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ENERGY CONSUMPTION IN DOMESTIC SECTOR - A CASE STUDY OF SRINAGAR CITY JAMMU AND KASHMIR

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ABSTRACT: The present study attempts to analyse the spatial, fuelwise and seasonal in the energy consumption pattern of Srinagar City (J&K). The study is based on sample survey of selected households in the study area during 1984. The analysis indicates that the consumption rate of energy for domestic sector has increased rapidly, adversely affecting the ecology of the area.

INTRODUCTION

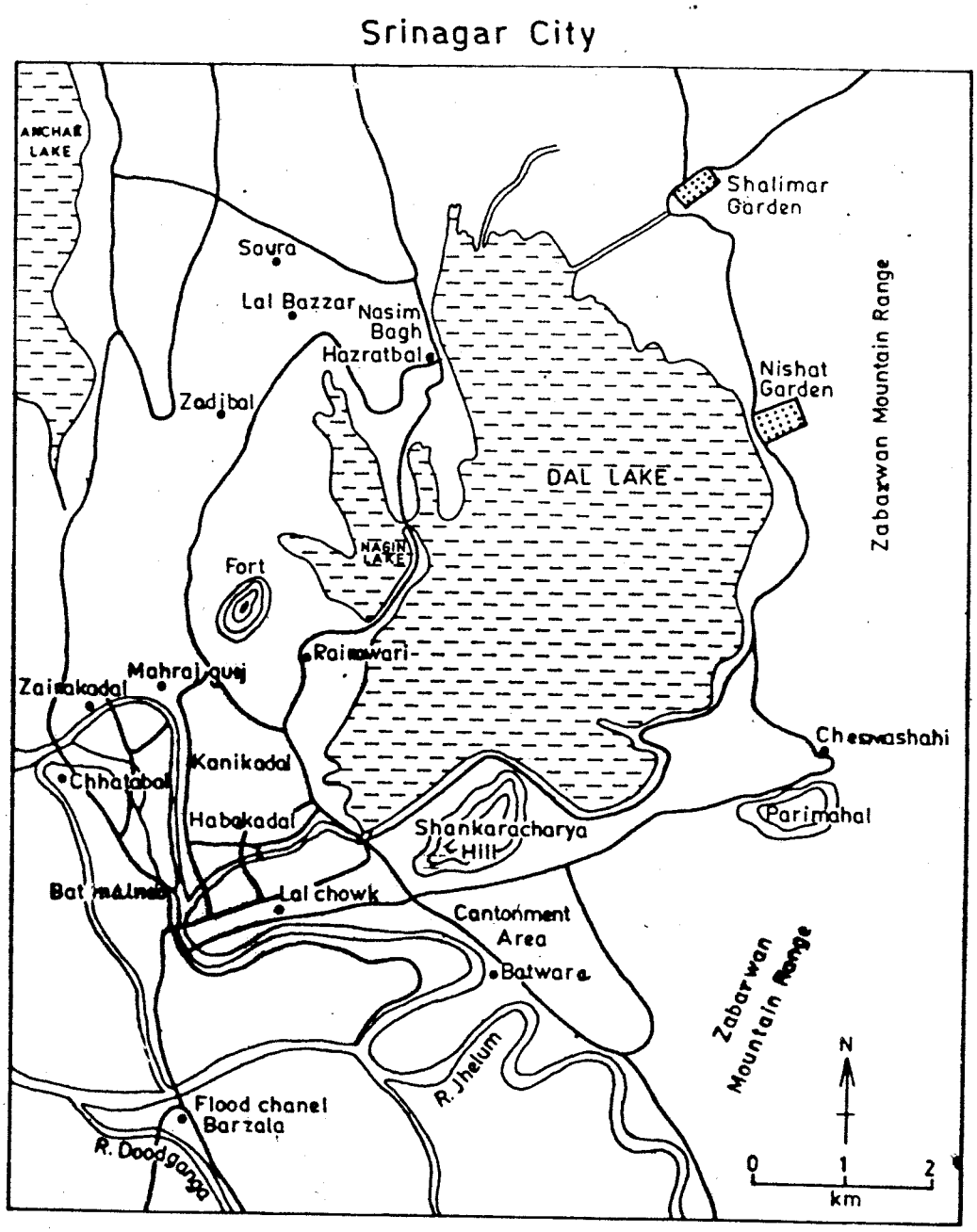
The life style of a society is closely and intimately related to its use of energy resources. Energy is an essential ingredient for the overall development. Economic development is, therefore, directly related to both the increased supply of energy and its efficient utilization. The studies conducted by Darmstadter (1971) and Tyner (1978) established high positive correlation between energy consumption and national income in both developing and developed countries of the world. However, large scale imbalances exist in the energy consumption rate between developed and developing countries. India's average annual consumption was 200 Kg. coal equivalent in 1973 as compared to 12300, 11900 and 5100 Kg. coal equivalent respectively for Kuwait, U.S.A. and U.S.S.R. according to the survey conducted by the United Nations (1970-73)

The domestic sector is one of the major consumers of energy along with manufacturing, transport and agricultural sector in India. However the bulk of energy consumed by domestic sector is at present met by non-commercial fuels especially in the rural areas. Urban areas on the other hand consume a large proportion of commercial fuels for domestic purposes. The studies of Nagarajan (1977) and Tyner (1978) found that about 15 percent of total energy extracted from commercial fuels is used for domestic purpose, while 85 percent of non-commercial fuels met the household requirements in 1970. N.C.A.E.R. (1966) study found that about 35.5 million ton coal equivalent from commercial fuels and 168.5 million ton coal equivalent from non- commercial fuels and were used for domestic sector.

Unfortunately very few studies have been conducted so far to find out the energy consumption in domestic sector for both the rural and urban areas. This is probably due to the non-availability of secondary sources of data, especially for non-commercial fuels. However, an earlier study conducted by N.C.A.E.R. (1959) for the urban areas of Delhi, Calcutta and Bombay indicated a shift from non-commercial to commercial fuels in the domestic sector. Fuels like soft coke, kerosene oil and electricity were consumed on a large scale. Average monthly energy consumption for domestic purposes in these three metropolitan centres were 16.6, 20.5 and 16.0 Kg. coal equivalent (The kilogram coal equivalent was worked out by converting the kilocalories into Kg. coal equivalent. One Kg. coal equivalent represents 6000 kilocalories) respectively for Delhi, Calcutta and Bombay in 1959.

OBJECTIVES:

The present paper is an attempt to study:
(i) Average annual energy consumption pattern, its spatial, fuelwise and seasonal variation.
(ii) The relationship of average annual energy consumption to the income of the consumers.


Srinagar City
ANCHAR LAKE
Shalimar Garden
Soura
Lal Bazzar
Nasim Bagh
Hazratbal
Zadjbal
Nishat Garden
DAL LAKE
Zabarwan Mountain Range
NAGIN LAKE
Fort
Raiwari
Mahraj gunj
Zainakadal
Kanikadal
Chhatabal
Habakadal
Shankaracharya Hill
Parimahal
Lal chowk
Cantonment Area
Batwara
Zabarwan Mountain Range
R. Jhelum
Flood chanel Barzala
R. Doodganga
N
0 1 2
km

MAP No I

(iii)Existing demand of various fuels used for domestic purposes.

The study is based on a sample survey of selected households from Srinagar city in the state of Jammu and Kashmir, conducted in 1985 to assess the energy consumption during 1984.

STUDY AREA

Srinagar city is the largest urban centre in the whole of the Himalayas (Siddique, 1986), both in terms of population size and area sprawl. The city registered a population of 586038 and an area of 177.25 sq. kms. in 1981. About 19 percent of the total population in Kashmir division is concentrated in Srinagar city. The city forms the core of Kashmir region and is located on the river Jhelum adjacent to the Dal Lake (Fig.1). Srinagar city has functioned and prospered, throughout its long history as the regional focal centre, due to its advantageous and strategic location. The city being equidistant from the rest of the areas of the Kashmir division has emerged as the main growth centre. The city has grown rapidly both in terms of population and area during the last two decades. Such a tremendous increase is probably due to the concentration of all economic, social and administrative activities.

Table I

Srinagar City - Population and areal Growth (1901-1981)

Year	Area in sq. Kms.	Population	Decadal Growth Area	Decadal Growth Population
1901	12.8	122618	-	+03.07
1911	12.85	126344	+00.39	+03.04
1921	14.48	141734	+02.68	+12.18
1931	17.60	173573	+21.54	+22.46
1941	17.60	207787	00.00	+19.71
1951	29.52	246522	+67.72	+18.64
1961	41.42	285257	+40.31	+15.71
1971	82.88	403413	+100.00	+41.42
1981	177.25	586464	+113.86	+45.37

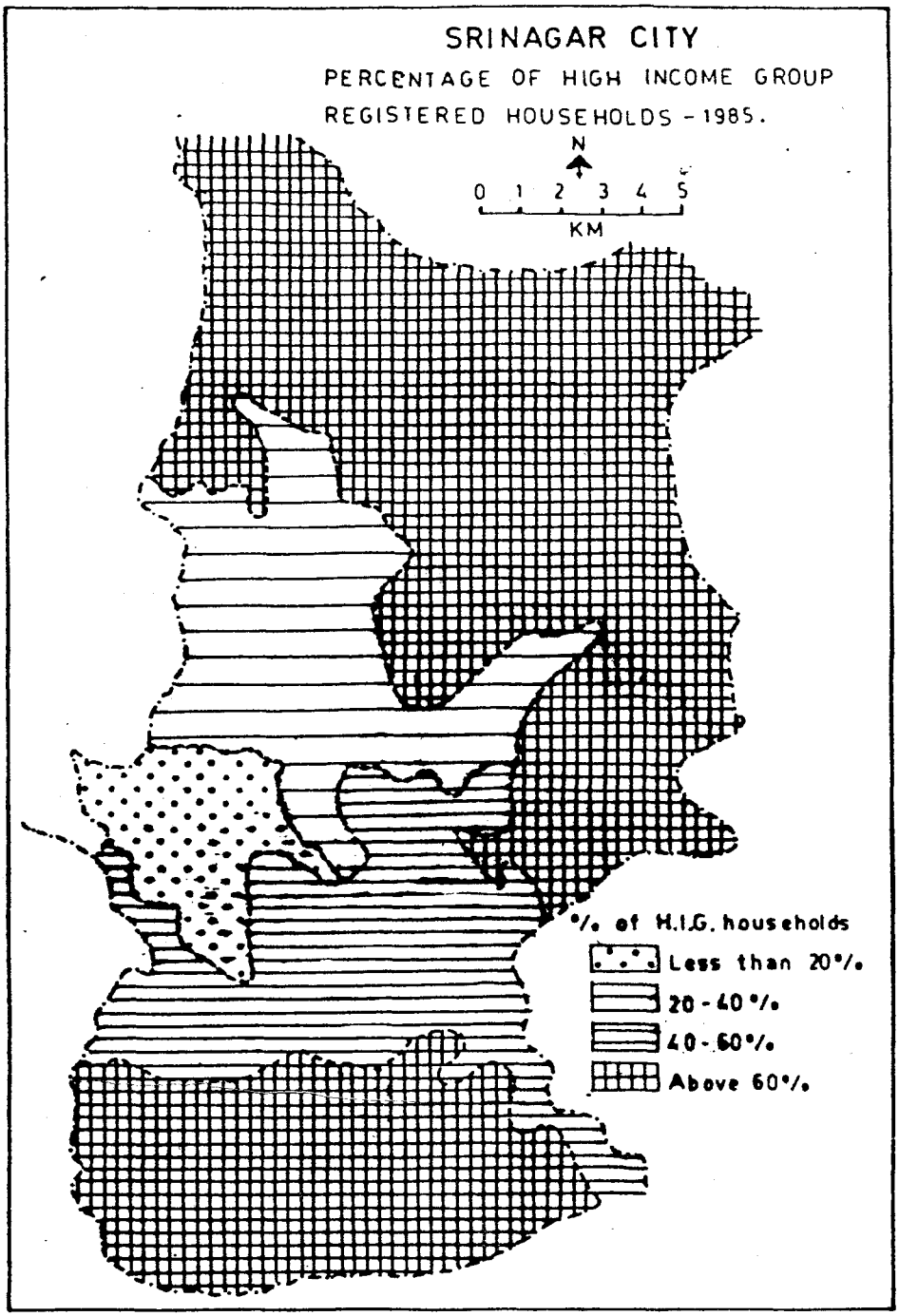
Source : Census of India, Jammu and Kashmir, Population Totals, Series - 8, 1981.

Exceptionally high positive growth rate was registered during 1961-81 both in terms of area and population. Such an excessive growth was due to large scale in-migration of population from the surrounding areas. This excessive increase in population has lead to very high consumption of fuels in the domestic sector. The demand for fuels has contributed in the exploitation of forest wealth leading to ecological imbalances and environmental pollution.

The Srinagar city is divided into 17 wards. Eight wards namely Chhatabal, Kanikadal, Naisarak, Maharajgunj, Safakadal, Rainawari, Zainakadal and Zadibal are located in the old city area all along, on both sides of the river Jhelum. The area represents the old city adjacent to the Fort (built by Akbar the Great). Most of the population are engaged in small scale trade activities. Five wards namely Nishat, Hazratbal, Lal Bazzar, Soura and Barzalla are the recent outgrowths and are mostly devoted for residential and large scale business activities. These wards are thronged with rich business class population as well as high ranking civil servants. These people have moved out from the congested core areas of the city. The remaining four wards of the city namely Batwara, Habbakadal, Amirakadal and Batmalnoo represent the "Central Business District" (CBD) area with large scale commercial and administrative activities. The area has a mix of both trade and service sector population.

DISTRIBUTION OF HIGH INCOME GROUP HOUSEHOLDS

In order to study the relationship between income of the consumers and the rate of energy consumption, the distribution of high income group households in each ward was worked out. (The data for identifying the high income group households in all the wards was collected form the Directorate of Food and Supplies department, Srinagar. The department issues ration tickets to nearly 90 percent of households in the city. Two types of ration tickets are issued one for low income group and the other for high income group.)



Source - Directorate of Food & Supplies Department, Srinagar.

High Income Groups are those whose monthly income is more than Rs 600 /-

Fig. 2 depicts four major area with various levels of high income group households. Old city area, constituting of Chhatabal, Kanikadal, Naisarak, Maharajgunj and Safakadal registered less than 20 percent households in the high income group. (High income group households are those whose monthly income is more than Rs.600/-). Old residential areas of Rainawari, Zainakadal and Zadibal registered 20-40 percent high income group households. On the other hand the CBD areas of Batwara, Amerikadal, Batmalnoo and Habbakadal registered 40-60 percent high income group households. The recent outgrowth are of Nishat barzalla, Hazratbal, Soura and Lal Bazaar had more than 60 percent households with high income. The future analysis of the study has been done on the above four identified areas.

SAMPLE DESIGN

The data for the present study has been collected after conducting sample survey. Sixty households were selected for the sample survey. 15 households each from old city, old residential area, central business district and new residential area were selected. These households were selected from the various income groups. 35 households were selected form the income group of less than Rs.600/- per month, 19 from Rs.600-Rs.1500 income group and 6 households from more than Rs.1500 income group. The proportion of households from these income groups among the four areas was inaccordance with the percentage of high income group households already identified from secondary sources. Thus 12, 10, 7 and 6 households from the income group of less than Rs.600 per month were selected respectively from Old City, Old residential, Central business district and New residential areas. Similarly 3, 4, 6 and 6 households from the income group of Rs.600 - Rs.1500 per month were selected respectively from the above mentioned areas. On the other hand 1, 2 and 3 households from income group of more than Rs.1500 per month were selected respectively for Old residential, Central Business and new residential areas. Habits regarding the choice of fuels used for domestic purposes have been assumed not to differ significantly from one household to other. This was confirmed by a pilot survey of interviewing households at random in each income group.

Monthwise data regarding consumption of commercial and non-commercial fuels for cooking and heating was ascertained. However data regarding electricity consumption could not be ascertained due to non availability of records in most of the households. Hence the study does not include electricity consumption. data regarding firewood, kerosene oil, charcoal, sawdust, cowdung cakes and vegetable wastes have been grouped as sawdust.

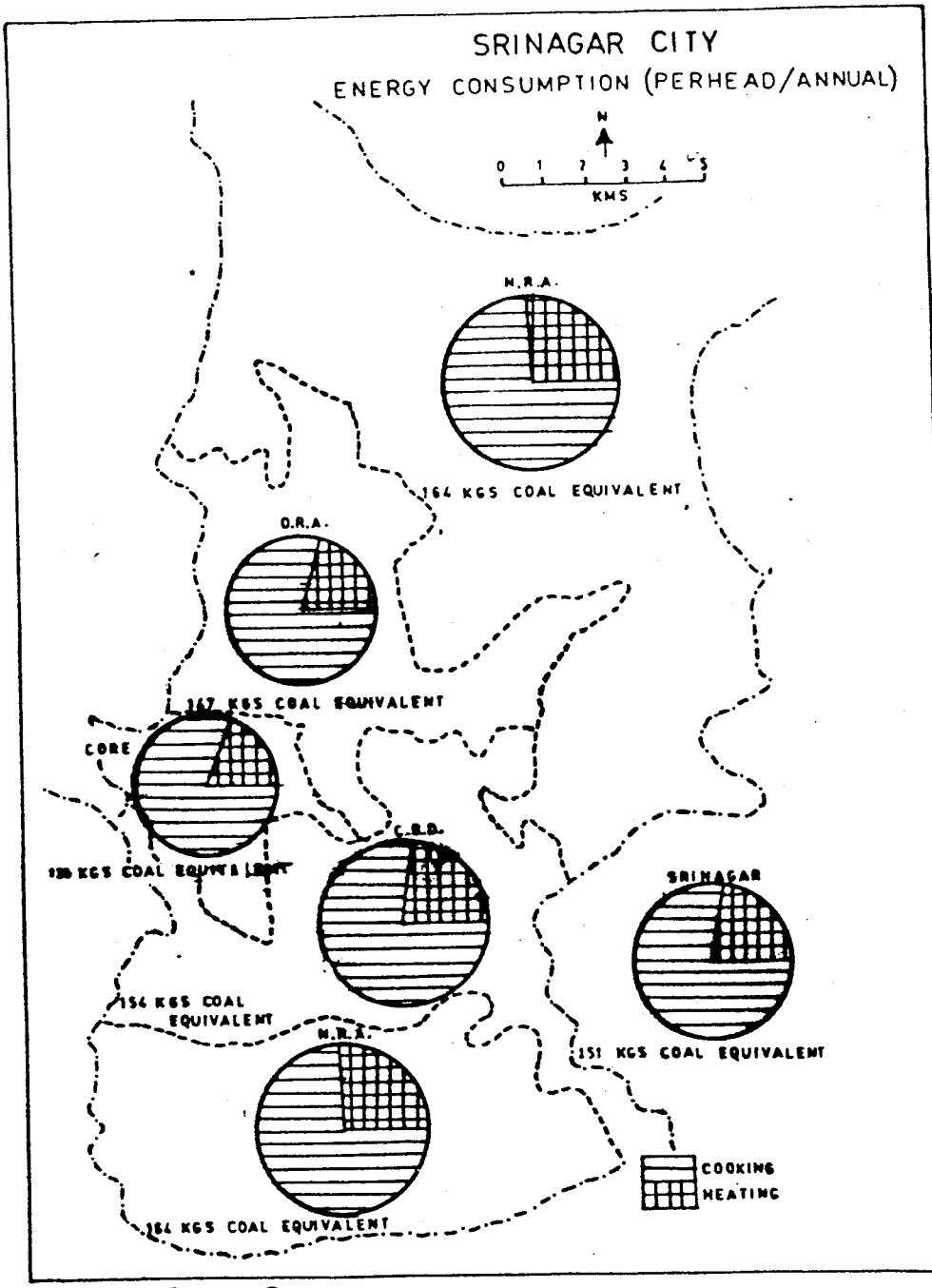
A major difficulty in assessing energy consumption is the relative valuation of various types of fuels used. In the present study the figures of consumption of fuels were converted into their energy equivalent in kilogram coal equivalent (Kce) according to the table of conversion devised by Energy Survey of India Report (1965).

Table II
RELATIVE VALUATION OF FUELS
IN TERMS OF KG.COAL EQUIVALENT

Fuel type	Unit	Kg.coal equi.
1. Coal	Kg	1.0
2. Firewood	Kg	0.95
3. Charcoal	Kg	1.0
4. Sawdust & cow-dung cakes	Kg	0.40
5. Kerosene oil	litre	2.00
6. L.P. gas	cu.m	2.00

AVERAGE ANNUAL ENERGY CONSUMPTION

The average annual energy consumption used for domestic purposes in Srinagar city was 151 Kce during 1984. However sharp variations in the consumption rates were observed among



Source - Sample Survey

the four areas. The average annual consumption was 138 Kce in the old city, 147 Kce in the Old Residential areas, 154 Kce in the Central Business district area and 164 Kce in the New Residential area. (Table III). The variation was largely due to the imbalances in the energy used for heating purposes. Average annual energy used for heating was exceptionally high in the New Residential area as compared to the other areas (Fig. 3). On the other hand energy used for cooking did not register such variations among the four areas. The variations in the consumption rate for heating among the four areas could be attributed to the presence of large number of households with high incomes. These households have recently shifted from the core congested areas of the old city. They have newly constructed houses, which are more spacious and comparatively sparsely distributed. Hence more energy is required for heating purposes. Since they have high purchasing power, hence they can afford to purchase commercial fuels for heating and cooking purposes. The second reason could be attributed to the materials used for the new constructions. In the old city areas houses are highly congested and cold resistance materials lime mud, brick and wood are commonly used. But in the new residential areas cement and iron are ubiquitoubly used. This requires more energy for heating. Thus the socio-economic conditions, the architectural pattern, materials used for constructions, and the spatial distribution of houses could be probably responsible for such variation in the energy consumption rates among the four areas. This is testified by the fact that even within the high income group households from the Old City, the average energy consumption was low for heating as compared to other areas in the same income group.

FUELWISE ENERGY CONSUMPTION

Firewood and kerosene oil are the two major fuels consumed for domestic purposes in Srinagar city. The average annual consumption of firewood and kerosene oil was 70 Kce and 33 Kce respectively. The other fuels used were sawdust, cowdung cakes, charcoal and L.P.gas. The consumption of charcoal, sawdust etc. and L.P.gas was 14, 13 and 6 Kce respectively. The fuelwise consumption, however indicates that average annual consumption of kerosene oil was very high for the new residential and central business district areas, i.e. 47 Kce and 35 Kce respectively as compared to 29 Kce for Old residential and 22 Kce for Old city area. Such a high average consumption of kerosene oil did not on the other hand show a significant reduction in the use of firewood in the new residential and central business district areas. L.P.Gas consumption was more or less restricted in the new residential and CDB areas.

The fuelwise average annual consumption for heating and cooking separately depicts large variations among the four areas. Average annual consumption of firewood for cooking was low in the new residential areas i.e. 56 Kce as compared to 76, 75 and 70 Kce respectively for Old city, Old residentail area and CBD area consumed high average energy both from firewood and kerosene oil for cooking purposes. This is to a large extent due to the presence of large number of hotels and restaurants, to meet tourist demands.

Three fuels viz. firewood, charcoal and sawdust etc. were used for heating purposes during winter months. The avarage annual consumption of firewood for heating was exceptionally high for new residential and CBD areas i.e. 22 Kce and 18 kce respectively. Charcoal consumption was more or less same for all the areas. Charcoal was usually used for 'Kangri' (an earthen pot enclosed in cane. Charcoal is usually used in the earthern pot for heating the body) and firewood for 'Bukhari' (a heating system for the room, which is commonly used by middle and high income groups). The use of 'Bukhari' was mostly restricted in the new residential and CBD area. However along with 'Bukhari', the use of 'Kangri' was also common in these two areas.

SEASONWISE ENERGY CONSUMPTION

The average consumption of energy during the three seasons viz. summer (April to July), Autumn (August to November) and Winter (Decem-

Table III
SRINAGAR CITY
Average Annual Energy Consumption (Kce)
1984

AREA	PURPOSE	TOTAL ENERGY	FUELWISE AVERAGE CONSUMPTION				
			Wood	K.Oil	Coal	Sawdust	L.P.Gas
Old City	Total	138	85	22	14	15	2
	Cooking	112	76	22	4	9	2
	Heating	26	10	-	10	6	-
Old Residential area	Total	147	88	29	11	13	6
	Cooking	116	75	29	1	5	6
	Heating	31	13	-	10	8	-
Central Business Area	Total	164	78	47	17	12	10
	Cooking	121	56	47	3	5	10
	Heating	43	22	-	14	7	-
New Residential Area	Total	164	78	47	17	12	10
	Cooking	121	56	47	3	5	10
	Heating	43	22	-	14	7	-
Srinagar City	Total	151	85	33	14	13	6
	Cooking	117	69	33	3	6	6
	Heating	34	16	-	11	7	-

Source : Sample survey of 60 households

ber to March) indicates that nearly 45 percent of total annual energy consumed was used during the winter months. Hence major energy used for domestic purpose is needed during winter months. During the survey it was observed that nearly 25 to 30 percent more energy is required for cooking during winter months as compared to the other months, due to the low temperature of water. Average energy consumption during April to July was the least. However the consumption during August to November was comparatively high, due to large number of social and religious functions usually socialised during these months.

Table IV

Srinagar City (average Annual Consumption) in Kce 1984

Area	Dec./ March	Apr/ July	Aug./ Nov.
Old city	65	31	42
Old residential area	68	36	44
C.B.D.	79	36	44
New Residential area	78	38	48
Srinagar City	71	36	44

Source : Sample survey of 60 households

INCOME AND ENERGY CONSUMPTION.

The average annual energy consumption among the income groups selected indicates that large scale variations are existing. average annual energy consumption for the income group of more than Rs.1500 per month was 229 Kce, as compared to 156 Kce for the income group of Rs.600 to Rs.1500, and 134 Kce for the income group of less than Rs.600 per month. the variations in the consumption was comparatively higher for the energy use for heating i.e. 80 Kce, 36 Kce, and 25 Kce respectively for high, medium and low income groups. Similarly variation was also observed for the energy used for cooking among these three income groups. This indicates the strong positive association between Energy consumption and the income of the households.

Fuelwise use of energy for the three income groups indicates preference of kerosene oil and L.P.Gas in case of high income groups for cooking purposes. The average annual consumption of kerosene oil and L.P. gas for cooking was 66 Kce and 34 Kce respectively for high income

groups. On the other hand firewood consumption for cooking for low income group was high i.e. 77 Kce as compared to 64 Kce and 40 Kce respectively for middle and high income groups. Limited use of charcoal and sawdust fuels was for cooking purposes, especially for high income groups. (Table IV) and (Fig.4)

The average annual consumption for heating among the three income groups depicted reverse trend, as firewood consumption for heating was exceptionally high i.e. 58 Kce for high income group, 16 Kce for middle income group and 8 Kce for the low income group. The use of charcoal and sawdust for heating did not show any significant variation among the three income groups.

The correlation coefficients worked out to establish relationship between income of the households and the level of Energy consumption, depicts high positive correlation i.e. +.7632, which was significant at 0.1 percent level of confidence. Similarly high positive correlation between income of households and average consumption of kerosene oil and L.P.gas (converted to Kce) was found. The correlation co-efficient derived were +.8753 and +.9463 respectively. Both were significant at 0.1 percent level. On the other hand negative correlation was found between income of the households and average consumption of firewood (converted to Kce). The value obtained was -.4216, which was significant at 0.5 percent level.

Table V

Srinagar City

Income groups and average annual energy consumption (Kce) 1984

Income groups (Rs. Month)	Purpose	Total energy	Fuel type F/Wd	K.Oil	coal	saw dust	L.P. Gas
Below Rs. 600	Total	134	85	24	11	13	1
	Cooking	109	77	24	2	5	1
	Heating	25	8	-	9	8	-
Rs. 600 - Rs. 1500							
	Total	156	77	40	18	13	8
	cooking	120	64	40	4	4	8
	Heating	36	13	-	14	9	-
Rs. 1500 and above							
	Total	229	98	66	13	18	34
	Cooking	149	49	66	-	9	34
	Heating	80	58	-	13	9	-

Source : Sample survey of 60 households

EXISTING DEMAND OF FUELS

Existing demand of fuels was worked out to assess the current consumption of various fuels in Srinagar City. The demand was obtained on the assumptions that the average annual energy consumption would remain constant for a fuels. Growth rate of 4 percent per annum for the population was assumed for Srinagar City till 1986. On the basis of above assumptions the demand for 713520 persons in 1986 for Srinagar city was obtained.

Table V, indicates a consumption of 57616 tons of firewood, 9989 tons of charcoal, 3710 tons of sawdust etc., 23546000 liters of kerosene oil for these fuels separately was ascertained for cooking and heating.

Table VI

Srinagar City

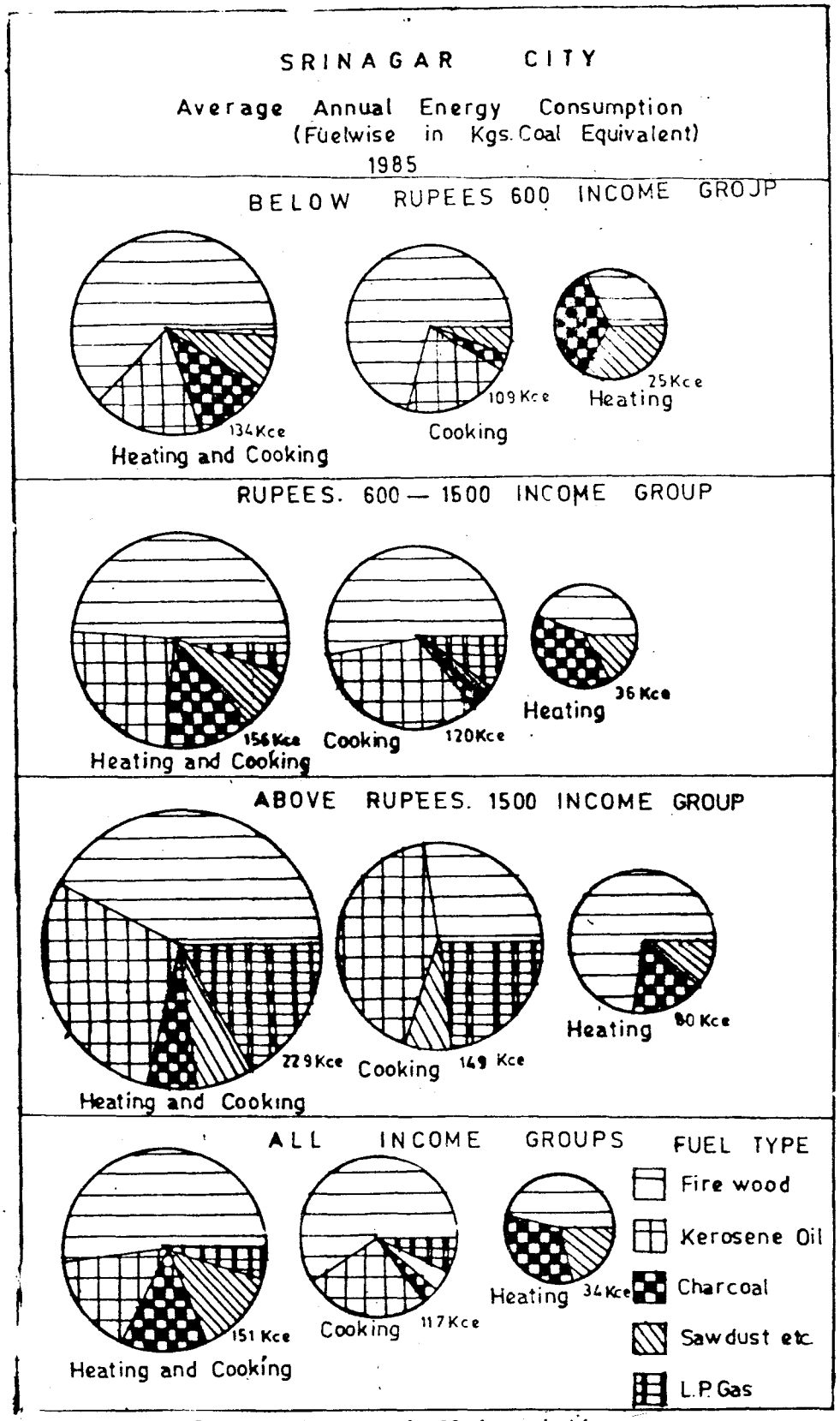
Demand for Domestic fuels (1986)

Fuel Type in (Kgs.)	Total	Cooking	Heating
Firewood	57616700	46771200	10845500
Charcoal	9989200	2140500	7848700
Sawdust	3710300	1712400	1997800
K. Oil	23546000	23546000	-
L.P.gas (No. of Cylinders of 16.1 Kg.)	59049	59049	-

Source : Sample Survey

CONCLUSIONS

The above analysis of energy consumption in Srinagar city indicates that due to large scale immigration of population from the surrounding areas, the consumption rate of energy for domestic sector has increased rapidly. This has lead to the extracting of forest resources, as firewood continues to be a major fuel used for cooking and heating purposes. If such a situation continues, the consumption of firewood will lead to large scale deforestation. This will adversely effect the ecology of the area. This will probably lead to decrease in tourist flow, which is the major contributor of state economy.



Source : Sample Survey of 60 households

The use of less pollutant bearing fuels like kerosene oil and L.P.gas is restricted to high income groups. This is due to the non availability of these fuels at stipulated rates especially during winters, when they are most needed. Constant use of pollution borne energy fuels like firewood and sawdust have posed a serious health and pollution problems especially in the congested old city area.

Hence alternate sources of energy should be evolved for heating and cooking purposes to reduce the excessive consumption of firewood. Electricity generated through a mix of small scale and large scale hydro-electric schemes could probably reduce the excessive use of firewood, charcoal and sawdust. The distribution system of kerosene oil and L.P. Gas through ration depots at the stipulated rates should be strengthened. Moreover the supply of kerosene oil during the winter months must be assured. the use of heat efficient cooking stoves by low income groups could probably reduce the excessive use of energy for cooking.

Similarly adequate attention must be paid to the designing of constructions as well as the use of construction materials, so that less energy is required for constructions. On the other hand non conventional sources of energy like biomass, wind and geo-thermal must by explored, as the region has significant potential for the development of these energy sources. Efforts must also be made to regenerate the forest wealth through constant afforestation schemes.

REFERENCES

Darmstadter, J et al, (1971) : Energy in the World Economy, The Johns Hopkins Press, Baltimore
Nagarajan, R and Lahiri, A (1977) : India in Perspective, Development Issue, Vol. II, Arnold Heinemann, pp.211.
N.C.A.E.R. (1959) : Domestic Fuels in India, Asia Publishing House
Parmar, D.S. and Others (1985) : "Renewable Energy Resources and Requirements in Jammu & Kashmir States" Paper presented in the Seminar on Energy Problems and Prospects in J&K State, (June 24-26, 1985), University of Kashmir, Srinagar.
Report on Energy Survey of India, (1965) : Government of India, New Delhi
Report of the Fuel Policy Committee (1974) : Government of India, New Delhi.
Tyner, W.E (1978) : Energy Resources and Economic Development in India, Allied Publishers, Pvt. Ltd.
United Nations (1973) : World Energy Supplies, Series J, No.18, pp.13-35
Siddique, M (1986) : "Srinagar - the Primate city in the valley of Kashmir, its planning and development," paper presented in the National Seminar on Regional Planning and Urban Development in the state of Jammu & Kashmir (29 June - 2nd July, 1986) University of Kashmir, Srinagar
Zutshi, B and Datta, M (1985) : "Fuel Consumption Pattern in srinagar Municipality - A Spatial Analysis". paper presented in the Seminar on Energy Problems and Prospects in J&K state, (June 24-26, 1985), University of Kashmir, Srinagar.

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