Energy for women and women for energy (engendering energy and empowering women)[1]

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The women-energy nexus involves the challenge of engendering energy and the challenge of empowering women through energy. The first challenge arises from the gender disaggregation of energy consumption patterns. A quantitative account of the share of women in these patterns is presented through a description of the rural energy consumption pattern of the village of Pura in South India. The results indicate that women work more hours than men. Women also perform the back-breaking tasks and are displaced by agricultural mechanisation. The energy output-input imbalance is aggravated by the fact that, in developing countries, women traditionally eat last and least in a family – women therefore take in less food energy than men. The gender distribution of labour results in negative health impacts. The scarcity of energy services in rural areas has serious social and gender impacts. Tackling them requires energy interventions to improve the quality of life for women. Examples of such energy interventions are the community biogas plant at the village of Pura and the multi-purpose platforms of the Mali project.

Since technological opportunities exist for such energy interventions, attention is turned to the second challenge of empowering women through energy entrepreneurship. This requires a change of mind-set on the part of energy planners and activists – they must promote the notion of women as managers and entrepreneurs, and not just beneficiaries, of improved energy services. The idea is to push the following sequence: women as deprived in energy consumption patterns → women as beneficiaries of energy interventions → women as managers of enterprises → women as energy entrepreneurs. This is nothing short of a paradigm shift – but once achieved and implemented, the results will speak for themselves. Such an approach will engender energy by converting it into a force for improving the quality of life as well as enhancing productive capacities – a virtuous circle of energy for women and women for energy.

1. Women in energy consumption patterns

Energy analysis was traditionally restricted to the supply side of the energy fuel cycle[2]. Fortunately, the demand side has also received attention over the past three to four decades. However, even this shift has by and large focused on sectoral demands and end-uses, with little attention being paid to the gender distribution of energy consumption.

Perhaps one of the first exceptions to this gender blindness was the work on rural energy consumption patterns carried out in the 1980s by the ASTRA[3] programme of the Indian Institute of Science in Bangalore, India. Even the first papers on rural energy consumption patterns from this programme brought out clearly the gender aspects of energy [Ravindranath et al., 1979; Reddy, 1978; Reddy and Subramanian, 1979]. Subsequently, there were excellent reports on the gender aspects of the ASTRA energy consumption studies by Shailaja [Shailaja and Ravindranath, 1990; Shailaja, 2000]. These gender aspects were also highlighted in the book *Energy for a Sustainable World* [Goldemberg, Johansson, Reddy and Williams, 1988]. More recently, the *World Energy Assessment* (Chapter 2) [WEA, undated], available on the Web, summarized the research linking gender and energy.

Energy consumption patterns have to be the baseline for analysis of the gender aspects of energy. This baseline must include the pattern of expenditure of energy (including human energy), the type of tasks performed by women, the impact of mechanisation and commercial energy inputs, the intake of food energy, and the health impacts of women's labour.

1.1. Rural energy consumption patterns

The vast majority of the women in developing countries live in rural areas, mostly in villages. Hence, it is necessary at the outset to examine the nature of energy consumption patterns at the village level.

There have been several studies of the patterns of energy consumption in villages. Among the earliest of the studies was that of six villages in the Ungra region of Tumkur district, Karnataka state, southern India, carried

Table 1. Energy sources and activities in Pura (1977)

	Agriculture	Domestic	Lighting	Industry	Total
Human hours	34848	255506	-	20730	311084
(Man hours)	(19914)	(82376)	-	(16485)	(118775)
(Woman hours)	(14934)	(113928)	-	(4245)	(133107)
(Child hours)	-	(59202)	-	-	(59202)
Bullock hours	5393	-	-	-	5392
Firewood (kg)	-	207807	-	8930	216737
Kerosene (l)	-	-	1938	156	2094
Electricity (kWh)	7264	-	3078	820	11162

Table 2. Pura energy source-activity matrix (GJ/year)

	Agriculture	Domestic	Lighting	Industry	Total
Human	31.72	212.77	-	20.82	266.99
(Man)	(20.87)	(86.27)	-	(17.26)	(124.40)
(Woman)	(12.53)	(95.49)	-	(3.56)	(111.58)
(Child)	-	(31.01)	-	-	(31.01)
Bullock	51.96	-	-	-	51.96
Fuelwood	-	3,308.68	-	142.17	3,450.84
Kerosene	-	-	72.91	5.87	78.77
Electricity	26.19	-	11.10	2.97	40.27
Total	111.54	3,521.44	84.01	171.83	3,888.82

Total energy = 3,888.32 GJ/year = 1.079 GWh_t/year = 2.955 MWh_t/day = 8.28 kWh_t/day/capita (Wh_t = watt-hours thermal)

out in the late 1970s [ASTRA, 1982]. Despite the vintage of these studies, they are sufficiently generic and illuminating to warrant brief recapitulation here to establish the context.

Pura (latitude 12º 49′ 00″ N, longitude 76º 57′ 49″ E, height above sea level 670.6 m, average annual rainfall 127 cm, population (in September 1977) 357, households 56) was one of the six villages surveyed in the Ungra region in Kunigal *taluk,* Tumkur district, Karnataka state, southern India.

The energy-utilising activities in Pura consisted[4] of: (1) agricultural operations (with *ragi (Eleusine coracana)* and rice as the main crops); (2) domestic activities – grazing livestock, cooking, gathering fuelwood and fetching water for domestic use, particularly drinking; (3) lighting; and (4) industry (pottery, flour-mill and coffee shop)[5].

These activities were achieved with human beings, bullocks, fuelwood, kerosene and electricity as *direct*[6] sources of energy.

An aggregated matrix showing how the various energy sources were distributed over the various energy-utilising activities is presented in Table 1 in the units appropriate to the sources.

Using appropriate conversion factors, a source-activity matrix for Pura village was obtained (Table 2). The matrix yields the following ranking of *sources* (in order of percentage of annual requirement): (1) fuelwood 89 %, (2) human energy 7 %, (3) kerosene 2 %, (4) bullock energy 1 %, and (5) electricity 1 %. The ranking of *activities* is as follows: (1) domestic activities 91 %, (2) industry 4 %, (3) agriculture 3 %, and (4) lighting 2 %.

Human energy is distributed thus: domestic activities 80 % (grazing livestock 37 %, cooking 19 %, gathering fuelwood 14 %, fetching water 10 %), agriculture 12 %, and industry 8 %. Bullock energy is used wholly for agriculture, including transport. Fuelwood is used to the extent of 96 % (cooking 82 % and heating bath water 14 %) in the domestic sector, and 4 % in industry. Kerosene is used predominantly for lighting (93 %), and to a small extent in industry (7 %). Electricity flows to agriculture (65 %), lighting (28 %), and industry (7 %).

There are several features of the patterns of energy consumption in Pura that must be highlighted. Even though not all of them are directly relevant to gender aspects, the overall context needs to be appreciated.

1. What is conventionally referred to as *commercial* energy, i.e., kerosene and electricity in the case of Pura, accounts for a mere 3 % of the inanimate energy used in the village, the remaining 97 % coming from fuelwood[7]. Fuelwood must be viewed as a *non-commercial*

source since only about 4 % of the total fuelwood requirement of Pura was purchased as a commodity, the remainder being gathered at zero private cost.

2. Animate sources, viz., human beings and bullocks, only account for about 8 % of the total energy, but the real significance of this contribution is revealed by the fact that these animate sources represent 77 % of the energy used in Pura's agriculture. In fact, this percentage would have been much higher were it not for the operation of *four* electrical pumpsets in Pura, which account for 23 % of the total agricultural energy.
3. Virtually all of Pura's energy consumption comes from traditional renewable sources – thus, agriculture is largely based on human beings and bullocks, and domestic cooking (which utilises about 80 % of the total inanimate energy) is based entirely on fuelwood[8].
4. However, the environmental soundness of this pattern of dependence on renewable resources is achieved at an exorbitant price – levels of agricultural productivity are very low, and large amounts of human energy are spent on gathering fuelwood (on the average, about 2.6 hr (of time spent) and 4.8 km (of distance walked) per day per family to collect about 10 kg of fuelwood).
5. Fetching water for domestic consumption also utilises a great deal of human energy (an average of 1.5 hr and 1.6 km per day per household) to achieve an extremely low *per capita* water consumption of 17 litres (l) per day.
6. 46 % of the domestic human energy is spent on grazing livestock (5.8 hr/day/household), which is a crucial source of supplementary household income.
7. Only 25 % of the houses in the "electrified" village of Pura had acquired domestic connections for electric lighting. The remaining 75 % of the houses depend on kerosene lamps, and of these lamps, 78 % are of the open-wick type.
8. A very small amount of electricity, viz., 30 kWh/day, flowed into Pura, and even this was distributed in a highly inegalitarian way – 65 % of it went to the 4 irrigation pumpsets of 3 landowners, 28 % to illuminate 14 out of 56 houses, and the remaining 7 % for one flour-mill owner.

It is obvious from Table 3, which shows the end-uses of human energy in Pura, that the inhabitants of Pura, particularly its women and children, suffer burdens that have been largely eliminated in urban settings by the deployment of inanimate energy. For example, gathering fuelwood and fetching water can be eliminated by the supply of cooking fuel and piped water respectively. The serious gender and health implications of rural energy consumption patterns have been brought out in several studies [Batliwala, 1982; 1987; 1984; Aggarwal, 1986; Singh and Burra, 1994; WHO, 2000-2002; Laxmi et al., 2003].

Since then, there have been innumerable studies [Barnett et al., 1982] of rural energy consumption patterns. The actual numbers show differences depending upon the region of the country, the agro-climatic zone, the proximity to forests, the availability of crop residues, prevalent cropping pattern, etc., but the broad features of the patterns of energy consumption in Pura highlighted above have been generally validated.

Table 3. End-uses of human energy in Pura

Human activity	Human energy expenditure		
	Hours/ year	Hours/day/ household	GJ/year
1. Domestic	255,506	12.5	212.85
1.1. Grazing livestock	(117,534)	(5.7)	(98.05)
1.2. Cooking	(58,766)	(2.9)	(49.02)
1.3. Gathering fuelwood	(45,991)	(2.3)	(38.13)
1.4. Fetching water	(33,215)	(1.6)	27.65
2. Agriculture	34,848	1.7	33.52
3. Industry	20,730	1.0	20.95
Total	311,084	15.2	267.32

1.2. Women spend more labour hours

The Pura study showed that women contributed a vital 42 %, 80 %, 15 %, and 44 % of the labour hours for gathering fuel, fetching water, grazing livestock, and agricultural work. All told, women contributed 53 % of the total human labour hours in Pura, i.e., they work more than men. Their labour contributions are vital to the survival of families.

Ideally, time series data should have been provided to show the changes, if any, of the energy consumption patterns. Unfortunately, surveys similar to the one above to describe Pura's energy consumption pattern have not been repeated after suitable intervals. There is, however, a study [SuTRA, 1997] of rural energy in 24 villages, including Pura. This study confirms that women are responsible for fetching water for domestic purposes in 98 % of Pura's households, and women account for 74 % of the labour hours gathering firewood, the utilisation of which remains at about 0.6 tonnes (t)/capita/year over a 30 year period. The basis pattern continues to be biased against women.

1.3. Women perform the back-breaking tasks

There is a gender bias in agricultural operations (Table 4). For instance, men carry out the operations of land preparation (including ploughing and harrowing), whereas women carry out the operations of transplanting, weeding and harvesting. The thumb-rules appear to be: (1) if the operation is assisted by animal power involving the use of bullocks, men take charge of it; and (2) if the operation requires continuous bending or sitting postures and is back-breaking and strenuous, then the women do it. For instance, transplanting of rice and weeding are critical operations performed manually by women in ankle-deep slush, often under steady drizzle. Barefoot, women transplant and weed continuously for 6 to 10 hours a day.

1.4. Women are displaced by agricultural mechanisation

Unfortunately, agricultural mechanisation does not seem

Table 4. Human hours spent in agricultural operations/year in Ungra village

Operations	Woman hours/year		Man hours/year	
	Total crop land	% to total	Total crop land	% to total
1. Ploughing	-	-	31,753.38	23.63
2. Harrowing	-	-	17,548.30	13.06
3. Manure transport	-	-	4,115.99	3.06
4. Bunding	-	-	9,222.17	6.86
5. Transplanting	29,842.24	30.00	5,983.90	4.45
6. Weeding + interculture	9,323.80	9.40	4,874.24	3.63
7. Fertiliser application	1,457.80	1.46	1,186.17	0.88
8. Harvesting	23,994.92	24.13	10,272.81	7.64
9. Bundling	13,092.43	13.31	7,978.71	5.94
10. Produce transport	2,062.12	1.91	5,536.38	4.12
11. Threshing	7,165.94	7.20	20,296.79	15.10
12. Winnowing	9,065.79	9.11	6,892.33	5.13
13. Rolling	-	-	3,486.33	2.60
14. Others	3,095.53	3.50	5,242.49	3.90
Total	99,100.57	100	1,34,389.99	100

Source: Karnataka State of Environment Report IV

to have a positive impact on women. As soon as a machine is developed to eliminate the hardship of an agricultural operation, it is appropriated by men in a culture that considers machines the prerogative of men, and men the most suitable beneficiaries of mechanical training. Not only are women relieved of the hardship, but they are relieved of the job itself, i.e., women lose employment by female jobs being converted into male jobs. For instance, when power threshers are introduced to reduce the burden of winnowing (traditionally carried out by women), their operation is taken over by men, resulting in the displacement of women. The introduction of mechanical harvesters also leads to the loss of employment by women. In such cases, whether women's displacement from such jobs should be seen positively or negatively depends on whether they are able to do something more worthwhile and of their own choosing.

1.5. Women take in less food energy

If women work more than men, are they compensated by greater intake of food energy? The "universal" but sad truth in developing countries is that *women traditionally eat last and least* in a family – this is a result of the dominant cultural value assigned to adult males and to boys.

Quantification of this truism is a more difficult proposition because it involves studies on intra-family distribution of food. One approach is via multiple regression analysis of the total cereal consumption of households versus the number of males, boys, girls and women in the households. The coefficients then yield the consumption per gender category, for instance, per male and per woman consumption. Thus, the gender biases in food consumption can be estimated.

It turns out that the greater energy output of women is not compensated by a proportionately greater intake of food. In fact, men eat more – the ratio of intra-household male-female food distribution can be 2:1. Studies in several locations corroborate the gender bias in access to food within the family [Development Forum, 1982; Sen and Sengupta 1983; Shatrughna, 1986; Batliwala, 1987; Lund-Skar et al., 1982]. This means one more hole in the "leaky bucket" of women's health and nutrition – overwork and underfeeding, which increase their vulnerability to disease apart from raising a human rights issue.

Surveys by the National Nutrition Monitoring Bureau in India have found that the weights of adult women are well below par all over the country. Further, while women's weight gain ceases after the age of 16 years, men continue to gain weight until at least 25 years [Shatrughna, 1986]. What is more, weight gain in pregnancy of rural women is a mere 4-6 kg, as opposed to the desired norm of 10-12 kg.

1.6. Negative health impacts of women's labour

Among the most serious costs of energy scarcity for women is the range of health problems caused, directly and indirectly, by the dependence on increasingly scarce biomass to meet daily subsistence needs.

1.6.1. Health hazards of biomass cooking fuels

First and foremost are the health hazards caused by the use of biomass fuels for cooking in most poor households in the world. It is estimated that "more than half the world's households cook daily with unprocessed solid fuels, i.e., biomass or coal" [WHO, 1982]. Evidence from around the world indicates that firewood, dung-cakes, and other fuels release toxic emissions such as carbon monoxide, suspended particulates and hydrocarbons [WHO, 1992].

Furthermore, these fuels are used primarily in traditional open cookstoves with a fuel efficiency of roughly under 10 % [Geller, 1980], in poorly-ventilated one- or two-room homes. Even where ventilation is relatively good (such as in thatch-roofed dwellings), the emissions are so great that the health effects are still alarming.

For instance, one of the earliest studies, conducted in Gujarat state in western India, found that fuels such as firewood, dung-cakes and crop wastes emit more total suspended particulates (TSPs), benzopyrene, carbon monoxide and polycyclic organic pollutants than fossil fuels such as coal or natural gas. The study showed that, in clinical terms, women spending an average of 3 hours a day on cooking are exposed to 700 μg of particulate matter per m^3 (as against a permissible level of less than 75 $\mu g/m^3$), and inhale benzopyrene equivalent to 400 cigarettes [Anon., 1983; Smith, 1991] a day. Moreover, the study found that women began regular cooking at around the age of 13, which meant a much longer period of exposure to pollutants.

Table 5. Health effects of biomass fuel use in cooking

Processes	Potential health hazards
Production	
Processing/preparing dung-cakes	Faecal/ oral/ enteric infections Skin infections
Charcoal production	CO/smoke poisoning Burns/trauma Cataract
Collection	
Gathering/carrying fuel	Trauma Reduced infant/child care Bites from venomous reptiles/insects Allergic reactions Fungus infections Severe fatigue Muscular pain/back pain/arthritis
Combustion	
Effects of smoke	Conjunctivitis, blepharo conjunctivitis Upper respiratory irritation/inflammation Acute respiratory infection (ARI)
Effects of toxic gases (CO)	Acute poisoning
Effects of chronic smoke inhalation	Chronic obstructive pulmonary disease (COPD), chronic bronchitis Cor pulmonale Adverse reproductive outcomes Cancer (lung)
Effects of heat	Burns Cataract
Ergonomic effects of crouching over stove	Arthritis
Effects of location of stove (on floor)	Burns in infants/toddlers/children

Source: Based on data given in [WHO, 1992] and own observation/experience.

Similar studies – though not always focused on the health effects – have been carried out in Africa, Latin America, Southeast Asia and China (where the focus has been on coal-burning stoves).

The health hazards of dependence on biomass cooking fuels are not limited to those arising from air pollution alone. Experts contend that each part of the fuel cycle – from production, through collection and processing to actual cooking – has health implications that can be serious. Table 5 shows a list of potential health hazards arising from different functions in the fuel cycle.

1.6.2. Health and nutrition effects of energy scarcity

Apart from the direct health effects of cooking fuels used by the poor, there are clear indications that the growing scarcity of and difficulty in obtaining biomass fuels for cooking affect the health of the poor in several indirect ways.

Firstly, the scarcity of biomass fuels such as firewood – and the high time and labour cost involved in obtaining them – may result in measures to minimise fuel consumption in cooking in various ways. For one, fewer hot meals may be prepared per day, leading to consumption of stale/leftover foods that may have become contaminated. This could lead to nutrient losses, and increased risk of infections. Undercooking may also be resorted to in order to save fuel, and this can cause health problems, particularly with some pulses and oils that are toxic when undercooked. Another health effect could result from the switching-over to cereal staples that require less cooking, but which may be less nutritious (from wheat or coarse grains to rice, for instance). While there is no documented statistical evidence of any of these problems, they have been widely observed by grassroots workers in many developing countries [Batliwala, 1983b]. The lack of combustion energy or electricity also means that drinking water cannot be boiled and this has health implications.

There are other health impacts on the poor resulting from their dependence on human energy in the absence of alternative sources for performing survival tasks. Chief among these is the impact on the nutrition and health status of poor women and girl children in societies where the burden of performing these tasks is distributed along gender lines. A benchmark study of the early eighties [Batliwala, 1982], based on the Pura village energy matrix data cited earlier, highlighted the relatively greater health costs borne by poor women, particularly in nutritional terms, as a result of the daily chores of cooking, gathering fuel, fetching water, and grazing. The study showed that these daily subsistence activities lead to a higher calorie expenditure per woman per day than per man, particularly since these domestic tasks are perennial, while agricultural work (where men's energy contribution is higher than women's) is seasonal.

The reduction of water consumption, particularly for personal hygiene, because of the time and labour costs involved in water collection also has negative effects on women's health: lack of adequate water for bathing/washing has been cited as a major contributing factor to the high rate of genito-urinary and reproductive tract infections in poor women. One recent Indian study found that 92 % of the sample women had reproductive tract infections (RTIs), many of which had gone untreated for years [Bang et al., 1989; Jeejeebhoy, 1994]. This can be a significant contributing factor to female sterility, cervical cancer and uterine prolapse. The last is also related to women carrying excessive loads (of water, firewood, etc.) [GOI, 1988].

It is clear that the health costs of the nexus between energy scarcity, the resultant dependence on biomass fuels and human energy to meet basic needs, and the gender division of labour are extensive. They include widespread protein-calorie malnutrition, poor immunity and high risk of and morbidity and mortality from infectious and communicable diseases, chronic anaemia, higher maternal/female morbidity and mortality, poor reproductive outcomes, including low birth-weight infants with reduced chances of survival, and increased infant and child mortality, poor reproductive health status of women and girls, and depletion of women's health from repeated child-bearing, overwork, and inadequate food.

The burden of this syndrome is carried mainly by millions of women who are already the most socio-economically disadvantaged segment in most countries. Consequently, it has serious implications for the health and development status of entire nations. The quality of life for the majority of people cannot be improved without urgently addressing these problems, which arise directly and indirectly from unmet energy needs.

Another health dimension of the energy scarcity syndrome, combined with the absence of labour-saving appropriate technology (and once again borne by women), is the possible health hazards for pregnant women and their unborn infants as a result of traditional rice cultivation methods. A study conducted in a sample population of 30,000 in western India in 1982 showed a sharp increase in still-births, premature births and neo-natal mortality during the rice-planting months, when women labour for hours, bent almost double, transplanting rice. The fact that no maternal deaths occurred was probably due to the presence of an effective non-governmental community health care project in the area [Batliwala, 1983a; 1988].

2. Engendering energy

2.1. Social and gender impact of scarcity of energy services

The need for social justice – including gender justice – is universally accepted[9]. Eradicating discrimination on the basis of gender, caste, class, race, ethnicity, and nationality, both formally and substantively, is a prerequisite for creating a just society. At the most fundamental level, substantive justice means meeting the basic human needs of all citizens and providing equal access to productive resources.

It is self-evident that energy plays a key role in achieving both the twin goals of meeting the basic human needs of all citizens and providing equal access to productive resources. In the case of women, shortcomings in meeting basic needs (for food, water, fuel, shelter, a clean environment, health and education) perpetuate their social, economic and political disadvantages and powerlessness. The energy question must be addressed for the sake of both social justice and economic growth, and investments in improved energy systems serve both ends.

Low levels of energy services are a serious obstacle to raising the social status of women and other oppressed groups, since energy services lie at the heart of any strategy to alter or mitigate the gender-, caste- or class-based division of labour and its consequent physical and social impact. When survival is dependent on human energy and primitive technologies, a whole range of obstacles to social and gender equality is set in motion.

1. The poor in general, and poor women and girls in particular, are trapped in an unceasing cycle of work which condemns them to poor health and little or no education, and deprives them of equal participation in local development programmes (e.g., adult literacy, credit and income-generation schemes), self-government bodies, or local social/political movements. This means a nation with a seriously undeveloped human resource base.
2. Schooling is an unaffordable luxury for poor children whose labour is required for family survival, resulting in low literacy levels.
3. Girls are deprived of education altogether, or are allowed fewer years of schooling than boys.
4. When female illiteracy is high, it acts as a barrier to new knowledge and ideas[10], which might catalyse women to question the patriarchal order and demand change, or to gain economic mobility.
5. The demand for children's labour perpetuates the need for large families. This contributes to high birth-rates, which further impairs the health of poor women by keeping them trapped in the cycle of child-bearing and rearing, thus further circumscribing their participation in change processes and development programmes. Apart from keeping family sizes small, reduction of child labour in the household also improves the life chances of the children.

Almost every one of these socio-economic preconditions for improvement in living standards depends upon energy-utilising technologies. Infant mortality has much to do with adequate and safe supplies of domestic water and with a clean environment. The conditions for women's education become favourable if the drudgery of their household chores is reduced, if not eliminated, with efficient and clean energy sources and/or devices for cooking and with energy-utilising technologies for the supply of clean water for domestic uses. The deployment of energy for industries that generate employment and income for women can also help in delaying the marriage age, which is an important determinant of fertility. If the use of energy results in child labour becoming unnecessary for crucial household tasks (such as cooking, gathering fuelwood, fetching drinking water, and grazing livestock), an important rationale for large families is eliminated.

From this standpoint, it is obvious that the prevailing patterns of energy consumption in villages (typified by Pura) do not emphasise energy inputs for providing safe and sufficient supplies of drinking water, the maintenance of a clean and healthy environment, the reduction, if not elimination, of the drudgery of household chores traditionally performed by women, the relief of menial tasks carried out by children, and the establishment of income-generating industries in rural areas.

Thus, current energy consumption patterns exclude the type of energy-utilising technologies necessary to improve the living standards. In fact, they aggravate the conditions of poverty.

Alternative energy strategies can contribute to a dramatic improvement in the living standards if they are directed preferentially towards the needs of women, households and a healthy environment [Reddy and Batliwala, 1979; Batliwala and Reddy, 1994; Batliwala, 1995]. Energy strategies must provide the mundane, but momentous, energy inputs that would improve the quality of life. Otherwise, the strategies would be missing an opportunity to contribute to a reduction of the intensity of the poverty problem.

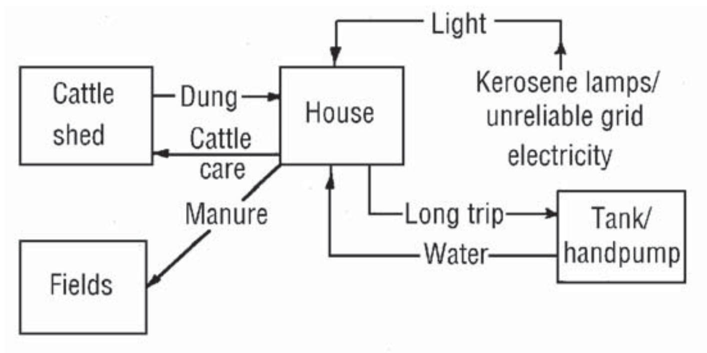

Figure 1. The traditional system for obtaining water, light and feritiliser in Pura

2.2. Energy interventions to improve the quality of life for women

An example of an energy intervention that is a small step towards establishing village-level conditions that would play a role in improving living standards will now be described. The purpose of this example is to illustrate in a concrete fashion how augmentation of energy services can improve the quality of life of women. Fortunately, the intervention is in the same village of Pura, whose energy consumption pattern has just been described.

The traditional system of obtaining water, illumination and fertiliser (for the fields) in Pura village is shown in Figure 1. This traditional system was replaced in September 1987 with a *rural energy and water supply utility* (REWSU) based on a community biogas plant system [Reddy and Balachandra, 1991; Rajabapaiah et al., 1993; Reddy et al., 1995; Reddy, 1995], whose main components and flows of inputs/outputs are shown in Figure 2.

A comparison of the community biogas plants system with the traditional system of obtaining water, illumination and fertiliser shows that women are winners on all counts. Not only do they lose nothing, but they can also gain the following: deep-borewell water that is better and safer than the water from the open tank, less effort to get this improved water, reduction in the incidence of water-borne intestinal diseases (because of the safer water), and therefore noticeable improvement in the health of children, better illumination than the traditional kerosene lamps or even the unreliable, low-voltage grid electricity, cheaper illumination for the households formerly using kerosene lamps, less pressure to finish chores during daylight, and improved fertiliser which has greater nitrogen content and is less favourable to the growth of weeds and proliferation of flies than farmyard manure. In addition, the women perform the bulk of a crucial plant operation function by delivering the dung to the plants. They also earn income for this task, a dung delivery fee. In addition, they are largely responsible for taking back the sludge for use as fertilizer.

The system worked satisfactorily from 1987 to 1997. During that period, the system was able to pay for the operating costs until the rise in wages and diesel costs required significant tariff increases, which in turn hinged on negotiating a consensus. But repayment of the capital costs required a two- to three-fold increase in the hours of utilisation of the system. Though there was enough dung available in the village and therefore an increase in engine utilisation was not input-constrained, it was demand-constrained as long as the demand was restricted to providing electricity for lighting and pumping water for domestic purposes. What was required was an increase in revenue-generating demand based on an installed and operating engine.

In the midst of this challenge, a new management decided to experiment with vegetable oil from *honge* seeds as the fuel for the diesel engine-cum-generator. This drastic change from the proven technology of a biogas source (for the dual-fuel engine) to an unproven technology of vegetable oil fuel without adequate reliability studies of the performance of these engines with the new feedstock led to system reliability problems.

Instead, what should have been done was to convert the biogas-based diesel engine into the promising alternative of a multi-purpose platform of the type being disseminated in Mali, Burkina Faso, Senegal, Guinea and Côte d'Ivoire. There, an Indian diesel engine (of the same type used in the Pura community biogas plant project) is the basis of a platform that, apart from being able to run lighting and water distribution systems à la Pura, can drive various types of equipment such as cereal mills, de-huskers, oil presses, battery-chargers, welders, and joinery and carpentry tools. In the Mali project, it is envisaged that the 450 multipurpose platforms targeted by 2003 will be owned and managed by women's associations.

3. Empowering women through energy entrepreneurship[11]

Whether it is water or biomass fuel or livestock wastes, women are the traditional gatherers and users. And because this gendered division of labour starts in childhood, they start this resource management training as young girls and are forced to acquire the necessary expertise.

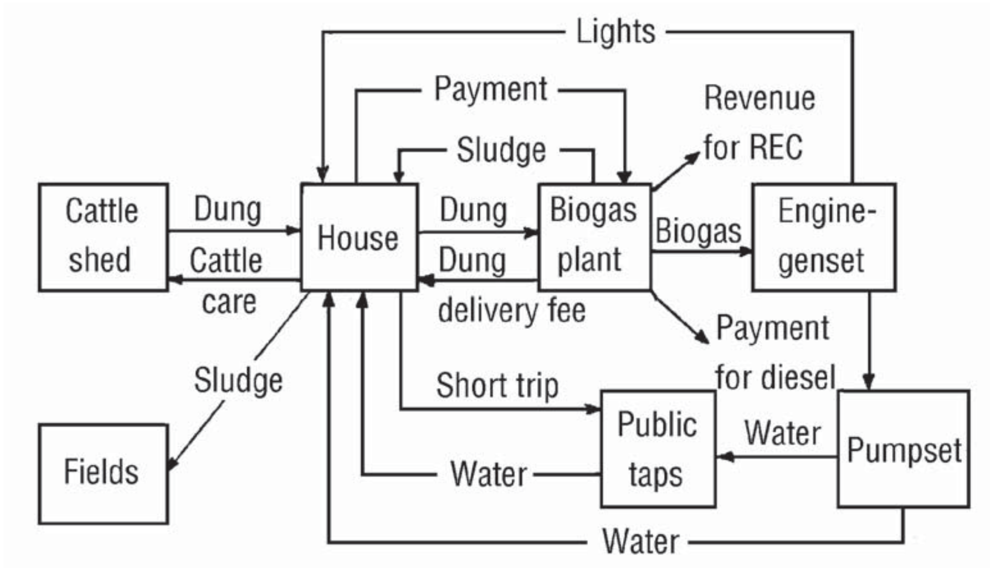

Figure 2. The rural energy and water supply utility based on a community biogas plant in Pura

This is because they pay an immediate price in terms of time/labour, if not money, if they are wasteful in energy use. In fact, in order to survive, women willy-nilly become excellent managers of energy resources. The most important point that emerges from the discussion of women in energy consumption patterns is that women – particularly in the rural areas of developing countries – have been playing, and are playing, a major role in the management of energy resources, particularly biomass.

When energy interventions involve new ways of producing and using energy, the experience from several projects around the developing world demonstrates that women are not only the main beneficiaries, but play a key role in the operation of these utilities since their stake in the success of the utilities tends to be greater. The experience with rural energy and water supply utilities such as the one in Pura and other villages, as well as with the Mali multipurpose platform project, confirms this general observation. Women are also the main beneficiaries of such projects. As such, they become as interested as men, if not more so, in the success of the utilities. And wherever women have opportunities, it becomes clear that they are potentially the best managers of energy enterprises. Nor is this resourcefulness and managerial efficiency limited to energy. Evidence from around the world points to the fact that poor urban and rural women are excellent managers and entrepreneurs in a number of contexts, for example milk cooperatives in India, when given the opportunity and resources.

It is also relevant that large programmes such as the Grameen Bank[12] of Bangladesh have unambiguously testified to the crucial role that women can play in microenterprises. It is now clear that these projects are succeeding because they are overwhelmingly based on women who have established an outstanding record of timely repayment of small loans and utilisation of these loans to raise the living standards of their families.

The explanation is simple: women "are better investors and planners than men. They think in terms of steps and consensus, borrowing step by step to generate income, investing in the mid- and long-term as well as the short term. When a woman has the capacity to invest, one of her first thoughts involve[s] children, so women are prepared to invest in things men won't consider. The evidence on this is clear and becoming clearer....", as La Rocco says.

Experience is mounting to confirm that the decisions of women take into account the long term and the next generation, a natural consequence of their linkage with children. They are prepared to sacrifice immediate gains for long-term benefits, i.e., the discount rate used by women is lower than that of men. It is precisely such a view that leads to sustainability. Hence, women are naturally endowed to be the implementers of sustainable development.

Who will implement energy interventions of the type designed to improve the quality of life for women? Quite apart from the global tendency to diminish the role of government, governments themselves are becoming increasingly reluctant to take on additional burdens. Utilities are too preoccupied with their capital crises to devote attention to rural activities. It is clear that there is a need for entrepreneurs in general, and women entrepreneurs in particular.

Women have achieved a track record of functioning as effective entrepreneurs in successful organisations and networks (such as Grameen Bank and the Self-Employed Women's Association, SEWA, in Ahmedabad, India). The challenge is to transform them and their organisations into *energy* entrepreneurs.

The role of the public sector, including state, multilateral and charitable sources, is to create support systems that enable and promote entrepreneur response. What must be ensured is that entrepreneurs have choices and access to technology and resources.

What is needed therefore – as La Rocco suggested in 1996 in a personal communication – is "to create a *women's energy entrepreneur project* which will have as its objective the training and financing of developing country women to be new energy entrepreneurs..." The project would help women to learn to establish, own, run and manage energy enterprises. In the process, they will engender energy – they will turn energy into an instrument of improving the quality of life and generating income. And they will acquire and increase control over their destinies – they will be get empowered. From energy for women the process will lead to empowerment of women. This is the challenge.

4. New challenges and opportunities

The entrepreneurial capacities of poor women have been demonstrated in a number of ways: the success of micro-credit and micro-enterprise schemes rose dramatically when poor women, rather than men, became the main targets. The Micro Enterprise Summit reports that for the 34 largest projects from around the world reporting the poorest[13] clients, an overwhelming 76 % of the 9.1 million borrowers were women [MSS, 1999]. The shift in focus to women borrowers came out of the pioneering experience of organisations such as SEWA in India and the Grameen Bank in Bangladesh, which reported repayment rates of over 90 % by their women borrowers, a rate that has been largely borne out by the experience of subsequent women-focused micro-credit programmes around the world [Albee, 1994; ILO, 1998]. What is more, the evidence showed that while poor women experienced the greatest constraints in gaining access to productive credit, their application and use of the credit for income generation was in general extremely effective, all else being equal. The success of women's dairy and livestock cooperatives in Kenya, Sudan, southern India, Nepal, Bangladesh and Senegal [IFAD, 1994], SEWA's success with support to women vendors, recyclers, and textile printers, and thousands of other examples testify to this. Similarly, projects that have given poor women leadership roles in the management of basic community services such as water, sanitation, housing, health and education have shown that women can usually deliver better results, at lower cost and with less corruption. In short, poor women's managerial and entrepreneurial skills have been validated in diverse contexts, where opportunity, resources, training and leadership have been transferred to them [SPARC, 1997; GROOTS et al., 2001; SSP, 2002; Batliwala, 2002]. Unfortunately, this evidence has never been used to advantage in the energy sector, particularly in rural energy programmes. The reasons for the failure to do so have yet to be elucidated but there are many conjectures: these programmes view women as passive beneficiaries rather than as energy managers and entrepreneurs; energy solutions are restricted to the technological, to the exclusion of the managerial, dimension; management of energy systems will alter the power relations between the genders, etc.

In fact, the scope for such an approach is greater than ever before, owing to two critical and historic forces that have emerged over the past two decades: (1) the increasing privatization of the energy sector as a result of economic reforms; and (2) the emergence of organized women's groups in extraordinary numbers around the developing world, particularly in rural areas.

As the world's markets have become increasingly integrated, and the neo-liberal economic formula has been either imposed upon or adopted by the vast majority of developing countries, state subsidies have been drastically reduced and the provision of basic services increasingly privatised. The sometimes devastatingly negative impacts of these policies on the poor and on poor women have been extensively documented [e.g., IUCN, undated; Phelan, 2001]. But they have also opened up a small window of opportunity that is less well known, and needs to be explored in the context of rural energy services, viz., that while privatisation of basic services has usually opened the door to profit-oriented enterprises and interests, there are a growing number of cases in which non-governmental, non-profit groups have also entered this space. In many countries of Eastern Europe, for instance, child care services are being provided by women-run "Mothers' Centers" (see [GROOTS, undated] for information on Czech and German Mothers' Centers); in several cities in India, slum-dwellers' organizations are taking over the construction and maintenance of toilets and low-income housing; thousands of NGOs around the world are managing community health care and education services. While non-profit – and particularly community – organisations face serious disadvantages in raising the capital for larger-scale service provision and in competing for contracts [McLeod, 2001], when they succeed they have in general demonstrated a greater ability to provide lower-cost, equitable, and affordable services. This trend – what we might call "democratising" basic services, rather than "privatising" them – is on the rise, and there are major global campaigns to promote this model [CNES, undated; Appadurai, 2002].

At the same time, there is an extraordinary increase in the number of women's collectives and self-help groups at the grassroots level. This is the result of several forces that have been at play for at least two decades. Women's movements and development organisations around the world have increasingly focused on forming organised women's collectives that work to empower their members socially, economically and politically. Disenchanted with the slow pace and poor impact of government-run poverty alleviation programmes, the majority of bilateral aid and international development agencies have adopted a strategy of supporting women-centred micro-credit and micro-enterprise groups in developing countries. Even development banks such as the World Bank, IADB and ADB have adopted this approach. The result is the emergence of tens of thousands of women's self-help groups in the villages and shanty towns of poor countries. While there are no definitive figures or even guesstimates of the possible number of such groups world-wide, the following statistic should give us an idea of their magnitude: in just nine states of India, with World Bank and IFAD assistance, the Swa Shakti project alone has built 17,000 women's self-help groups. Organised women's groups of one kind or another can be found in virtually every developing country of Africa, Asia, and Latin America.

The challenge now is to link the two objectives of engendering and democratising rural energy services. If basic services such as energy are being privatised, the volume of credit going to poor women entrepreneurs is on the rise, and organised women's groups exist in a virtual grid across developing countries, the time is ripe for innovative strategies that link these three forces into a completely new approach for empowering women as energy entrepreneurs.

The obstacle in addressing this challenge is perhaps lack of imagination. Unfortunately, energy is one of the less obvious factors in the development and poverty eradication discourse. It is the basic resource that fuels both production and the reproduction of daily life, but is rarely addressed in either policy or grassroots interventions in the same way that other development inputs – such as credit – are. Nor is energy availability particularly well acknowledged as a factor underlying the success of other anti-poverty measures. Micro-credit and -enterprise programmes, for instance, simply assume the availability of energy resources for such activities, or disregard how its inadequacy could actually limit their success.

It is necessary therefore to recognise the transformative potential of energy in its two critical dimensions: as a resource for improving the quality of life (for providing lighting, cooking fuel, pumping water closer to the user, etc.); and as an essential resource for productive, income-generating work that could raise incomes and standards of living. Women, in fact, are interested in both these dimensions. So, arguably, given the awareness and training, women's self-help groups could seek finance for setting up and maintaining sustainable and renewable energy systems that serve both their subsistence and production needs. Improved and extended hours of lighting through photovoltaic cells, for example, could become more financially viable in rural households or communities if they served to increase hours of home-based production.

This requires a change of mind-set on the part of energy planners and activists: they must promote the notion of women as managers and entrepreneurs, not just beneficiaries, of improved energy services. The idea is to push to its limit the following sequence: women as deprived in energy consumption patterns → women as beneficiaries of energy interventions → women as managers of enterprises → women as energy entrepreneurs. The role of the public sector, development aid and private philanthropies is to create an enabling environment and support systems that encourage this approach. Technical assistance must help entrepreneurs make informed choices and gain access to technology and resources.

This is nothing short of a paradigm shift – but once achieved and implemented, the results will speak for themselves. Such an approach will engender energy by converting it into a force for improving the quality of life as well as enhancing productive capacities – a virtuous circle of energy for women and women for energy. ■

Notes

1. A rudimentary version of this paper was presented at the Brainstorming Meeting of *ENERGIA: Women and Energy Network* on June 4-5, 1996, at the University of Twente, Enschede, the Netherlands (cf. [Batliwala and Reddy, 1996]).
2. The fuel cycle is a description of the flow of energy from source to service -- from *primary energy* as found in nature to its conversion into convenient carriers *(secondary energy)* to *final energy* as delivered to users and *useful energy* emerging from the end-use devices to provide the energy services that human beings require.
3. The ASTRA programme of the Indian Institute of Science, Bangalore, focused on (and its name is taken from the initials of) the Application of Science and Technology to Rural Areas. Since science and technology could become weapons against poverty, the term ASTRA was appropriate because it means "weapon" in Sanskrit.
4. The past tense is used because the numbers refer to the period when the survey was carried out.
5. Transport has been included in agriculture because the only vehicles in Pura are bullock carts and these are used almost solely for agriculture-related activities such as carrying manure from backyard compost pits to the farms and produce from farms to households.
6. Direct energy is distinguished from *indirect* energy, which refers to the embodied energy used in the manufacture of materials and equipment.
7. Pura uses about 217 tonnes (t) of firewood per year, i.e., about 0.6 t/day for the village, or 0.6 t/year/capita.
8. Unlike in some rural areas of India, dung-cakes are not used as cooking fuel in the Pura region. In situations where agro-wastes (e.g., coconut husk) are not abundant, it appears that, if firewood is available within some convenient range (determined by the capacity of head-load transportation), dung-cakes are never burnt as fuel; instead dung is used as manure.
9. The Beijing Declaration of the Fourth World Conference on Women states "Women's ... full participation on the basis of equality in all spheres of society, ... are fundamental to the achievement of ... development, ..."
10. One reviewer pointed out that "radio and television do not require literacy skills and can be very good media for raising awareness."
11. This section owes a great deal to a personal communication from Phil La Rocco from which the quotations have been taken.
12. Grameen Bank (GB) has reversed conventional banking practice by removing the need for collateral and created a banking system based on mutual trust, accountability, participation and creativity. GB provides credit to the poorest of the poor in rural Bangladesh, without any collateral. The Grameen Bank Project began in one village in 1976. In 1983 it was transformed into a bank under a law passed for its creation. It is owned by the poor (women). It works exclusively for them. Borrowers of Grameen Bank at present own 93 % of the total equity of the bank. The remaining 7 % is owned by the government. The total number of borrowers is 2.6 million, 95 % of whom are women. Grameen Bank has 1181 branches, works in 42,127 villages and has a total staff of 11,777. The total amount of loans disbursed by Grameen Bank since its inception is US$ 3.87 billion. Out of this, US $ 3.52 billion has been repaid. During the last financial year from April 2002 to March 2003, Grameen Bank disbursed Tk. 16.90 (US $ 0.292) billion. The loan recovery rate is 98.74 %.
13. "Poorest" is defined here (for each country) as the bottom half of that part of the population that lies below the country's poverty line.

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Corrigendum

In Volume VII No. 2 of *Energy for Sustainable Development* (Special issue on Bangladesh), the caption to Figure 2 on Page 46 reads "Growth of fertilizer sector. The units shown on the y-axis are million standard cubic feet of gas per day (MMSCFD). 35.315 MMSCF = 1 m^3."

It should read "Growth of fertilizer sector. The units shown on the y-axis are million standard cubic feet of gas per day (MMSCFD). 35.315 MMSCF = 1 Mm^3." .I.e., 35.315 cubic feet make 1 m^3.

– Editorial Team