The Role of Women in Sustainable Energy Development

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Abstract:

This study explores the question of how sustainable energy development- specifically, decentralized renewable energy technologies - can complement and benefit from the goal of increasing women's role in development. Many of the examples given in the paper draw on contributions to and thinking developed in connection with ENERGIA News, the newsletter of the International Network on Women and Energy.

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Introduction:

Renewable energy will play an increasingly important role in energy supplies in both developing and developed societies in the future. Like all energy, renewable energy production and consumption are closely linked with the goals of sustainable human development: eradicating poverty, increasing women's role in development, providing people with income-earning opportunities and livelihoods, and protecting and regenerating the environment (United Nations Development Programs [UNDP] 1997). This paper explores the question of how renewable energy development can complement and benefit from the goal of increasing women's role in development.

Prospects for Renewables

Today, both large- and small-scale renewable energy sources have an important role to play in both developing and developed societies. This role can be expected to grow as capital costs decline and hidden subsidies on competing fuel source and electricity are eliminated. Indeed, there may be many opportunities for developing countries to leapfrog the industrial countries precisely because most energy demand growth and capital investment in the future will take place in the present developing countries. Both private- and public-sector involvement in overcoming the obstacles to wider dissemination of renewable energy sources have intensified in recent years. The establishment of dedicated institutions for renewable energy and energy efficiency finance has opened new avenues for finance and technical assistance. And concerns about climate change have led to the creation of new financing possibilities such as the Clean Development Mechanism (CDM) in the Kyoto Protocol. Large-scale renewable energy technologies have begun to be adopted by electric utilities and some of the institutional and financial problems of integration in the grid are being solved. Some but not all of these have both large- and small-scale application potential. Biogases-based cogeneration and sale of surplus electricity for export to the grid is under way in sugar mills in Maharashtra, India; geothermal energy serves the grid in the Philippines; and wind farms generate about 3% of total electricity supply for utilities in Denmark and California, with rapidly falling costs likely to fuel even more rapid growth in the near future. Thermal solar plants are in operation in Europe and the United States. Hydroelectric power is a well-established renewable energy technology, already contributing a fifth of global electricity supply, though its future will be somewhat limited by environmental and social concerns (UNDP 1997).

Biomass-based technologies have been adopted (though at some cost in subsidies) on a large scale in Brazil, both the use of charcoal rather than coal in steel production, and the national fuel alcohol program replacing about half the gasoline needed for automobiles. Biomass gasification and the use of vegetable oils as fuel may also be showing up in large-scale commercial programs as well as village applications soon, as maintenance problems with producer gas engine generators are being solved. Decentralized small-scale renewables are making considerable inroads, not limited to remote areas. Solar water heaters are by now a fairly well-established technology: in India, promotional subsidies have even been withdrawn (Doraswami 1994). Photovoltaic lighting may be the only hope for rural electrification in much of Africa, due to fiscal constraints on grid expansion: in rural Kenya, more households obtain their electricity from solar energy than from the official rural electrification program (van der Plas 1994). Village-level biogas plants still appear mainly applicable on a large scale in China and India, with a high level of community participation. Small-scale wind and hydro installations are widely used, where resources permit, for pumping water and grinding grain in remote areas, and in some cases, integrated with the grid or acting as mini/isolated grids.

The contribution of renewables to global commercial energy is expected to increase over time from the 9% contribution (mostly hydroelectric power) made in 1990, to 17% in 2020-2025, and 35% in 2050, and possibly as high as 50% by 2050 in a sustained growth or biomass-intensive scenario. Most scenarios project that renewables could contribute some 200 EJ (exajoules) per year or more by 2050 (UNDP 1997).

The issue for a number of renewable energy technologies is no longer technical eliability or economic competitiveness, which have been established in a variety of markets, but the institutional, management, and financing frameworks necessary for broader dissemination. Social and economic linkages with development issues are therefore beginning to achieve more prominence in renewable energy strategy.

Implications for Women

More than three decades ago, Boserup (1970) documented the role of women in development. Today, especially since the Beijing Conference on Women in 1995, virtually all major development organizations seek to some degree to integrate gender issues into their work, both on efficiency grounds and on the basis of social equity as a development goal in itself.1 Nonetheless, many development projects continue to be designed without consideration of their effect on women or of the role of women in their implementation. Energy and renewable energy projects are no exception. The different implications of the wider use of renewable energy sources for women and for men have hardly been examined. Research and project reports on renewable energy rarely include gender disaggregated information. Just as women's activities have often been overlooked in development and energy policy generally, they could be ignored by renewable energy programs to the extent that the same supposedly "gender-indifferent" approaches and channels are involved.

In part, this state of affairs results from the masculine images conjured up in the word energy.. The reality is, in fact, often the opposite of the image. Women indeed have an important role to play in sustainable energy development. This paper, originally prepared to address concerns of renewable energy technical experts at the World Renewable Energy Congress, reviews the literature on women's involvement in energy and presents some examples of the results of including or excluding women in renewable energy development. Four questions are addressed:

* Why do women need renewable energy?
* Are women really interested in decentralized renewable energy technologies?
* Will renewable energy technologies automatically benefit women?

Why Do Women Need Renewable Energy?

Women's roles and interests in energy use and production have been well-documented (Agarwal 1986; Cecelski 1992). Rural women face a crisis of biomass energy and of time and human energy, both to meet basic human needs and to earn livelihoods. Both urban and rural women must find means to meet their family and enterprise energy needs in the energy transition to more modern, commercial fuels as well. Energy efficiency and especially pricing and availability of alternative fuels continue to be a concern to women in both modernizing and developed countries, as women are primarily responsible for cooking and household management in all societies.

Biomass Cooking Energy Crisis: Fuel Scarcity, Health and Safety

Women's role in biomass cooking, the major use of energy in the household energy sector, is well-known. More than 2 billion people globally have been estimated to depend on biomass to meet their basic energy needs (UNDP 1997). Biomass fuels comprise 80% of household fuel consumption in poor developing countries, used mainly for cooking and heating. As the major users of traditional biomass energy resources, women have practical interests and expertise about how different fuels burn, efficient fire management, fuel-saving techniques, and the advantages and disadvantages of different fuels and stoves (Intermediate Technology Development Group [ITDG] 1992; International Labour Organisation [ILO] 1987).

Rural women (and their children) are the primary collectors of wood and residue fuels for household use. They often produce biomass fuels in their own home gardens and manage and protect common lands to maximize sustainable production of a variety of forestry products Food and Agriculture Organisation (FAO 1987). Although deforestation is generally due to market forces (such as urban and industrial fuel demands, agricultural clearing, and overgrazing), it directly affects the effort and time required for women to harvest biomass fuels. Rough estimates of the proportion of rural women affected by fuel scarcity (based on estimates by the FAO of the percentage of household energy provided by fuel wood) are 60% in Africa, nearly 80% in Asia and nearly 40% in Latin America and the Caribbean (UNDP 1995). Time spent in fuel collection in fuel-scarce areas can range from 1 hour to 5 hours per household per day. Other effects documented include reduced water heating and washing, and decreased time and fuel used for cooking, the whole at times even resulting in decreased female time devoted to agricultural work and food production and negative impacts on nutritional and health status (Cecelski 1987; Brouwer 1989; Kumar and Hotchkiss 1988).

Health and safety are major concerns of women in their use of biomass fuels. Smoke education and improved safety for children are often the two most important reasons cited by women for adopting improved stoves and fuels. In South African urban townships, the prevention of accidental kerosene poisoning of children, and the prevention of devastating housing fires caused by kerosene cooking and lighting, are important motivations given by both women and men for desiring household electrification (Mehlwana and Qase 1996; Jones, et al. 1996; Banks, et al. 1996).

The largest energy-related health impact on women and children on a global basis, however, is their high exposure to indoor air pollution in the more than half of the world's households that cook daily with wood, crop residues, and untreated coal. Typical indoor concentrations of important pollutants, such as

Table 1. Women's Exposure to Indoor Air Pollution from Biomass Fuel Combustion

	Measurement conditions	Particulate concentration (micrograms of pollutant per cubic metre of air)	Suspended particulate micrograms as multiple of WHO peak guideline [a]
		Kitchen area concentration levels	
Kenya, 1972	*Overnight*		
	Highlands	2,700-7,900	12-34
	Lowlands	300-1,500	2-7
Kenya, 1988	24 hours	1,200-1,900	5-8
Gambia, 1988	24 hours	1,000-2,500	4-11
India, 1982	Cooking with wood	15,800	69
	Cooking with dung	18,300	80
	Cooking with charcoal	5,500	24
India, 1988	Cooking	4,000-21,000	17-91
Nepal, 1986	Cooking with wood	4,700	20
China, 1987	All day in wood-burning kitchen	2,600	11
Papua New Guinea, 1968	Overnight at floor level	200-4,900	1-21
	Overnight at sitting level	200-9,000	1-39
		Individual exposure during cooking (2-5 hours per day)	
India:			
4 villages, 1983		6,800	30
2 villages, 1987[b]		3,600	16
8 villages, 1987[b]		3,700	16
5 villages, 1988		4,700	20
Nepal:			
2 villages, 1986[b]		2,000	9
1 village, 1988	With traditional stove	8,200	36
	With improved stove	3,000	13

[a] The World Health Organization standard is 150-230 micrograms per cubic meter. The WHO peak guideline recommends that a concentration of 230 micrograms per cubic meter not be surpassed more than 2 percent (7 days) of the year.

[b] Approximately half the households used improved cooking stoves.

Source: Pandey (1989) cited in UNDP (1995).

respirable particulates, carbon monoxide, benzene and formaldehyde, are excessive by comparison to health-based standards. Table 1 shows some typical exposures. The largest direct impacts are on respiratory infections in children-the most significant class of disease in the world-and chronic lung disease in non-smoking women (Smith 1993).

Physical and psychological violence against women was a major issue at the Beijing Conference on Women, and the current energy system is not exempt from these social forces. Women face violence where fuel must be collected in areas of contested access or civil disturbances, as in Sarajevo, where women faced snipers while seeking fuel supplies, or in Somalia, where the United Nations High Commission for Refugees (UNHCR) documented hundreds of cases of refugee women raped and brutalized by bandits while away from camps to collect wood fuel (*The Economist* 1993). There are even reports of bride suicides in India partially due to women.s inability to meet their family.s wood fuel needs (Agarwal 1986).

Implications for Renewable Energy Development

Thus, women need renewable energy to address their critical need for cooking energy and indeed the whole fuel cycle from production to consumption. Women need cooking energy that is less labor intensive, more convenient, and safer. A broad view of the entire household fuel cycle needs to be taken, including not just improved stoves but kitchen and housing design, food preparation and processing, and improved technology for the ergonomic collection and transportation of firewood by women. Some improved stoves programs have sought to do this; but compared to other energy initiatives, household energy programs have been marginalized and under-resourced (Peskin, et al. 1992).

Biomass-based renewable energy projects need to take into account women's dependence on biomass energy for basic needs, and the possible effects of new biomass technologies on women's access to traditional biomass resources. For example, in India some biogas plants used cow dung that previously had been available to poor landless women to use as cooking fuel, removing from them an important resource (Kelkar 1981). In Senegal, a charcoal project designed to provide fuel from state forests to urban Dakar resulted in women living in the forest area losing access to the forests for pasturing animals and gathering forest foods for home consumption (Sow 1986).

Human Energy Crisis: Women's Invisible Time and Effort

Women's long working hours in both domestic and economic activities (11 hours to 14 hours per day) have been documented in nearly every country. Of the total burden of work, women carry on average 53% in developing countries and 51% in industrial countries (United Nations (UN) 1995). Compared to men, women in rural areas of developing countries spend long hours working in survival activities such as firewood collection, water hauling, food processing, and cooking (Table 2). Women's energy and time scarcity impinges on the provision of these basic services. The proportion of rural women affected by water scarcity, for example, is estimated at 55% in Africa, 32% in Asia, and 45% in Latin America, with the median time for collecting water in the dry season at 1.6 hours per day (UN 1995).
Human energy is essential to survival in the rural production system. Much of this human energy is unpaid family labor provided by women. Because it is unpaid, it does not enter the market system. Because it is metabolic energy and difficult to measure, it does not enter the conventional energy system, which consists in this view of oil, natural gas, coal, hydropower, nuclear, wind, solar, biogas, and geothermal energy and does not account for the muscle power provided by human beings and animals performing the same tasks. Because they work longer hours than men and a larger proportion of their work falls outside the market, women are not credited for their true contributions when metabolic energy is excluded from energy analysis.

Table 2. Time Allocation to Survival Activities Among Women and Men (Hours per Day)

Activity	Indonesia	Burkina Faso	India	Nepal
Firewood collection				
Women	0.09	0.10	0.65	2.37[a]
Men	0.21	0.03	0.57	0.83[a]
Water hauling				
Women	0	0.63	1.23	0.67
Men	0	0	0.04	0.07
Food processing				
Women	2.72[b]	2.02	1.42	0.70
Men	0.10[b]	0.17	0.27	0.20
Cooking				
Women	-	2.35	3.65	2.10
Men	-	0.01	0.03	0.38
Average total work time				
Women	11.02	9.08	9.07	11.88
Men	8.07	7.05	5.07	6.53

[a]Includes grass and leaf fodder collection.
[b]Includes cooking.

Source: Constructed by the author using data from Tinker (1990) and Hotchkiss (1988) in Cecelski (1995).

Women's time spent on these survival tasks is largely invisible in current methods of reporting energy patterns and statistics. For example, while the energy used by an electric pump that transports drinking water can be easily measured and reported, the human energy expended by a woman carrying water goes unmeasured, unmonetized, and unrecorded in energy statistics. Although the energy expended for a water-mill grinding grain is accounted for in industrial energy balances, the calorific efforts of women doing the same task with mortar and pestle are not. Trucks transporting crops consume fossil fuels that are traded and valued through market mechanisms; the energy of women head loading the same maize to market in baskets is excluded from quantified energy balances.
Because such non-monetized .human energy. services are not included in national energy accounts, a misleading picture of the real economic importance of informal production is given, under-representing women's muscle as an energy source. This omission in the statistical accounts tends to support an investment bias towards large-scale energy infrastructure projects.

Implications for Renewable Energy Development

An important portion of women's economic contribution to development is unpaid, unrecognized and undervalued, resulting in less attention to technology development and to investment in improving women's work than men's work. Women need renewable energy to address their labor-saving and human energy needs, such as pumping water for household uses, food processing and grain grinding, and transport. For example, new energy technologies for agricultural irrigation and pumping and their large infrastructures are primarily within the domain of men. These have received far more energy policy attention than technologies for pumping and transporting drinking water, which falls almost exclusively within the domain of women's work in the informal sector.

Similarly, ways to improve pedestrian and public transport, used more by women, have received far less attention in transport energy policy than have alternative liquid fuels for automobiles, used and owned more by men in most countries. Currently, enormous attention is being directed at photovoltaic household electrification, used for lighting and media, while women's critical need for improved cooking with electricity or other sources is under-researched and under-financed.

Will Women Automatically Benefit from Renewable Energy Technologies?

Rural women are often assumed to be the principal beneficiaries of .improved. technologies, in particular of renewable energy technologies. Labor-saving devices are clearly a priority for rural women, given the inordinate amount of time and energy that they expend in necessary household drudgery. Two phases in rural technology initiatives can be identified that have had gender effects: those introduced to improve efficiency of production in general, and those aimed specifically at reducing women's drudgery. Unfortunately, numerous studies have shown that not only have many labor-saving technologies failed to save women's time and energy, but they have sometimes even worsened women's social and economic conditions. Can renewable energy development learn from and improve on this experience?

Technologies to Increase Efficiency: The Green Revolution

The Green Revolution in the late 1960s and early 1970s, while directed at raising efficiency and productivity in general, had unforeseen impacts on women. .The short-term impact of productivity enhancing technologies on women was usually non-existent, whereas the medium and long-term effects were frequently negative.. (Bryceson and McCall 1997, p. 31) Because technologies were aimed at the male head of household, who already controlled legal and cultural rights to land, water and other resources, the ability to organize hired labor, and the legal prerequisites for credit, the introduction of new technologies in most cases simply exacerbated the situation (Bryceson and McCall 1997).

One common pattern .was for .traditionally. male tasks to be mechanized before traditionally female tasks: ". . . . In the Green Revolution, the male tasks of clearance, land preparation, and planting were mechanized by animal- or tractor-drawn equipment, whilst female tasks of weeding and harvesting, and transport to and from fields were not" (Agarwal 1985, p. 32). Similarly, women's human energy tasks such as drinking water provision, fuel collection and food processing have received minimal attention in terms of improved energy technologies, even though these are necessary for household production (and reproduction) to take place.

Furthermore, in the Green Revolution, wage labor tended to be mechanized for cost-efficiency reasons, with detrimental effects on women's earnings. .Traditional rice-milling in Java, Sri Lanka and Bangladesh involved hand pounding of rice, a drudgerous, labor intensive female task paid very low wage rates. This was almost totally replaced in a short period by mechanized milling employing mainly male labor. Thus, a drudgerous task was removed, but at great cost by placing women back into unpaid domestic work.. (Agarwal 1985, pp. 32-33) In Indonesia on government initiative, mechanized rice hullers replaced 90% of manual rice hulling between 1970 and 1978, with estimates of jobs lost as high as 1.2 million in Java alone and 7.7 million in all of Indonesia as a result. It is estimated that the loss to women hand pounders in earnings due to the use of hullers was $50 million (U.S. dollars) annually in

Java, representing 125 million woman days of labor (Dauber and Cain 1981). Similar results with introduction of more efficient energy technologies are easy to imagine.

Carr 1984) has noted that when attempts are made to introduce improved techniques or technologies aimed at increasing productivity, the result can often be that men take over traditional women's industries. Once a new technology brings upgraded skills and higher returns, the men take over. Such outcomes have been noted more recently with palm oil milling in Nigeria and improved fish-smokers in Senegal (Bryceson and McCall 1997) as well as improved gari processing in Nigeria (UNIFEM with ITDG 1989):

The high purchase cost of these [improved gari-processing] technologies has resulted in only men owning and operating these machines. With the introduction of mechanical graters and presses, work traditionally done by women became the work of men. This transfer of control resulted in a transfer of income. Women lost an important income source (UNIFEM with ITDG, 1989, p. 60). In the Green Revolution, furthermore, because technical innovations were mostly taken up by more resource-endowed households, .the detrimental impact was most deeply felt by women from households which did not adopt the technology, especially the landless women deprived of their former employment. In Bangladesh for instance, whereas poorer households still husked rice with a pestle and mortar with much unpaid family labor, richer households hired mechanical rice huskers. Thus, the mechanization of harvesting and post-harvest processing displaced the poor hired women, whilst having a negligible effect on the women of richer households. (Bryceson and McCall 1997, p. 33).

Increasing the efficiency of production processes usually implies larger-scale production. Women producers, who are often part-time and small-scale, can easily be marginalized and lose control of the production process to male owners who can afford the necessary capital investment. In Ghana, for example, a World Bank pre-feasibility assessment found that most producers would benefit from a project aimed at improving the efficiency of making charcoal from sawmill wastes. However, smallscale itinerant producers were unlikely to be able to secure land tenure for fixed kilns, to invest in the new equipment, or to purchase the now more valuable residues. Although only about 300 charcoal makers would be affected, most of these small producers turned out to be women (Cecelski 1989).

Conclusion:

This paper has shown that women are not a special interest group in renewable energy, they are the mainstream users and often producers of energy. Without their involvement, renewable energy projects risk being inappropriate, and failing. Women are the main users of household energy in developing and industrial countries; they influence or make many family purchases related to energy; they are experienced entrepreneurs in energy-related enterprises; and women's organizations are effective promoters of new technologies and active lobbyists for environmentally benign energy sources.

Renewable energy manufacturers that do not pay attention to women's needs will be missing a huge potential market. Energy policymakers who ignore women's needs will be failing to make use of a powerful force for renewable energy development. Energy researchers who leave women out of energy research and analysis will be failing to understand a large part of energy consumption and production. Donors who do not support gender-sensitive energy assistance will be overlooking one of their primary target groups. Much work remains to be done. For example, an economic framework for including human energy and health externalities would greatly facilitate including women's activities in the energy sector. More detailed case studies of the results of including or not including women in renewable energy projects would be of enormous use in convincing policymakers and practitioners, as well as in training. The disaggregation of data by gender should be standard practice in all renewable projects offering immediate insights to those directly involved in implementation, and also in monitoring of impacts and benefits.

Nonetheless, the main conclusions necessary for action are clear, as stated in the report of the World Renewable Energy Congress-V. A growing group of women and men, ranging from grassroots women and extensionists to researchers to policymakers and donors, believe that gender is important enough to warrant special attention in renewable energy. At the same time they know that a gender perspective represents but one piece of the complex equation that can lead to successful renewable energy projects and enterprises-not a sufficient piece alone to assure success, but a necessary piece for success.

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