DEMAND FORECASTS OF HOUSEHOLD ENERGY AND POLICY FOR WASTELAND MANAGEMENT IN INDIA

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Estimates of future demand for a good or a set of goods should be helpful for planned adjustment in production capacities; and for assessing the financial and manpower resources, and the policy support required for that purpose. More importantly, the forecasts should bring out the likely gaps between demand and supply which, in turn, should necessitate and facilitate assessments of managerial, administrative, and social feasibilities of demand-supply management.

The main objectives of this paper are

- to assess the demand forecasts for household energy with special reference to fuelwood in India, and

  to discuss the policy implications of the forecasts for improved management of the forest and non-forest wasteland.

Fuelwood, dung cakes, and agricultural residues continue to be classified as non-commercial energy sources; the non-commercial fuels account for more than half of the total and more than three-fourths of the household energy use; and fuelwood's contribution to the non-commercial energy supplies has been more than 55 and 85 per cent in the rural and urban areas, respectively [GOI, 1985; NCAER, 1985].

Demand forecasts usually meet with problems. The problems can be relatively more severe for a commodity like fuelwood due to the difficulties in assessing the direct and indirect impacts of a large number of causal variables such as the product price, prices

of substitutes, size and location of user households, price and income elasticities of demand; and likely changes in the causal variables themselves. In spite of such problems, attempts to estimate the demand for fuelwood and other sources of household energy have been done for the past, at least, three decades.

These are discussed in the next seven sections. Section 8 presents some general observations on the methodology and assumptions of the forecasts, and their lessons for wasteland management policies.

1. Energy Survey of India

Probably the first attempt to estimate and to forecast the total energy consumption, and the sources of its supply was made by a 1965 Committee of the Energy Survey of India (ESI). The data on consumption of non-commercial fuels were derived from i) the 1962 all India sample surveys of rural households; and ii) the 1958 household sample surveys in Bombay, Calcutta, and Delhi conducted by the National Council of Applied Economic Research (NCAER).

The surveys estimated the average per capita domestic energy consumption at 0.38 and 0.40 tonne coal replacement (TCR) in the rural and the metropolitan areas, respectively. The income elasticity of demand for domestic energy was estimated only for the city dwellers and was 0.4 for the group with per capita income above Rs.300 a year.

Since the energy use estimates for urban areas other than the three metropolitan cities were not available, the Committee assumed it to be 0.39 TCR per capita. The Committee also assumed that energy consumption during the preceding decade had increased

by 4.5 per cent, i.e., equivalent to the income elasticity of energy demand in the cities. The past per capita energy use patterns were reconstructed on that basis (Annexure 1).

The data in Annexure 1, and the rural and urban population estimates were used to arrive at the total domestic energy consumption. To arrive at the non-commercial energy use, commercial energy consumption (for which relatively better data were available) was deducted from the estimated total energy consumption. Within the non-commercial sources, the estimated contribution of fuelwood, animal dung, and agricultural residues was based on the assumption that their relative shares did not change over time. The results are presented in Annexure 2.

For projecting the energy demand till 1980-81, the Committee assumed that

- the average per capita energy consumption was 0.38 and 0.39 TCR in the rural and urban areas, respectively;
- the per capita energy consumption would rise by 25 and 15 per cent in the rural and urban areas, respectively (1/);
- the commercial energy consumption would double every ten years, as in the past; and
- the use of farm residues would increase in proportion to the expected increases in agricultural output, but the proportionate contribution of fuelwood and dung cake in the remaining non-commercial energy use would stay at the 1963 level.

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1. This was based on the assumptions that i) the total real per capita consumption may be nearly doubled, ii) electricity may be more widely available so that around 50 per cent of the urban and 30 per cent of the rural population would belong to the category with income elastic energy demand, and iii) income elasticity of energy demand across the country would be 0.5.

It may, however, be noted that the Committee's report is not specific on this point and the reference seems to be to the average income elasticity of energy demand. It may also be noted that the NCAER had earlier estimated the income elasticity of commercial energy demand in rural areas at 0.18-0.20 [NCAER, 1960].

The demand projections are summarized in Table 1. During 1961-81, the total energy demand was expected to increase by 94 per cent. The demand for electricity, coal, oil, and commercial energy as a whole was expected to increase by more than 11, 10, 5, and 6 times, respectively. Compared to that, the demand for non-commercial energy, fuelwood, and dung cake was expected to increase only by 43, 31 and 17 per cent, respectively. A perusal of the data in Table 1 can also show that, within the non-commercial group, fuelwood's share was expected to decline from 65 to 60 per cent whereas the share of farm residues was expected to increase from 20 to 28 per cent.

Table 1 : ESC's projected household energy demand : 1961 to 1981

(MT except for electricity where TWH)

Description	1961	1971	1976	1981
Commercial				
Oil products	2.0(12.9)	4.3(28.0)	6.3(41.0)	10.2(66.0)
Soft coke	2.8(2.8)	9.2(9.2)	20.0(20.0)	28.0(28.0)
Electricity	1.5(1.5)*	7.3(5.1)	11.4(8.0)	17.0(14.0)
Sub-total	**(17.2)**	**(42.3)**	**(69.0)**	**(108.0)**
Non-commercial				
Firewood	100(95.3)	121(115.7)	130(124.0)	131(123)
Dung cakes	54(21.6)	60(24.0)	63(25.0)	63(25.0)
Agri residues	31(29.2)	45(43.0)	53(50.0)	62(59.0)
Sub-total	**(146.1)**	**(182.7)**	**(199.0)**	**(209.0)**
Total	**(163.3)**	**(225.0)**	**(268.0)**	**(317.0)**

MT = Million tonnes; TWH = Trillion watt hours.
* Figures in parentheses are million tonnes coal replacement(MTCR).
Source : GOI, 1965, p.70.

The Committee must have been satisfied with the expectation of a major shift towards commercial energy sources. It reasoned that growth in non-commercial energy use should be curbed. The suggested measures to achieve that objective included

i) enhanced production and subsidized supply of commercial energy in general, and soft coke briquettes in particular; and

ii) imposition of octroi duties and other taxes on fuelwood.

But a little reflection on the socio-economic dynamics could have sufficed to show that a major shift from fuelwood/dung cake/agricultural residues towards soft coke and oil products could not be feasible so long as the non-commercial continue to be non-commercial, i.e., till they are not appropriately priced.

The Committee did, however, emphasize planned development of non-commercial energy sources. For instance, it suggested that vigorous measures be adopted to enhance fuelwood production. A specific suggestion was to set-up a fuelwood division in the then Ministry of Food and Agriculture, Government of India (GOI).

But, such administrative actions could hardly be expected to lead to a developed fuelwood market. Similarly, octroi duties on fuelwood, even if feasible, could not be expected to substantially reduce illicit cutting, inefficient use, or even misuse of the material (2/).

It may also be noted that the demand forecasts were not validated (Tables 1 and 2 together). Whereas the observed consumption levels in 1963 were close to the Committee's expectations for 1961, the 1979 observations were substantially below that for 1981.

At the same time, animal dung has been an exception as its observed use in 1979 was significantly higher than the estimate

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2. At the same time, the suggestion to enhance fuelwood output should be welcome as enhanced production of soft coke briquettes could possibly not be a financially, socially, and environmentally preferred alternative.

Table 2 : Observed household consumption : 1963 and 1979

(MT except for electricity where TWH)

Description	1963(3/)	1979
Electricity	0.2	7.3
Soft coke	2.1	6.5
Oil products	2.4	4.2
Fuelwood	97.2	95.5
Dung cakes	52.2	71.1
Agril. residues	26.4	30.6

Sources : NCAER, 1965; and NCAER, 1985.

for 1981. This may mean that dung continued to be a preferred source of household energy due to

- its inherent characteristics such as slow burning, and/or
- relatively certain supplies, and/or
- perceptions of dung work as an integral part of the household chores even by the land owning families in rural India.

2. National Council of Applied Economic Research

The NCAER also used the results of their 1962 survey (Annexure 3) to project the rural households' energy demand up to 1976. It was assumed that

- the rural population by the mid 1970s would be around 477 million;
- the per capita income during 1962-76 would increase by about 70 per cent;
- as estimated earlier, rural areas' income elasticity of demand for commercial fuels would be 0.18 to 0.20 [NCAER, 1960]; and
- besides the income effect, consumer preference would shift towards commercial fuels by 5 to 7 per cent.

The results obtained are summarized in Table 3.

3. The 1963 survey was confined to the rural sector. However, the survey report took account of two earlier studies [NCAER, 1959 and 1960] to arrive at the all India estimates. Electricity data still pertain to rural areas only.

Table 3 : NCAER's estimates of rural households' energy consumption : 1976

(MT except for electricity where TWH)

Energy source	Quantity
Commercial	
Electricity	0.26(0.17)
Soft coke	2.2 (3.3)
Oil products	2.6 (16.9)
Sub-total	**(20.37)**
Non-commercial	
Charcoal	0.27(0.3)
Firewood	112.4 (106.8)
Dung cakes	60.6 (24.2)
Agril. residues	33.5 (31.7)
Sub-total	**(163.0)**
Total	**(183.37)**

Source : NCAER, 1965, various pages.

But the Council itself assessed the forecasted pattern to be infeasible mainly due to absolute shortages of non-commercial fuels. Thus, the forecast was reassessed with additional assumptions that:

- fuelwood supply from forest and non-forest areas could be around 70 million tonnes a year as estimated by the Ministry of Food and Agriculture, GOI [GOI,1962];
- fuelwood consumption in the urban areas would be negligible;
- the use of agricultural residues as fuels should be restricted to 17 million tonnes to enhance their use for compost making;
- success of the scheme to move milk colonies from the cities would limit the animal dung use to rural areas;
- soft coke use would be enhanced to meet the shortfalls in supplies of fuelwood and agricultural residues;
- around 202,000 villages would be electrified and 1.77 trillion watt hours a year would be available in rural areas;
- effective per capita consumption of lighting energy in rural areas would increase from one to six KWH; and
- kerosene supply would be eight to nine million tonnes of which about six million tonnes would be available to rural households.

The resulting demand estimates are summarized in Table 4.

Table 4 : NCAER's estimates of household energy demand : 1976

(MT except for electricity where TWH)

Energy source	Quantity
Commercial	
Electricity	1.77(1.2)*
Kerosene	8.5 (55.3)
Soft coke	37.0 (55.5)
Sub-total	**(112.0)**
Non-commercial	
Firewood	70.0 (66.5)
Dung cakes	60.0 (24.0)
Agril. residues	17.0 (16.1)
Sub-total	**(106.6)**
Total	(218.6)

* Figures in the parentheses are in MTCR
Source : NCAER, 1965, p.57.

A perusal of Table 4, and the preceding assumptions should suffice to say that the Council's estimates can neither be characterized as demand nor need. The terms demand and availability were used inter-changeably, and the estimation process made no reference to prices (4/).

3. The Fuel Policy Committee

In 1974, a Fuel Policy Committee (FPC) of the GOI estimated the household use of commercial and non-commercial fuels. The data generated by the NCAER surveys were, once again, used. It was also assumed that

- the annual per capita energy consumption was 0.38 and 0.40 TCR in the rural and urban areas, respectively; and
- fuelwood, animal dung, and agricultural residues contributed 65, 15 and 20 per cent, respectively, to the total non-commercial energy.

4. The expenditure data were available at the Council [NCAER, 1965]

With these assumptions, and the estimated rural and urban population, domestic consumption of non-commercial and total energy during 1961-71 was reconstructed (Annexure 4).

A comparative study of Annexure 4 and Table 1 shows that actual increase in domestic energy use during 1961-71 was estimated at 22 per cent whereas an earlier Committee expected it to be 37 per cent. Similarly, the consumption of commercial energy in the domestic sector increased by only 70 per cent against the earlier Committee's forecast of nearly 150 per cent.

The FPC also forecasted the demand up to 1991. It assumed that :

- the per capita energy consumption may not change considerably;
- almost all the urban and 70 per cent of the rural households would use electricity for lighting;
- about 20 per cent of the rural households would use kerosene for lighting;
- nearly 60 and 10 per cent of the urban and rural households, respectively, would use kerosene for cooking;
- up to 1984, the shares of fuelwood, dung and agricultural residues in the non-commercial energy use would be the same as estimated by the Energy Survey Committee for 1963; and
- the absolute consumption of agricultural residues would stabilize starting 1984 whereas that of fuelwood and animal dung would stay in the same ratio as in 1984 (5/).

The Committee's forecasts of household energy demand are summarized in Table 5.

The 1989 data with respect to household use of kerosene and LPG show that the forecasts for 1991 may be fairly well validated (Table 6). This should be a matter of some satisfaction as their consumption was stipulated to increase by about 75 per cent and

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5. The ESC had assumed the consumption of agricultural residues to increase in proportion to the farm output.

Table 5 : FPC's projections of domestic energy demand : 1979-1991

(MT except for electricity where TWH)

Description	1979	1984	1991
Commercial			
Electricity	8.0(8.0)*	13(13.0)	25(25.0)
Kerosene	3.5(29.1)	4.5(37.4)	6.0(49.8)
Soft coke	6.0(9.0)	14(21.0)	20(30.0)
L.P.G.	0.4(3.3)	0.8(6.6)	2.0(16.6)
Sub-total	**(49.4)**	**(78.0)**	**(121.4)**
Non-commerial			
Firewood**	132(125.4)	131(124.5)	122(115.9)
Dung cake	65(26.4)	65(26.6)	53(21.2)
Agril. wastes	46(43.7)	46(43.7)	46(43.7)
Sub-total	(195.1)	(194.2)	(180.8)
Total	**(244.5)**	**(272.2)**	**(302.2)**

* Figures in parentheses are in MTCR.
** including charcoal.
Source : GOI, 1974, p.93.

Table 6 : Domestic consumption of kerosene, LPG, and electricity in India : 1971 to 1989

(MT except for electricity where TWH)

Years	Kerosene*	LPG*	Electricity
1970-71	2.95	0.16	3.84
1975-76	2.80	0.31	5.82
1980-81	3.81	0.36	9.25
1982-83	4.67	0.54	12.10
1983-84	4.97	0.68	13.23
1984-85	5.40	0.86	15.04
1985-86	5.61	1.12	
1986-87	5.98	1.35	
1987-88	6.51	1.53	
1988-89	5.11	1.28	

* Assumed to be 90 per cent of the total.
Sources : GOI, 1987a; GOI, 1987b: GOI, 1988; GOI, 1989.

400 per cent over the 12 year period. Similarly, the 1984 electricity data show that the observed use was comparable to the forecast. Comparable data for soft coke were not available.

The data in Table 5 also show that while the commercial energy and total energy use was anticipated to increase by about 150 and 25 per cent, that of non-commercial energy was expected to decline by 8-10 per cent due to decline in fuelwood and animal dung use.

Such shifts from non-commercial to commercial energy sources must be welcome to facilitate the formulation and execution of sustainable energy policies. An important issue, at the same time, is whether at least fuelwood should continue to be treated as non-commercial.

The Royal Commission on Agriculture in 1928, believed that the use of animal dung as fuel could be reduced with assured fuelwood supplies at reasonable prices, i.e. prices which the rural households can afford to pay. The reasoning seems to be more relevant at present than in the 1920s. The relevance of observing nature's cycle is better and more widely appreciated than ever before. Those who burn animal dung seem to be aware, but can be better educated, of its opportunity cost. Since the society is to benefit by the shifts from non-commercial to commercial and non-renewable to renewable energy sources, and from animal dung to fuelwood; the most important step on the energy front must be to enhance fuelwood supplies beyond a critical minimum (6/).

4. National Commission on Agriculture

The National Commission on Agriculture (NCA) in 1976 projected only the fuelwood demand up to AD 2000. The Commission accepted the FPC's 1971 estimates of fuelwood consumption of 220 kg per

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6. There has been a policy emphasis on enhanced fuelwood production but the programmes and policies do not seem to match.

capita or total 120 million tonnes, but reasoned that 15-20 per cent of that is first used as timber and then as fuelwood. Thus, the net per capita fuelwood use was estimated at about 194 kg a year. Further, it was assumed that, starting around 1985, per capita fuelwood consumption would decline @ 1 per cent per annum and may be about 166 kg by the turn of the century (7/). The demand projections arrived on that basis are presented in Table 7.

Table 7 : NCA's fuelwood demand forecasts : 1970 to 2000

Years	million cubic metres	million tonnes*
1970	150.0	105.0
1975	165.0	115.5
1980	184.0	128.8
1985	202.0	141.4
AD 2000	225.0	157.5

* One cubic metre (cu m) = 0.7 tonnes in line with the FPC's estimate that 116.6 mtcr = 122.8 million tonnes, and the NCA's estimate that 116.6 mtcr = 175 million cu m [GOI, 1976, p.60].
Source : GOI, 1976, p.62.

The Commission did not expect an appreciable shift from non-commercial fuels. Within that category, however, it suggested deliberate policy interventions to reduce the share of dung cake from 15 per cent to 5 per cent. A large part of the gap caused by that was expected to be covered by enhanced availability of agricultural residues due to the anticipated increase in farm productivity [GOI, 1976, p.61].

5. Working Group on Energy Policy

A Working Group on Energy Policy (WGEP) in 1979 also adopted the FPC's methodology to reconstruct domestic energy use during 1954 and 1976 (Annexure 5). Following that, the Group adopted a

7. The Commission did not state the basis for the assumption.

scenario approach to make i) a reference level, and ii) an optimum level forecast of domestic energy demand up to AD 2000.

The reference level forecast (RLF) pertained to the situation without additional policy efforts for demand-supply management. The first step was to estimate the number of households in 1976 which used electricity and kerosene for lighting; and LPG, kerosene, soft coke, and non-commercial fuels for cooking (Annexure 6). Following that, the Group assumed that :

- the annual per capita energy consumption would continue to be 0.38 and 0.4 TCE in the rural and the urban areas, respectively;
- the number of electrified households would increase by 2.14, 3.6, 4.0, and 5.0 million during 1976-83, 1983-88, 1988-93 and 1993-2001, respectively;
- soft coke output would increase from 6.5 million tonnes in 1983 to 9, 14, and 30 million tonnes in 1988, 1993, and 2000, respectively;
- proportion of households using non-commercial fuels would decline to 70 per cent in the rural and 10 per cent in the urban areas by the turn of the century, and that would be mainly due to enhanced kerosene consumption;
- LPG would be a perfect substitute for kerosene, and the growth in kerosene demand would be reduced in proportion to the indigenous production of LPG;
- both rural and urban per capita consumption of kerosene and soft coke for cooking would be 240 litres and 1.75 tonnes; and
- the per capita consumption of kerosene and electricity for lighting would be 24 litres and 300 KWH in the rural, and 36 litres and 400 KWH in the urban areas.

The next step was to estimate the distribution of rural and urban households by use of different energy sources for lighting and cooking during 1983-2000 (Annexure 7). The above stated assumptions and the data in Annexure 7 led to the estimates of commercial energy demand up to 2001 summarized in Table 8.

Table 8 : WGEP's reference level forecast of household demand for commercial fuels : 1983 to 2001

(MT except for electricity where TWH)

Source	1983	1988	1993	2001
Electricity	10.7(10.7)*	15.5(15.5)	22.0(22.0)	35.8(35.8)
Kerosene	4.8(30.9)	6.6(42.7)	8.6(55.7)	13.0(84.2)
L.P.G.	0.7(4.6)	1.2(7.9)	1.8(11.6)	3.3(21.5)
Soft coke	5.2(5.2)	7.2(7.2)	11.2(11.2)	24.0(24.0)
Total	**(51.4)**	**(73.3)**	**(100.5)**	**(165.5)**

* Figures in parentheses are in MTCR.
Source : GOI, 1979, p.28.

The estimates in Table 8 and the assumed per capita consumption at 0.38 and 0.40 TCR in the rural and urban areas were used to estimate the i) total need for household energy (8/), and ii) shares of commercial and non-commercial fuels in that (Table 9).

Table 9 : WGEP's reference level forecast of household need for commercial and non-commercial fuels : 1983-2001

(MTCR)

Year	Commercial	Non-commercial	Total
1983	51.6(20.2)*	204.1(79.8)	255.7(100)
1988	73.3(26.5)	202.8(73.5)	276.1(100)
1993	100.6(33.9)	195.8(66.1)	296.4(100)
2001	165.6(50.3)	163.5(49.7)	329.0(100)

* Figures in parentheses are percentages to the total.
Source : GOI, 1979, p.32.

The need/demand estimates for non-commercial energy were disaggregated by assuming that the shares of fuelwood, dung cake and agricultural residues would be 65, 15, and 20 per cent, respectively (Table 10).

On the other hand, the optimum level forecast (OLF) pertained to the situation with the adoption of suggested policy interventions,

8. Terms need, requirements, and demand were used interchangeably.

and validation of assumptions regarding the likely changes in energy system.

Table 10 : WGEP's reference level forecast of household demnd for non-commercial fuels : 1983-2001

(million tonnes)

Year	Firewood	Agri residues	Dung cake
1983	139.7(133.0)*	42.9(40.8)	76.5(30.6)
1988	133.7(127.3)	42.7(40.6)	76.0(30.4)
1993	134.0(127.6)	41.3(39.3)	73.3(29.3)
2001	111.9(106.5)	34.4(32.7)	61.0(24.4)

* Figures in parentheses are in MTCR.
Source : GOI, 1979, p.32.

On the policy side, the Group emphasized that the production potential of the land mass under forests, road sides, tank bunds, etc. should be harnessed. **This was expected to enhance fuelwood supplies beyond the forecasted requirements.** It was also reasoned that the financial resources required to enhance the soft coke output, and to transport it throughout the country should be better used for improved land management [GOI, 1979, pp.33-36].

The Group's assumptions regarding the energy use system were that

- the efficiency of household electricity consumption would improve by 2.5, 5, and 10 per cent up to 1988, 1993 and 2001, respectively;

- the appliances can and would be improved to enhance the consumption efficiency of fuelwood and agricultural residues by at least 2, 5 and 10 per cent up to 1988, 1993 and 2001, respectively;

- the growth rate of soft coke production would be limited to 6.7 per cent, i.e. the rate projected for 1982-1987, so that its output by AD 2000 would be limited to 16.75 million tonnes rather than 30 million tonnes estimated in the case of RLF, and its demand would be reduced by 1.25 and 7.25 million tonnes (coal equivalent) by 1993 and 2001;

- by AD 2000, 8.7 per cent of rural households could be dependent on kerosene for cooking against 22.3 per cent estimated in the case of RLF, and the kerosene demand could be reduced by 0.91 and 1.24 million tonnes by 1993 and 2001; and

the quantities of animal dung and agricultural residues used for cooking could stabilize at the 1983 level.

The resulting projections are presented in Table 11. It can be observed that the OLFs and RLFs for 1983 and 1988 are comparable. The 1993 OLFs and RLFs with respect to electricity, LPG, fuelwood, animal dung, and agricultural residues are also comparable; but the OLFs for that year for kerosene and soft coke are substantially lower than the RLFs. More importantly, the two scenarios for 2001 are comparable only with respect to LPG and electricity; and the OLFs regarding fuelwood, kerosene, and soft coke are substantially lower whereas those pertaining to dung cake and farm residues are substantially higher than the RLFs.

Table 11 : WGEP's optimum level demand forecasts for domestic energy : 1983 to 2001

(MT except for electricity where TWH)

Source	1983	1988	1993	2001
Electricity	10.7(10.7)*	15.1(15.1)	20.9(20.9)	32.2(32.2)
Kerosene	4.7(30.6)	6.5(42.3)	7.3(47.5)	9.4(61.1)
LPG	0.7(4.6)	1.2(7.8)	1.8(11.7)	3.3(21.5)
Sub-total	**(51.1)**	**(72.4)**	**(90.1)**	**(131.6)**
Soft coke	5.2(5.2)	7.2(7.2)	10.0(10.0)	16.8(16.8)
Firewood	139.7(133)	138.3(131)	130.9(124)	97.0(92.1)
Dung cakes	76.5(30.6)	76.5(30.6)	76.5(30.6)	76.5(30.6)
Agril. res.	42.9(40.8)	42.9(40.8)	42.9(40.8)	42.9(40.8)
Sub-total	**(204.4)**	**(202.4)**	**(195.8)**	**(163.5)**
Total	**(255.5)**	**(274.6)**	**(285.9)**	**(295.1)**

* Figures in the parentheses are in MTCR.
Source : GOI, 1979.

Part of the reason for the divergent expectations may be substantially lower OLFs for commercial energy in 1993 and 2001 than the RLFs. At the same time, the total non-commercial energy use visualized under the two scenarios is strictly comparable for

all the reference years. Such results must raise a number of issues including

- their value for policy making, and
- the desirability of encouraging or even anticipating fuelwood substitution with animal dung and farm residues in spite of the concerns to observe the nature's cycle, and the prospects of substantial increase in fuelwood outputs with marginal improvements in forest and non-forest wasteland management.

6. Fuelwood Study Committee

The GOI also formed a Fuelwood Study Committee in 1981. It agreed with the the OLFs of the 1979 Working Group, but made some additional observations and assumptions on land availability and management for fuelwood production. A few of these follow.

1. Forests have not been managed for fuelwood supplies except casual supervision to avoid the right holders' "excesses'. But, 60 million hectares forest land could annually give at least 30 million tonnes recorded fuelwood output (against the current 15 million tonnes) a year, i.e. the output excluding removals by the privilege holders. Another 30 million tonnes is and can continue to be obtained from private lands, gardens and trees around houses; and about 25 million tonnes may be available from social forestry areas in the near future.

2. Private forests have been managed to raise industrial wood, but fuelwood is also produced and can be produced where in demand.

3. With the identification of appropriate tree species to minimise competition with the field crops; and with training, demonstration, and incentives; farm plans may include fast growing trees to at least meet the family needs for fuelwood.

4. Large tracts of low productivity land without clearly defined ownership or organized management, particularly in the arid and semi arid tracts, primarily support either scattered trees or xerophytic bushes, or shrubs. This land provides forage, and substantial quantities of fuelwood to the rural and the adjoining urban areas. Its scientific management is difficult due to undefined ownership and high biotic pressures, but its potential for enhanced fuelwood production is extremely high.

In essence, the Committee, emphasized an integrated approach to harness the photosynthetic process for enhanced bio-mass production. Fuelwood plantations @ 1.5 million hectares a year were considered an absolute necessity. It was estimated that at least 20 million hectares comprising wastelands, degraded forests, roadsides, railroad sides, canal banks etc. could be available for that purpose. It was also suggested that :

- the state agricultural universities should take up fuelwood farming with their research and extension education programmes, and fuelwood should be included in major farming systems;

  schools, colleges, local bodies, voluntary organizations, etc. should be encouraged to raise tree nurseries;

  hypothecation of standing tree crops should be permitted to facilitate institutional finance for the tree farmers; and

  tree growers be assured remunerative prices and assistance for organized marketing of the produce, and the scope of the Agricultural Prices Commision be enlarged for that purpose.

Thus, though the emphasis once again was on supply management, the objective was considered feasible with better use of forest and non-forest wasteland, harnessing the complementarity between timber/industrial wood and firewood production, inducing the farmers to grow fuelwood, etc.

7. Advisory Board on Energy

The GOI's Advisory Board on Energy in 1985 presented an energy demand supply perspective for 2005. The forecasts for the household sector, summarized in Table 12, were based on

- three alternative population levels : 1,003 million, 1,046 million, and 1,115 million;
- the rural and urban population mix at 67.2 and 32.8 per cent;
- the minimum per capita per day useful energy requirements at 620, 30, and 30 k cal for cooking, space heating, and lighting, respectively (9/);
- no significant change in relative share of cooking fuels (Annexure 8);

Table 12 : The ABE's foreasts of domestic energy demand : 2005

(MT except for electricity where TWH)

Energy source	Population (million)		
	1003	1046	1115
Commercial			
Kerosene	16(56.0)*	17(59.5)	18(63.0)
Soft coke	20(30.0)	21(31.5)	22(33.0)
LPG	2(20.4)	3(30.6)	4(40.7)
Electricity	96(67.8)	100(70.7)	107(75.6)
Sub total	**(174.2)**	**(192.3)**	**(212.3)**
Non-commercial			
Fuelwood	300(256.2)	312(266.5)	333(284.4)
Dung cake$	200(60.6)	208(62.9)	222(67.2)
Charcoal	3(5.4)	4(7.2)	5(9.0)
Agri residues	90(47.5)	94(49.6)	104(54.8)
Sub total.	**(369.7)**	**(386.2)**	**(415.4)**
Total	**(543.9)**	**(578.5)**	**(627.7)**

* Figures in the parentheses are in MTCR obtained on the basis of the ratios adopted by the NCAER in 1985.
$ Including the dung required for bio-gas production.
Source : GOI, 1985, p.80.

9. The computations for cooking energy requirements assumed that a 15 kg LPG cylinder with 154,500 K cal, and 60 per cent appliance efficiency would serve a five member household for 30 days, i.e. [154,500 x 0.6] [5x30]=618 k.cal/day. This is questionable as the requirement was assumed to be uniform throughout the country.

chulah efficiency at eight per cent (10/); and

the per capita energy requirements for lighting as observed for greater Bombay.

The Board, however, made two important observations on the data in Table 11.

1. It would be undesirable to use 200 to 220 million tonnes dung cake a year as fuel as that would deprive bio-gas production and the material's use as manure. Thus, it was emphasized that dung use for household energy be stabilized at 75-80 million tonnes a year, i.e. at the 1979 level. This was considered possible with enhanced supply of farm residues which, in turn, was considered feasible and desirable with the expected rise in farm outputs. It was also suggested that large scale commercial/industrial markets for farm residues should not be encouraged (11/).

Alternatively, it was estimated that an additional 56.4 million tonnes fuelwood would stabilize the animal dung use at 75-80 million tonnes. This meant that 375 million tonnes fuelwood would be annually required by 2005. This also was reasoned to be feasible as i) the productivity of forest land could be raised by at least 300 per cent; and ii) 50 per cent out of at least 60 million hectares forest and non-forest wasteland could be used for fuelwood plantations [GOI, 1985, pp.v and 151-152].

In spite of that, however, it was apprehended that the fuelwood supplies in Uttar Pradesh, Punjab, Haryana, Tamil Nadu, and Kerala may fall short of the requirements. For that reason, fuel

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10. The need for improved efficiency was emphasized.

11. The NCAER, on the contrary, had emphasized the use of agricultural residues be enhanced for compost making (Section 2).

efficiency measures including briquetting farm residues, and enhanced soft coke production and supply to the deficit states were recommended.

2. The commercial and non-commercial sources should contribute, about one-third and two-third to the total household energy use. In fact, the Board contested the most common suggestion to enhance the commercial fuels' consumption merely due to their higher use efficiency, and emphasized the multiple benefits of tree plantations : production of fuel/fodder/small timber, reclamation of degraded lands, improvement in bio-physical environments, etc.

The Board's thoughts on reduced dung cake burning, enhanced fuelwood output, etc. must be welcome. At the same time, the reasons for i) not assessing the fuelwood production potential with regional specialization (12/), and ii) concentrating or even confining the attention to enhance the fuel efficiency to a few states have been difficult to understand.

8. Some observations on forecasts and methodologies/assumptions

Table 13 presents a summary of the household energy demand forecasts. It can be observed that the forecasts of total demand (irrespective of the supply sources) for the reference years are fairly similar amongst the studies. At the same time, there are significant variations, rather inconsistencies, amongst the forecasts of commercial and non-commercial energy demand, and the demand for different fuels within these broad groups. For instance, the ESC's and the FPC's forecasts for early 1980s fo

12. The relative cost of fuelwood production and supply to the deficit states/regions could be lower than soft coke.

Table 13 : Demand forecasts for domestic energy in India

Fuels/studies	1971	1976	1981	1983	1991	1993	2000	2005
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Electricity (TWH)								
ESI	7.3	11.4	17.0					
NCAER		1.8						
FPC			8.0	13.0	25.0			
WGEP								
- OLF				10.7	15.1	20.9	32.2	
- RLF				10.7	15.5	22.0	35.8	
ABE								96-107
Kerosene (MT)								
ESI	4.3	6.3	10.2					
NCAER		8.5						
FPC			3.5	4.5	6.0			
WGEP								
- OLF				4.7	6.5	7.3	9.4	
- RLF				4.8	6.6	8.6	13.0	
ABE								16-18
Soft Coke (MT)								
ESI	9.2	20.0	28.0					
NCAER		37.0						
FPC			6.0	14.0	20.0			
WGEP								
- OLF				5.2	7.2	10.0	16.8	
- RLF				5.2	7.2	11.2	24.0	
ABE								20-22
L.P.G (MT)								
FPC			0.4	0.8	2.0			
WGEP								
- OLF				0.7	1.2	1.8	3.3	
- RLF				0.7	1.2	1.8	3.3	
ABE								2-4
Commercial sub-total (MTCR)								
ESI	42.3	69.0	108.0					
NCAER		112.0						
FPC			49.4	78.0	121.4			
WGEP								
- OLF				51.1	72.4	90.1	131.6	
- RLF				51.4	73.3	100.5	165.5	
ABE								174.2

contd...

Table 13 contd...

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fuelwood								
ESI	121.0	130.0	131.0					
NCAER		70.0						
FPC			132.0	131.0	122.0			
NCA	105.0	115.5	128.8	141.4			157.5	
WGEP								
- OLF				139.7	138.3	131.0	97.0	
- RLF				139.7	133.7	134.0	111.9	
ABE								300-333
Dung cake								
ESI	60.0	63.0	63.0					
NCAER		60.0						
FPC			65.0	65.0	53.0			
WGEP								
- OLF			76.5	76.5	76.5	76.5		
- RLF				76.5	76.0	73.3	61.0	
ABE								200-222*
Agril wastes								
ESI	45.0	53.0	62.0					
NCAER		17.0						
FPC			46.0	46.0	46.0			
WGEP								
- OLF				42.9	42.9	42.9	42.9	
- RLF				42.9	42.7	41.3	34.4	
ABE								90-104
Non-commercial sub-total (MTCR)								
ESI	146.1	182.7	199.0					
NCAER		106.6						
FPC			195.1	121.4	180.6			
WGEP								
- OLF				204.4	202.4	195.4	163.5	
- RLF				204.1	202.8	195.8	163.5	
ABE								369.7
Total (MTCR)								
ESI	163.3	225.0	268.0					
NCAER		218.6						
FPC			244.5	272.2	302.2			
WGEP								
- OLF				255.7	276.1	296.4	329.0	
- RLF				255.5	274.8	285.9	295.1	
ABE								543.9

* including the dung required for bio-gas production.

all the commercial fuels, and for agricultural residues in the non commercial group were substantially different. But, both the

Committees were very close in their estimates of fuelwood and dung cake demand. Similarly, the ESC, the NCA and the ABE expected substantially increased fuelwood use during the periods covered by them whereas the FPC and the WGEP expected the fuelwood consumption to decline over time.

Such differences may usually be explained by differences in data and assumptions. A perusal of Table 14 can show that whereas the NCAER surveys showed soft-coke consumption to be declining in the rural areas and speedily rising in the urban areas, the NSS surveys showed substantial increase in its consumption in the rural and just marginal increase in the urban areas. Similarly, the NCAER surveys indicated a decline in fuelwood consumption in rural and considerable increase in the urban areas, whereas the

Table 14 : Sample surveys' estimates of domestic energy consumption in India

(million tonnes)

Source/reference year	Soft coke	Kero-sene	Fuel wood	Dung cakes	Farm resids.
Rural					
NCAER/1962-63	1.4	1.6	85.6	46.3	26.4
NCAER/1978-79	1.1	2.6	79.3	66.7	29.5
NSS/1963-64	0.6	1.7	104.1	38.9	NA
NSS/1973-74	1.4	3.3	114.4	32.9	NA
Urban					
NCAER/1962-63	0.7	0.6	11.5	6.0	-
NCAER/1978-79	4.3	1.6	16.2	5.0	1.1
NSS/1963-64	1.4	0.7	14.4	2.8	NA
NSS/1973-74	1.9	1.3	17.6	3.8	NA
Total					
NCAER/1962-63	2.1	2.2	97.2	52.2	26.4
NCAER/1978-79	6.5	4.2	95.5	71.7	30.6
NSS/1963-64	2.1	2.4	118.6	41.7	NA
NSS/1973-74	3.3	4.7	132.0	35.9	NA

NSS surveys showed marginal to substantial increase in its consumption in the rural and urban sectors. Such differences in survey results must be a matter of serious concern. For the present, however, they cannot explain the variations in energy demand forecasts as the NSS data have rarely been used (13/).

The variations in the forecasts may also be explained by the number and nature of causal variables assessed, and variations amongst the assumptions. The ESC, for instance, assumed the per capita domestic energy consumption to increase whereas all other studies expected it to remain constant (14/). Similarly, the ESC and the NCAER in the late 1960s attempted to assess the impact of rising income on domestic energy use but that was not done by the subsequent studies. More importantly, the ABE made a unique assumption that the mix of domestic fuels would not change till the turn of the century.

A study of Table 15 can also show that such differences have also been conspicuous with respect to the presumed i) share of various non-commercial fuels, ii) appliance efficiency, iii) household distribution patterns, etc.

Except the ABE, the studies also bunched the lighting and cooking energy demand and, thus, implied that electricity would substitute for other cooking fuels (15/). This, to say the least, would be a rare phenomenon in India for at least a few decades to come.

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13. The NSS data have not even been referred to by some studies.

14. The NCA assumed the per capita fuelwood consumption to decline, but that is not comparable with the other studies.

15. Though the WGEP clearly noted that the electricity would be used only for lighting and recreation, the methodology adopted implicitly allowed such substitution.

Table 15 : Number and nature of variables considered by different studies for projecting the household energy demand in India

Description	Studies						
	ESC	NCAER	FPC	NCA	WGEP		ABE
					RLF	OLF	
1. Per Capita consumption	I	C	C	V	C	C	C
2. Population	A	A	A	A	A	A	A
3. Household distribution	NA	NA	NA	NA	A	A	NA
4. Income elasticity of demand	A	A	NA	NA	NA	NA	NA
5. Share of various non-commercial fuels	V	C	C	NA	C	C	C
6. Appliance efficiency	C	NA	C	NA	C	I	C
7. Mix of cooking fuels	NA	NA	NA	NA	NA	NA	C

I = Increasing; C = Constant; A = Assessed;
NA = Not assessed; V = Varying.

Some of the studies even projected the total energy demand with absolute constraints on the likely supplies of some of the fuels, and subsequently modified the forecasts to meet such constraints. That must defeat the very purpose of their efforts, leave aside comparisons with others for output planning.

A more important set of sources of variations in the forecasts has been the analysts' perceptions, even subjective assessments, with respect to marginal costs of different fuels, policy prescriptions, development strategies and the term demand itself.

Some groups, for instance, used the terms demand, requirements and needs, interchangeably. Similarly, a few studies have emphasized the need to enhance the use of commercial fuels such as soft coke and kerosene as replacement of non-commercial fuels in general, and of fuelwood in particular; whereas the reasoning of some

others has been just the opposite due to the existence of vast tracts of undermanaged or even unutilized forest and non-forest land which can produce more than the required (not just demanded) quantities of fuelwood.

Thus, the serious issue is not merely that the estimates of fuelwood demand/requirement/consumption by AD 2000 have varied from less than 100 million tonnes to more than 300 million tonnes, but that such variations emanate from differences in considerations of social, ecological and economic values of non-renewable and renewable energy sources.

The variations in energy demand forecasts can be minimized, not eliminated, with adequate and reliable data on i) output of priced and unpriced fuels; ii) consumption of various fuels by households classified by size, location, income, modes of living and working, etc; iii) prices and/or nationally agreed situation specific opportunity cost traded and untraded fuels; iv) use efficiency of various fuels; vi) fixed costs to the consumers of different fuels; vii) price parity index between energy and other necessities of life; etc.

In essence, considerable time series and cross sectional data must be collected, processed, updated, and shared. The initial costs may appear to be high, but the costs would more than be recovered through improved understanding of the likely trends in demand for different types of fuels, and separation of facts and sentiments to facilitate better choice of policy alternatives.

For the same reason, realistic estimates of fuelwood outputs with regional specialization in general and pragmatic management

strategies for the forest and non-forest wasteland in particular must be absolutely important. The nation can ill-afford to continue to work with varying estimates of the availability and productive capacity of an important component of the natural resource systems labelled as wasteland. Economic logic is that the societal cost of a waste resource should be zero. But that is not true in practice. The anomaly arises from the fact that the resource is not waste but is being wasted due to make-believe policies and programmes to manage it. If only one-third of the estimated hot arid land and wasted forest land can be fully utilized during the next decade, the nation may have more fuelwood than may be demanded. Let there be a policy level determination to achieve that objective. Similarly, let there be pragmatic estimates of the likely bio-gas output with appropriately chosen policy interventions. Forecasts of determination for other sources of energy can be much more realistic in such contexts, and can provide better guidelines for demand-supply management of total household energy.

This is not to reason that the household energy demand forecasts in the future can be very close to reality. The unknowns may continue to be at work. It must have, for instance, been difficult to visualize the dramatic increase in the output of oil products in general and the LPG in particular. Positive developmets of this type would be welcome even if the researchers and policy advisors are proved wrong.

Annexure 1 : ESC's estimates of per capita domestic energy consumption : 1954 to 1963

(TCR)

Sector	1954	1959	1961	1963
Three metropolitan cities	0.39	0.40	0.40	0.41
Other urban areas	0.37	0.38	0.39	0.39
Rural areas	0.36	0.37	0.37	0.38

Source : GOI, 1965, p.168.

Annexure 2 : ESC's estimates of household energy consumption by sources : 1954 to 1963

(MT except for elctricity where TWH)

Sources of energy	1954	1959	1961	1963
<u>Commercial</u>				
Oil products	1.2(7.7)*	1.7(10.7)	2.0(12.9)	2.4(15.7)
Soft coke	1.5(2.2)	2.1(3.1)	1.9(2.8)	1.7(2.6)
Electricity	0.7(0.7)	1.2(1.2)	1.5(1.5)	1.7(1.7)
Sub-total	**(10.6)**	**(15.0)**	**(17.2)**	**(20.0)**
<u>Non-commercial</u>				
Firewood**	86.3(82.2)	92.7(88.7)	100.0(95.3)	101.6(96.8)
Dung cakes	46.4(18.6)	52.7(21.1)	54.0(21.6)	54.9(22.0)
Agri residues	26.4(25.1)	29.9(28.4)	30.7(29.2)	31.1(29.6)
Sub-total	**(125.9)**	**(138.2)**	**(146.1)**	**(148.4)**
Total	**(136.5)**	**(153.2)**	**(163.3)**	**(168.4)**

* Figures in parentheses are in MTCR.
** Including fuelwood equivalent of charcoal.
Source : GOI,1965,p.61.

Annexure 3 : NCAER's estimates of rural households' energy consumption by sources : 1962

(MT except for electricity where MKWH)

Commercial	
Soft coke	1.4
Electricity	164.0
Kerosene	1.7
Non-commercial	
Fuelwood*	86.2
Dung cakes	46.3
Agil. residues	26.4

* Including charcoal equivalent fuelwood.
Source : NCAER, 1965.

Annexure 4 : FPC's estimates of domestic energy consumption : 1961 to 1971

(MT except for electricity where TWH)

Description	1961	1966	1971
Commercial			
Oil products	2.0(16.5)*	2.4(20.0)	3.3(27.6)
Soft coke	2.8(2.8)	4.1(4.1)	4.1(4.1)
Electricity	1.5(1.5)	2.4(2.4)	3.8(3.8)
Sub-total	**(20.8)**	**(26.4)**	**(35.5)**
Non-commercial			
Firewood	101.0(96.0)	111.8(106.2)	122.8(116.6)
Dung cakes	55.4(22.1)	61.3(24.5)	67.3(26.9)
Agri residues	31.1(29.5)	34.4(32.7)	37.8(35.9)
Sub-total	**(147.6)**	**(163.4)**	**(179.4)**
Total	**(167.8)**	**(189.8)**	**(214.9)**

* Figures in parentheses are in MTCR.
Source : GOI, 1974, p.92.

Annexure 5 : WGEP's domestic energy consumption estimates : 1954 to 1976

(MT except for electricity where BKWH)

Description	1954	1961	1966	1971	1976
Commercial					
Oil products*	1.5	2.5	3.1	4.2	4.3
Soft coke	2.2	2.8	4.1	4.1	3.7
Electricity	0.7	1.5	2.4	3.8	5.8
Non commercial					
Firewood	86.3	99.6	109.3	117.9	133.1
Dung cakes	46.4	54.6	59.9	64.6	73.0
Agri residues	26.4	30.6	33.6	36.3	41.0

* including LPG
Source : GOI, 1979, pp. 5 and 28.

Annexure 6 : WGEP's estimate of number of households using various fuels by purposes : 1976

(million)

Description	Rural		Urban	
	Lighting	Cooking	Lighting	Cooking
Electricity	4.0	-	11.0	-
Kerosene	82.3	0.5	14.0	4.5
L.P.G.	-	-	-	1.3
Soft coke	-	0.4	-	1.2
Non-commercial	-	89.2	-	19.1
Others	3.8	-	1.1	-
Total	90.1	90.1	26.1	26.1

Source : GOI, 1979.

Annexure 7 : WGEP's projected distribution of households by fuels' use : 1983 to 2001

(million)

Description	Rural				Urban			
	1983	1988	1993	2001	1983	1988	1993	2001
Lighting								
Electricity	13.0	20.9	32.0	58.0	17.0	23.0	31.0	46.0
Kerosene	84.7	85.6	82.9	69.2	14.5	13.6	10.7	5.4
Others	3.1	2.1	1.2	1.1	0.6	.30	.30	.30
Cooking								
L.P.G.	.80	1.3	1.9	3.5	2.7	4.7	6.9	12.8
Kerosene	4.0	9.4	15.4	28.6	8.5	11.9	16.2	26.0
Soft coke	0.7	1.2	2.6	6.4	2.2	3.0	3.8	7.3
Non-commercial	95.3	96.6	96.2	89.8	18.7	17.3	15.1	5.6
Total households	100.9	108.6	116.1	128.3	32.1	36.9	42.0	51.7

Source : GOI, 1979.

Annexure 8 : ABE's assumed fuel mix

(per cent of useful heat)

Energy source	Cooking		Lighting	
	Rural	Urban	Rural	Urban
Kerosene	3	28	12	6
Soft coke	2	22	-	-
Electricity	-	-	88	94
LPG	-	10	-	-
Gobar gas	0.3	-	-	-
Charcoal	0.7	3	-	-
Fuelwood	56	31	-	-
Dung cakes	20	4	-	-
Agri residues	19	2	-	-

Source : GOI, 1985, p.79.

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