 0.15	24.59 0.01 2.25 3.51 3.90 0.17	29.10 0.19 2.65 4.90 4.92 0.23	30.45 0.03 3.41 4.94 3.51 0.26	23.96 3.72 6.00 7.28 0.24	23.00 3.50 6.45 7.14 0.27	23.73 0.00 0.03 2.26 3.45 0.18
Total	17.90	21.40	25.32	29.33	34.43	41.99	42.60	41.20	40.36	33.24
NEAR ESSENTIAL	1.90 0.70	0.98 1.60 0.02 0.95	1.06 2.58 0.10 0.85	2.13 3.30 0.20 1.36	2.77 5.22 0.71 2.02	5.39 6.01 0.66 2.42	5.37 10.38 1.11 3.08	15.10 5.72 0.74 m3.30	9.80 13.14 3.05 3.73	3.60 5.02 0.52 1.86
Total	2.60	3.55	4.59	6.99	10.72	14.48	19.94	24.86	29.72	11.00
OTHERS	0.80 0.80 0.30	0.65 0.48 1.04	0.71 0.49 0.87	0.88 0.82 1.57	1.14 1.70 2.16	1.42 4.99 3.24	1.87 17.78 5.35	1.96 21.64 7.98	1.55 48.91 10.68	1.13 5.22 2.67
Total	1.90	2.17	2.07	3.27	5.00	9.65	25.00	31.58	61.48	9.02
DURABLE & OTHER ITEMS	1.10	0.12 1.89 0.43	0.51 1.98 0.36	1.68 3.29 0.54	1.79 0.14 6.65 1.29 0.04	2.92 0.12 9.24 2.22 0.19	5.74 0.24 10.61 7.91 0.15 0.12	20.92 31.88 17.18	36.95 62.88 33.45 11.14	3.69 0.07 7.94 3.13 0.01 0.28
Total	1.10	2.44	2.85	5.51	9.91	14.69	24.77	69.98	144.42	15.12
FUEL & LIGHTING	2.10	2.76	2.80	3.40	4.35	5.26	6.27	8.68	8.41	4.37
Total Consumer Expenditure	25.60	32.32	37.63	48.50	64.41	86.07	118.58	176.30	284.05	72.75

APPENDIX-E.

SCHEDULE OF SURVEY WORK.

1. Name of the household. -
2. Total No.of family members
   (a) Literate -
   (b) Illiterate -
3. (a) Occupation -
   (b) No.of persons employed -
4. Total expenditure of the household -
5. What type of fuel is used generally ?-
6. What amount of fuel by type require weekly/monthly ? -
7. What amount of income is spent on fuel weekly/monthly ? -
8. What is the amount of monthly electrical bill ? -
9. How much quantity of Keresene is used weekly/monthly ? -
10. What are the different types of uses of fuel ? -
11. Whether Kerosene is used for cooking;lighting/heating ? -
12. Whether electricity is used for cooking/lighting/heating ? -
13. Any other type of fuel is used for cooking/lighting/heating. -
14. From where Kerosene is purchased ? -
15. Any preference for and type of fuel ?-
16. Type of building -
17. Interviewers' name and remarks -

	Types of fuel				
	W.	K.	E.	G.	Total
Amount Kg. Unit					
Rs.					
W/M					
Rs.					
Amount Kg					
Rs.					

Types of uses				
E	L	C	H	Appl
W				
K				
E				
G				

Place -

Date -

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