Abstract

Household energy consumption continues to account for between 40 and 60 percent of total energy budgets in the Association of Southeast Asian Nation (ASEAN) counties—with Indonesia, Malaysia, and Thailand using traditional fuels for nearly three-quarters of their total energy. Most of the burnable energy is used for cooking.

The acceptance of new energy technologies requires time and money—both of which are in short supply among rural villagers. Their strategies for survival require very long days, with women everywhere working more hours than men. Women have the least amount of time since they are responsible for the most production activities and household chores. Thus, the introduction of new technology at the household level is generally attractive only to those few villagers with some money and considerable free time—with resultant income differentiation, displacement of labor, and further impoverishment of the poor.

Energy Needs of Poor Households

by

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ENERGY NEEDS OF POOR HOUSEHOLDS[1]

INTRODUCTION

Household energy for food processing and cooking consumes between 40 to 60 percent of the total energy budgets in many developing countries. Because it is estimated that two-thirds of burnable energy is used for cooking, there has been a tendency among development planners to try to reduce energy requirements by improving the efficiency of traditional cookstoves. The fact that to date such efforts have not succeeded in reducing fuel consumption to any important degree, gives greater validity to an alternate strategy of reducing energy needs in the household by changes in food processing. Technologies are available which not only reduce energy used in food processing itself, but can also reduce cooking time through different handling of the food as it is processed.

This paper will focus on the socioeconomic factors which influence and are influenced by the introduction of new technologies. The emphasis will be on the trade-off within the food system of different types of energy. For example, many food processing technologies currently in use in developing countries consume fossil fuels and so their products are rapidly becoming too expensive for the poorer families to afford. The result is that the human energy of the poor is once again becoming the major energy source used in food processing. The time demands this food processing places on women at the subsistence level make it almost impossible for them to respond to any other development programs such as literacy training, family planning, or nutrition improvement. Thus low energy technologies for use in food processing are clearly a vital ingredient in any rural development plan.

The adoption of any new technology requires some adaptation in the behavior of the user. Scientists and planners tend to minimize the impact of such adaptation on the life patterns of the intended beneficiaries and so are angered when energy-efficient, labor-saving technologies are not embraced by the poor rural or urban villagers they are designed to help. Yet any change in the precarious existence of the poor in developing countries is likely to threaten the fragile web of structures which have allowed survival in the past. Only with an understanding of these structures can change be affected and the lives of the poor improved.

SURVIVAL STRATEGIES

Lives of the poor are filled with a multiplicity of tasks performed by all members of the household just for the kin group to survive. Development has generally improved the infrastructure of most developing countries so that health and education services now reach the villagers over both radio and roads. However, the lives of the rural poor are, if anything, more constrained than they were a few decades ago. The rapidity of change and the pervasiveness of modernization have upset the balances most enclosed cultures had attained between population size and carrying capacity of the land.[2]

Rural Poor

Such trends were evident in the writing of anthropologists twenty-five years ago. Rural Indian villages could survive only through a systemic balance of economic, social, and cultural factors, so intertwined that pulling one string threatened to unravel the whole ball.[3] In a much-quoted sentence, R. H. Tawney described the similar precarious life in 1931 of Chinese peasants in this manner: "There are districts in which the position of the rural population is that of a man standing permanently up to the neck in water, so that even a ripple is sufficient to drown him."[4] Thus a major element in village survival is to minimize the ripples.

Writing about what he calls the moral economy of peasants, James C. Scott notes that the reliability of the harvest was more important than yield: "the local tradition of seed varieties, planting techniques, and timing was designed over centuries of trial and error to produce the most stable and reliable yield possible under the circumstances." Such technical arrangements were supplemented by special arrangements such as "patterns of reciprocity, forced generosity, communal land, and work-sharing," which "helped to even out the inevitable troughs in a family's resources which might otherwise have thrown them below subsistence."[5]

It is a mistake, however, to view rural villages as static communities. Clifford Geertz originated the term "agricultural involution" to describe the absorption of increased population into the survival system by proliferating jobs and roles. This crowding of more people into the same agricultural system resulted in a fall in the per capita rice production despite labor-intensive methods.[6] Looking only at rice production, however, it was easy to assume that involution led to underemployment.[7] The recent series of time-use studies in villages in Java, Nepal, Upper Volta, India, and Nicaragua disprove this assumption.[8] The variety of occupations and the daily as well as seasonal variation have meant severe underreporting of these activities on the part of men and almost no data for women and children.

Urban Poor

The lack of available jobs in rural areas now pushes villagers to migrate to nearby urban areas for seasonal or year-round jobs, leaving

the women behind to cope with survival. Most of these jobs are in the informal or tertiary sector, involving petty trading or services such as repairing bicycles and peddling pedicabs. Even when families move, contact is retained with the village as a sort of safety net. Urban poor live much as they did in the rural areas, with all members of the family working at jobs the census seldom counts. Few time-use studies have been made in urban slums, but other types of urban studies begin to enumerate the multifold survival jobs of women and men.[9] Even more fascinating are the new kin networks developed by women for survival in an urban setting, where high male unemployment discourages marriage and so fosters women-headed households. A woman will seek to weave a network of obligation and exchange with the mothers of the men who father her children.[10]

Little is known about the intermediary sector between modern and traditional in culture and between agricultural and industrial in economics. Development theory suggests that any such stage should be considered transitional. A few scholars have written about this sector in an attempt to refute the myths.[11] Yet, in some ways, this is the most dynamic sector of society in developing countries, both culturally and economically. More attention must be given to energy technologies which will assist women as heads of households in surviving and prospering.

Time-Use Studies

Java. Three separate time-use studies on Java indicate that men engaged in rice production under the double-cropping system still only spend about one-quarter of their work time on rice cultivation. These surveys also show that the working day of men, whose activities also include animal care, garden cultivation, trading, handicrafts, and wage labor, is 8.7 hours. Women work a total of 11.1 hours, which includes 5.9 hours on directly productive or income-generating work similar to men's; 2.8 hours on such income-substituting work as drying, pounding, and cooking rice and vegetables and collecting firewood with which to cook; and 2.4 hours on household, childcare, and shopping duties (Table 1.). In the early 1970's, when these surveys were made, the variation in the size of landholdings had already produced a class hierarchy in rural areas--ranging from landless to large landholder. Household income studies in the same part of Java indicate that among the virtually landless households, the woman's income provides one-third or more of total family income.[12]

Class differentiation appears to be growing and is caused by the complex interaction of population pressure, monetization of the economy, and the green revolution. Heavy capital investment in new technology made it advantageous, if not necessary, for the larger landholders to slough off obligations that were part of the traditional survival strategies and to offer cash wages for farmwork. Harvesting, for instance, was "modernized" from hand knife--used by women, to hand sickle--used by men, and gleaning was virtually abolished.[13]

Rice-milling technologies introduced in Java at about the same time also reduced work available to poor women. Small rubber rollers pro-

cessed more usable rice than handpounding, so both commercial traders and the more prosperous farmers quickly switched to milling. The result was that poor women lost a major source of income, as much as 125 million woman-days per year, representing perhaps $55 million in wages. This loss is offset by about $5 million in increased male wages and an improved product at a lower price for the villager. The poorer women, however, cannot afford to pay scarce money for the milling and so continue to pound grain for themselves, unable to take advantage of the new technology.[14]

The impact of technologies for the green revolution and for milling of rice has been to increase unemployment among the poorest segment of rural Java, and especially among the women. From a poor rural society of shared poverty and shared survival, a society with greater income differential is emerging--where the poorest have even less security and resources than before.[15]

Stoler argues that the concept of egalitarian rural society has long since eroded, and may have never existed. Her study shows that even the exchange labor--paid in grain from the harvest--is governed by kin and neighborhood ties. Thus, close relatives have the first rights to share in the harvest and receive between a quarter to a half of what they harvest. Neighbors have the next claim to work and receive between an eighth and a sixth; more distant harvesters receive one-tenth or less of the grain they harvest.[16] In one sense this arrangement provides for all villagers to share in the harvest of the wealthy; even the weak and elderly have the right to glean. Contrastingly, the system also increases class differentials as land becomes increasingly scarce.

A second aspect of the life of poverty which is documented in the Stoler research is that poor women are willing to do almost any type of work to provide for their families, and society accepts these efforts.

> It is men, in fact, who have a smaller set of viable alternatives to agricultural labor. Women are, in a sense, better equipped to deal with the situation of increasing landlessness and can manipulate a more familiar set of limited options.[17]

Other studies have shown that men are more bound by concerns of status and so are less willing to take just any job, while women will work at anything to provide for their families. This has been shown particularly among migrants and refugees in countries as varied as Vietnam, Korea, and the United States.[18]

Nepal. A recently completed study on the status of women in Nepal confirms that conventional definitions of work and typical census statistics do not accurately reflect economic activities undertaken by all members of rural families. Using a mixture of observation and survey, the research team studied eight Nepalese villages, detailing time-use over a 16-hour period daily. They recorded only activity which took place within the village, thus excluding seasonal migration for wage labor or pasturage. Their findings indicate that, while men work 7.51 hours a day,

women work 10.81 hours. Female children in the 10 to 14 age group work almost as long as adult males--7.31 hours, while boys in the same age group work only 5 hours. Sex differences in work are even observed in the 5 to 9 age group, where girls work 3.39 hours compared to 2.33 for boys.[19]

Definitions of work in this survey include conventional economic activities, expanded economic activities, and domestic activities (Table 2). When purely domestic activities are excluded, women work 6.78 hours to men's 6.72 hours. Analysis also indicates that people in the middle and lower strata work harder.

Another important finding is the importance of food processing to the total family income. "This component of income is totally ignored in the conventional income statistics." It is evident from Tables 2 and 3 that about 15.6 percent of the total material production in these villages is generated in food processing and another 2 percent in manufacturing, which are performed within the household and mostly by women. The contributions from food processing to total household income are proportionately larger for wealthier households.[20] Village women in aggregate contribute 13 percent of all household income by this food-processing activity. In two villages, where women brew beer, their contribution is 15 and 23 percent, respectively.[21] It is clearly the income from women's work as well as their income-substituting activities that place a premium on help from daughters. The need for female children to work on the farm and in the household is the major reason given by villagers for not sending their daughters to school.[22]

Upper Volta. Work demands for survival in rural Upper Volta have a similar impact on schooling--with only 10 percent of the eligible age group in primary school (7 percent of the girls and 11.2 percent of the boys). As shown in Table 4, the women in this study spend many more hours working than do their husbands. Also, since this study includes only the first 14 hours of the day, it does not cover preparation and clean up after the evening meal. According to Table 4, women carry out 64 percent of the tasks classified as production. The lack of distinction between work on food for household consumption and that for sale makes comparison with the previous tables difficult, and illustrates once again the classification problems in deciding what is work. The list of activities, however, leaves no doubt about the heavy working day of both women and men in Upper Volta.[23]

Included in this study was the testing of three technologies designed to lighten the workloads of women--mechanical grain mills, carts to haul firewood, and more accessible water wells. Grinding and pounding grain require an average of 1.75 hours a day. It was assumed that mills would reduce this time. As with the poor women in Java, however, women in Upper Volta only use the mills when they have worked a longer than usual day in the fields; even then, less than half the women can afford to pay to have the grain ground. Despite the long workday, women see their effort at pounding grain as free, while taking grain to the mills costs money.

Similar findings were observed in another study in Upper Volta where mills are used primarily during the rainy season, which is also the planting season and so makes the heaviest demands on labor in the fields.[24] Thus, women use the mills only when they cannot find time in their crowded day to pound grain, and thereby they also limit their expenditure of money. Similarly, fuel carts are used by only half of the women; nonusers cite lack of money as the reason for not using the carts.[25]

Such findings emphasize that women have fewer opportunities than men to earn money. Yet, especially in Africa, women are expected to provide for their children themselves. As more and more goods and food are purchased rather than bartered, women need cash. Thus, with development, women are frequently worse off than before since their need for money increases but the opportunity for cash income diminishes.[26]

Summary

The above discussion of time-use surveys support the following points:

-- The rural poor have little margin of risk in their struggle for survival.

-- Both rural men and women work incredibly long hours, but women work longer days.

-- Poor women contribute significantly to the income and, hence, survival of their families.

-- Regardless of costs, the poorest cannot afford to own or even pay to use such simple, energy-efficient technologies as grain mills or fuel carts.

-- The cycle of poverty is becoming more arduous as populations increase and as the slightly better off villagers move into a more technologically adaptive world.

-- Food processing at the village level is an important income source.

-- Economic activities in the informal sector provide major employment for poor urban villagers.

NEW ENERGY TECHNOLOGIES

Given the precarious existence of rural and urban villagers and the heavy demands on the time of all able adults, it is not surprising that new technologies must prove a clear advantage to the intended beneficiaries before they will make the effort to take the risk of adopting them. This section describes those new energy technologies which have been designed for use by the rural or urban poor in light of the constraints of time and money which so characterize their lives.

Fuelwood and Charcoal

While rural villagers in developing countries continue to use firewood, agricultural residues, dung, and bushes as fuel, accurate measurement of amounts is almost nonexistent. However, two anthropologists have kept careful consumption records.[27] Estimates of fuelwood usage in most national energy assessments are based on a formula which is now being questioned.[28] Norman Brown has culled the best available information, as shown in Table 5; in 67 countries, which together include 41 percent of the world's population, firewood supplies 20 percent of total energy consumption; in another 61 countries, with 38 percent of the world's population, firewood accounts for a quarter of all energy used. But in 48 countries, with 16 percent of the total world population, more than half of all energy comes from firewood.[29]

It is clear that most of this energy is used for survival needs:

> It is instructive, finally, to examine the uses to which this energy is put. From various estimates, it appears that somewhere between 60 and 80% of the total energy consumed in rural areas of the developing countries is used in the food system-production, processing, storage, transportation, and preparation--and that on the average, about two-thirds of this amount goes to food preparation, i.e., cooking. Thus, rural India alone uses approximately 26% of the country's total energy budget for cooking, while Bangladesh's total national energy budget is used to cook food in the rural areas.[30]

A recent World Bank report on traditional energy sources estimates that 53 percent of the world's population uses fuelwood, dung, and crop wastes as the major cooking fuel. It is additionally noted that rural communities in developing countries remain largely closed systems with respect to energy.[31]

This is an important fact too easily overlooked. Indeed Axinn and Axinn have proposed using "the recycling ratio" as a measure for development:

> The Recycling Ratio is the proportion of the total materials and energy flow into, out of, and within a farm family ecosystem which recycles within that ecosystem. It is calculated from estimates of the materials and energy flow among such components

> of that system as the plants, the animals, and the people; each of them transforming energy from one form to another. It also takes into account such components of the near environment as solar energy, water, forests (for firewood), and outside grazing for livestock.
>
> In the large-scale, mono-crop, capital-intensive, commercial market-oriented farms of North America, the Recycling Ratio tends to be very low. Most inputs are purchased from outside the farm family ecosystem (seeds, feed, fertilizer, inputs for traction). Most outputs are sold in the market in exchange for cash.
>
> By contrast, in the small-scale, mixed crop plus livestock, labor-intensive, subsistence-oriented farms of Africa and Asia, and in many parts of Latin America, the Recycling Ratio tends to be much higher. Most inputs are produced within the farm. Most outputs are consumed within the farm.[32]

Such a measure would avoid some of the pitfalls of current economic planning and modern statistical collection. But in much of the developing world, rural villages remain quite self-sufficient with regard to energy.

Consider the time-use studies quoted above. All three studies show surprisingly little time being spent in fuel collection in rural areas (Table 6). In Java, men spend 12.5 minutes to a woman's 5.25 in firewood collection. This is consistent with reports of other anthropologists who note that women pick up leaves and twigs daily, but men trek off to the forests during slack seasons and cut down trees for fuel. Despite subsidized kerosene, the poor in Java cannot afford either the fuel or a stove.

Reports on the ecology of Nepal make frequent reference to erosion due to firewood use. Yet adults spend only about 20 minutes a day collecting fuelwood. Girls between 10 and 14 spend nearly half an hour on this task, compared to perhaps 10 minutes for boys of a similar age. When villagers are classed by economic level, it is found that all family members of the lower strata spend more time collecting firewood than those of similar age and sex from the upper strata.[33]

In Upper Volta, little time is spent by villagers collecting firewood. Women spend only 6 minutes a day searching for fuel; men spend a mere 2 minutes.

Such data do not suggest a fuel crisis in rural areas. Indeed, in one of the few village studies of fuelwood consumption, Deepak Bajracharya argues that:

> The pressures from food shortages and hence to expand agricultural land by clearing forest areas have a much greater influence on deforestation than those arising from extraction of fuelwood. This finding is supported by the observation that the people of Pangma are much more preoccupied with means of increasing their food supply than conserving their fuel demand.[34]

Rapid deforestation in Ghana is similarly caused by the increasing numbers of farmers practicing traditional shifting cultivation in forest areas. This trend, in combination with overgrazing and cyclical climatic shifts, will soon deplete woodland reserves unless new policies are adopted. Currently, three-quarters of all Ghanian households use wood; these households are primarily rural. The 22 percent of households using charcoal as the main fuel are predominantly urban. Prices for charcoal in Accra increased four times between 1975 and 1978 and certainly have continued to rise, though firewood is free in rural areas.[35]

Many writers have commented on the lack of trees surrounding Sahelian cities, such as Niamey and Ouagadougou, due to the cutting of firewood for sale in urban areas.[36] But even here, the ecological degradation began with overgrazing and cyclical climatic shifts. Further, the rural villagers in these countries apparently do not yet spend inordinate amounts of time searching for fuel. It is in such overpopulated countries as India and Bangladesh--where fuel is scarce in rural areas--that dung is routinely used and where as much as one-fifth of a family's time is spent gathering anything that burns.[37]

The fuelwood crisis is an urban problem in most developing countries. In the Sahel, as much as one-third of an urban family's income may go for firewood.[38] Thus, the strategies being sponsored by the U.N. Food and Agriculture Organization (FAO) and others for development of rural community forests or village woodlots need to be supplemented by new programs catering to urban needs.

Survival among the rural poor requires long hours of drudgery. Community forests require more time for watering and tending. But for whose benefit? Ownership rights are often unclear, allowing national governments or tribal chiefs to cut freely what others have nurtured.[39] Further, it is likely to be the women, who already work more hours than the men, who are expected to tend the trees. Conversations with rural women suggest that they are more concerned about the lack of such forest products as berries, leaves, and bark, which they use in sauces.[40] Indeed, such products often come from useless looking scrub which may be cleared for planting of fast-growing exotic trees to supply urban, not rural, needs.[41]

It is clearly difficult to ask hard-working women to add new tasks to their over-filled days unless they will clearly benefit from the effort. One obvious response is to plan rural mini-forests to provide both commercial wood for the cities and traditional forest products for the rural villagers. Such an approach requires great accommodation between the professional foresters and rural people. Some such meeting of minds is taking place with regard to the large-scale forests that supply export crops; generally they espouse mixed usage--plantation forests which allow intercropping of food and cash crops between immature plantings (from a letter by William Knowland to the Institute of Current World Affairs, 1980). But this solution still does not provide for the variety of plants traditionally used by villagers.

Further, wood from different species has different qualities for burning--not only are some types fast, or slow, burners, but they have fragrant or odious smoke. Yet women are seldom consulted about their preferences.[42] A recent FAO seminar in Bamako has started a series of such consultations.[43] There is growing concern over the health effects of smoke on women, but most solutions deal with cookstoves rather than wood.[44]

Increased fuel supplies for the urban poor from mini-forests or plantations will continue to have a high price. Efforts should be made to encourage the growing of bushes and trees--for fuel and food--within urban areas. Many cities and most small towns in the developing countries contain pockets of traditional settlements. Barrio inhabitants in the Philippines have been urged to plant the "magic meter" with food crops that will supply important nutritional supplements for the family.[45] Perhaps some of the "magic" fast-growing trees can be propagated by similar methods. Public spaces are available in most large cities, but protection and ownership rights would have to be carefully considered before planting. One idea comes from the "Greenbelt" concept in Kenya where citizens can pay to adopt a tree. Monies from such adoption pay for the hiring of a handicapped person in each village to provide care and protection.

Cookstoves

Engineers have proven time and time again that traditional cooking methods are carried out at efficiencies of 10 percent or less.[46] Yet one must continue to ask "efficiency for what?"[47] The assumption has been that more efficiently burning cookstoves will reduce fuel consumption.[48] However, a study by the National Academy of Sciences, just being completed, indicates that, while improved cookstoves provide energy for additional tasks and add to the quality of life, "there is no evidence that they save fuel" (personal communication from Michael Dow, National Academy of Sciences).

The fad that propelled cookstoves into the forefront of "solutions" might have been avoided if the realities of village life and needs had been more carefully considered. This is not to say that research on improved stoves should not be continued. But they are no panacea. The much-touted Lorena stove is simply not universally acceptable, even with local adaptation, because of size, because it requires fuelwood, and because it is not moveable.[49] Furthermore, women in most societies use more than one method of cooking.[50]

Biogas

This technology is deceptively attractive--providing both fertilizer and fuel. The apparently successful wide-scale use of biogas digesters in China has encouraged experiments in other countries. Generally, these plants work best where there is abundant refuse (and thus are less successful in India). At the single-farm level, pigs are more adaptive than cows because they require less effort in feeding. Furthermore, roaming

cows naturally leave dung where it can be collected by the poor. Changes in collection that require more time, or more structured time, are frequently too onerous for village women even when they receive methane gas in return.[51] The fact that only the better off villager can risk building a digester, or even has enough cows to do so, results in greater income disparity.[52] While this trend is apparent in Nepal as well, no negative social impact has yet been observed.[53]

While experiments on family-size digesters continue, there is growing consensus that, in the absence of strong social control mechanisms (as present in China), community or commercial digesters may be more promising.

Solar Energy

Much has been made of the unacceptability of early solar cookers that require the cook to stand in the sunlight. Solar ovens provide a lower heat and have not been widely tested. Small-scale solar ponds are still experimental in the United States, and are likely to be more expensive than solar ovens.

Solar ovens are usually black-painted metal boxes, often with additional reflectors, in which food will slow-boil. They would seem to be an ideal method of cooking grains and legumes. Solar steam cookers have similar properties. However, there are several obvious obstacles to widespread individual usage of solar ovens. First, most rural women work in the fields during the day when the cookers would be in use, and they cook when it is cool, either in the early morning or late at night. Furthermore, poor women do not have money with which to buy such a technology.

Difficulty in finding time to cook in the midst of agricultural demands is common and was noted in the Upper Volta study cited earlier. In Korea, women have organized communal kitchens through their local women's organization to provide meals during the harvest and planting seasons.[54] Such communal efforts lend themselves to the use of solar ovens, and might be extended to cover a greater part of the year.

Also of interest are increasing reports of changed diets in response to fuel shortages.[55] Most of these changes relate to long-cooking grains or legumes. A solution might be for a local women's organization to sponsor a solar oven so that a woman could be hired to pre-cook these staples. Women, after all, are already engaged in a variety of food-processing activities, so that this small commercial venture would be within customary bounds. The change in cooking habits that such an enterprise would entail would presumably be less of an adjustment than changing from millet to rice, or drinking uncooked flour mixed with water.

Solar dryers are also an inexpensive technology which is nonetheless out of reach of the individual woman as she dries her grain and vegetables. Various types of village organizations could experiment to see whether the higher return from better dried food would not make the dryer

affordable. Such efforts should consider the local cultural and economic conditions. Previous attempts by village organizations have often used a cooperative model not adapted to the local societal structure. Other attempts have assumed voluntary contributions of time on the clearly mistaken theory that women always have time.

These various solar technologies, combined with affordable mechanical technologies which might lessen the time spent in food processing, might best be tied into the income-producing activities of women rather than focused on household use. The fastest way of intervening in the cycle of poverty is to lessen the poverty.

Water Power

The milling of grain is a traditional usage of water power. Presumably, the cost of milling with water power will rise less quickly than the cost of milling via diesel fuel. But we have noted that even in Indonesia where the price of fossil fuel is low, the poor still cannot afford to pay for milling. As is so often the case, the obstacle of poverty prevents the use of technology designed to lessen the burden of drudgery. Some imaginatively designed community or women-owned facilities might allow wider use; alternatively, if women are able to include milling as part of the cost for greater commercialization of food prepared for sale, then the floor of their income would be raised high enough to use milled flour in home consumption as well.

Small hydroelectric installations are considered competitive with large-scale electric grids in Tanzania.[56] This will increasingly be the case in many areas as costs of fossil fuels continue to rise. Electricity for lighting is readily acceptable, even in the most remote areas, but even modest charges quickly outprice the poor villagers. A unit installed by the community in a distant valley in Papua New Guinea was set up for a provincial school and its teachers.[57] The availability of dependable electric current might well form the basis for a very small-scale food processing or handicraft industry.

To date, there has been little attempt to adapt electrical power for use in village cooking. Because Nepal has great hydroelectric power potential, a Cornell University graduate student has attempted to design a device that will "allow energy that is generated between cooking periods to also be applied to the cooking process."[58] Again, it seems that even such experimental efforts might better be applied to small-scale production processes than to individual households.

CONCLUSIONS

-- The time constraints of villagers, especially women, are a key factor in introducing new technologies for poor households.

-- Money constraints are an even greater factor in inhibiting the use of new energy technologies, especially for women.

-- New technologies must fill a perceived need.

-- New technologies must show a clear benefit to the user.

Concentration on the household level is unlikely to help the poorest villagers break the cycle of poverty. Most technologies favor the better off, and tend to increase income differentiation. Thus, mini-commercial uses of energy technologies are most highly recommended. Since women around the world are already engaged in food processing, this is a useful activity on which to focus. While the data herein only refer to such activities among villagers, the selling of street foods has long been recognized as an important source of income for women and men.

A second argument for concentrating energy technologies at the mini-commercial rather than the household level is the widely held stereotype concerning women's inabilities to use technology. Because of this myth, technologies at the village level have tended to be placed in the hands of men. As with cashcropping, the concentration of modern technologies on men has increased the gap in income opportunities and has had a deleterious impact on women's lives.[59]

A third argument involves local decisionmaking. As so clearly articulated by Brown and Smith, it is the women who need the new technologies but the men who make decisions:

> The sexual differentiation may be quite important in understanding the barriers to expanded uses of traditional fuels as well as the structural characteristics of the switch to commercial fuels. To the extent that men make the investment decisions, energy system changes may have a lower priority than they might appear to warrant in the eyes of an outsider concerned with overall technical or labor efficiency.[60]

Cultural values have their roots in the lives of the people. Over time, religious values become more intellectualized and split between the more adaptive "little" traditions and the "great" traditions. An overlay of modernization has tended to affect intellectuals much more than villagers. Thus, values and religious conflicts projected by national leaders may have little to do with the reality of the lives of the poor.[61] It is imperative, therefore, to acknowledge the reality of survival--to observe coping mechanisms and income activities of the poor--in considering the design and advocacy of new energy technologies for the developing countries.

NOTES

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Table 1

WORKING TIME DEVOTED TO VARIOUS ACTIVITIES BY ADULT MEN AND WOMEN (AGED 15 AND OVER) IN JAVA (NOVEMBER 1972 - OCTOBER 1973)[a]

Activity	Total Working Hours (%) Men (N=31)	Women (N=33)
Childcare	4.2	9.3
Housework	0.9	9.4
Food preparation[b]	1.2	24.5
Firewood collection	2.4	0.8
Shopping	0.5	2.5
Directly Productive (income-generating) Work		
Handicrafts	5.1	20.9
Food preparation for sale	3.9	3.7
Animal care and feeding	15.2	1.3
Trading	8.3	12.9
Garden cultivation (own)	8.4	0.9
Sawah cultivation (own)	21.7	3.7
Gotong royong[c]	8.8	1.4
Wage or exchange labor (agricultural)	3.4	6.9
Wage or exchange labor (nonagricultural)	12.8	1.5
Other	3.2	0.3
Average hours of directly productive work per day	7.9	5.9
Average hours of all work per day	8.7	11.1

[a]Data from a sample of 20 households.

[b]Includes the drying of rice and other crops for home consumption, hand-pounding and cleaning of rice, and cooking.

[c]Includes unpaid work in village projects and unpaid reciprocal labor for another household (especially housebuilding and repair). It does not include unpaid exchange labor in agriculture.

SOURCE: White, Benjamin, "Population, Involution and Employment in Rural Java," Development and Change, Vol. 7 (1976).

Table 2

TIME-USE PATTERNS BY SEX FOR MALES (AGED 15 AND OVER) AND FEMALES IN NEPAL

	Time Use (hours)		
Conventional Economic	Male	Female	Both
Animal husbandry	1.43	0.97	1.17
Agriculture	2.73	2.74	2.73
Manufacturing	0.42	0.45	0.44
Outside income-earning activities (in-village)	1.24	0.46	0.81
Subtotal	5.81	4.62	5.15
Expanded Economic			
Hunting and gathering	0.17	0.05	0.11
Fuel collection	0.24	0.38	0.32
Water collection	0.07	0.67	0.40
Household construction	0.25	0.08	0.16
Food processing	0.18	0.97	0.62
Subtotal	0.91	2.16	1.60
Domestic			
Cooking/serving	0.27	2.05	1.25
Washing dishes	0.03	0.39	0.23
Cleaning house	0.04	0.46	0.27
Laundry	0.02	0.15	0.09
Shopping	0.24	0.17	0.20
Other domestic	0.04	0.13	0.09
Childcare	0.16	0.69	0.45
Subtotal	0.79	4.03	2.57
Subtotal (conventional economic, expanded economic, domestic activities)	7.51	10.81	9.32
Education	0.43	0.10	0.25
Personal Maintenance	1.45	1.12	1.27
Social Activities	0.31	0.16	0.23
Leisure	6.30	3.81	4.93
Subtotal	8.49	5.19	6.68
TOTAL IN-VILLAGE ACTIVITIES	16.00	16.00	16.00

SOURCE: Acharya and Bennett, op. cit.

Table 3

COMPOSITION OF PER HOUSEHOLD INCOME
IN NEPAL BY ECONOMIC STRATA[a]

Sectors	Economic Strata[b] Top (N=84)	Middle (N=85)	Bottom (N=110)	All Strata (N=279)
Household Production				
Farm production	8,000 (47.4)	4,983 (51.1)	2,936 (46.7)	4,871 (48.4)
Kitchen gardening	239 (1.4)	373 (3.8)	200 (3.9)	264 (2.6)
Animal husbandry	1,390 (8.2)	836 (8.6)	365 (7.1)	817 (8.1)
Hunting and gathering	727 (4.3)	442 (4.5)	333 (6.5)	485 (4.8)
Manufacturing	330 (2.0)	165 (1.7)	96 (1.9)	188 (1.9)
Food processing	2,766 (16.4)	1,474 (15.1)	745 (14.5)	1,575 (15.6)
Subtotal	13,451 (79.7)	8,273 (84.8)	4,135 (80.6)	8,200 (81.4)
Outside Income				
Wage/salary	1,442 (8.6)	1,250 (12.8)	913 (17.8)	1,175 (11.7)
Investment trading	1,978 (11.7)	234 (2.4)	81 (1.6)	699 (6.9)
Subtotal	3,420 (20.3)	1,484 (15.2)	994 (19.4)	1,874 (18.6)
TOTAL	16,871 (100.0)	9,757 (100.0)	5,129 (100.0)	10,074 (100.0)

[a]Data from 279 sample households.

[b]Amounts are in Rupees; figures in parentheses indicate sector percentages.

SOURCE: Archarya, op. cit.

Table 4

TIME ALLOCATIONS TO RURAL ACTIVITIES
AMONG WOMEN AND MEN IN UPPER VOLTA

Activity	Average Time Allocated (in minutes)[a] Women	Men
Production, Supply, Distribution		
Food and cash crop production	178	186
--Sowing	69	4
--Weeding, tilling	35	108
--Harvesting	39	6
--Travel between fields	30	19
--Gathering wild crops	4	2
--Other crop-production activities	1	47
Domestic food storage	4	1
Food processing	132	10
--Grinding, pounding grain	108	0
--Winnowing	8	0
--Threshing	4	0
--Other processing activities	12	10
Animal husbandry	4	3
Marketing	4	0
Brewing	1	0
Water supply	38	0
Fuel supply	6	2
Subtotal	367	202
Crafts and Other Professions		
Straw work	0	111
Spinning cotton	2	0
Tailoring	2	10
Midwifery	41	0
Other crafts/professions (e.g., metal work, pottery, weaving cloth, beekeeping, etc.)	0	35
Subtotal	45	156
Community		
Community projects	27	0
Other community obligations	0	91
Subtotal	27	91

Table 4 (cont'd)

Activity	Average Time Allocated (in minutes)[a] Women	Men
Household		
Rearing, initial care of children	18	0
Cooking, cleaning, washing	130	1
Housebuilding	0	0
House repair	0	3
Subtotal	148	4
Subtotal (production, supply, distribution; crafts and other professions; community; household activities)	587	453
Personal Needs		
Rest, relaxing	117	233
Meals	21	29
Personal hygiene and other personal needs	20	7
Subtotal	158	269
Free Time		
Religion	2	6
Educational activities (learning to read, attending a UNESCO meeting or class)	17	4
Media (radio, reading a book)	0	14
Conversation	14	69
Visiting (including such social obligations as funerals)	43	19
Errands (including going to purchase personal consumption goods)	1	6
Subtotal	77	118
Subtotal (personal needs and free time)	235	387
Not Specified	18	0

[a]Based on time budgets prepared by direct observation.

SOURCE: McSweeney, op. cit., p. 281.

Table 5

FIREWOOD CONSUMPTION RELATIVE TO COMMERCIAL ENERGY

	Firewood Use as Percent of Total Energy Consumption					
	50%		25%		20%	
Region	No. of Countries	Population (millions)	No. of Countries	Population (millions)	No. of Countries	Population (millions)
Africa	32	279	35	292	37	317
Asia	9	363	14	1,095	15	1,172
Latin America and the Caribbean	6	23.4	10	168	13	181
Oceania	1	30	2	3.2	2	3.2
TOTAL	48	668	61	1,558	67	1,674
Percent of world population (4.1×10^9)		16.3		38		41

SOURCE: Brown, op. cit.

Table 6

TIME ALLOCATIONS TO RURAL ACTIVITIES
AMONG MEN AND WOMEN

Country	Average hours of work day in hours		Food (hours & minutes)		Firewood (minutes)		Water (minutes)	
	Female	Male	Female	Male	Female	Male	Female	Male
Java	11.1	8.7	2.7 hours	6.26 minutes	5.25	12.5	-	-
Nepal	10.8	7.5	3.0 hours	27 minutes	22.8	14.4	40.2	4.2
Upper Volta	9.8	7.55	2.2 hours	10.0 minutes	6.0	2.0	38.0	0

SOURCE: Java - White, op. cit.

Nepal - Acharya and Bennett, op. cit.

Upper Volta - McSweeney, op. cit.

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