Energy Use and Social Structure in a Bangladesh Village

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Analyses of energy use in developing countries typically compare the aggregate availability of energy with the aggregate requirement for energy and implicitly assume that distribution takes place according to need.[1] For an important energy resource, food, such a method is obviously flawed: at the global level because widespread chronic malnutrition coexists with an adequate supply of food to feed the world population; at the village level because it is primarily inequalities in food consumption that explain why, during famines, landless villagers die at much greater rates than their landed neighbors.[2] Whether the context is global or local, the issue of distribution is crucially related to control of available resources and the structure of social organization that governs the distribution of these resources from owners to users.

This paper examines energy availability and patterns of energy use in the context of a single village in rural Bangladesh. From a quantification of the average daily flows of energy use by the study population in the village, the analysis proceeds to an examination of patterns of landownership and of the relations governing transactions between members of different classes in land, labor, and crop residues. The data confirm the observation of the older villagers that the patron–client system of old, in which the richer peasants tried to underwrite the minimal needs of their poorer clients, is being replaced by a system in which transactions between families of the same class are the norm.

Since fuel for cooking food is by far the largest component of energy use in rural areas of the Indian subcontinent, data on specific fuels used by different classes in the village are analyzed in light of the social and economic organization. It is shown that families of different classes use different types and sources of fuel, and, in particular, it is the socially and economically most disadvantaged villagers who are forced to purchase this increasingly scarce resource from the market. The current social structure and current mechanisms governing resource distribution in the village are contrasted with historical patterns, and future patterns of energy use in the village are estimated. The final section assesses the likely effects of specific energy and rural development projects on different classes in the village.

The Study Population

The study village, Ulipur, is situated in the deep-water flooding plain of the Meghna River, in the western part of Comilla District. The village consists of an amorphous cluster of dwellings near a canal a mile west of the Dhanu, a major distributory of the Meghna River. The land is only ten feet above mean sea level and becomes covered with a sheet of water when the rivers flood their banks in June. By the end of October the waters have receded, leaving the land covered with a soft, fertile, sand-clay silt.

The 2,300 people per square mile in this densely populated rural area live in *baris,* clusters of predominately bamboo-walled and straw-roofed houses surrounded by trees and bamboo groves. The baris, which are raised above the level of the monsoon water on earthen mounds, are scattered over the flat plain. There is no road in the village, and no path remains above the monsoon water. The nearest market, at Raipur Bazaar, the administrative center for the 250,000 inhabitants of Raipur Thana, can be reached in an hour, by foot in the dry season and by country-boat when the land is under water.

The families of each bari are usually a patrilineal descent group, identified by a quasi-hereditary title that once indicated an occupation. The most important extra-familial social grouping is the *somaj* ("society"), which usually includes between 200 and 500 people. This informal multipurpose institution is referred to by the name of its most prominent member. The somaj is most easily identified at religious festivals, but it also functions as an economic unit, with exchanges in land, labor, and fuel taking place between members of the same somaj.

The study population consisted of 8 Hindu fishing families and 40 families of Muslim agriculturalists. These families represented a random sample of 50 percent of the inhabitants of both the Hindu community of Jelepara and the adjacent Ali Sardar somaj.

Data Collection

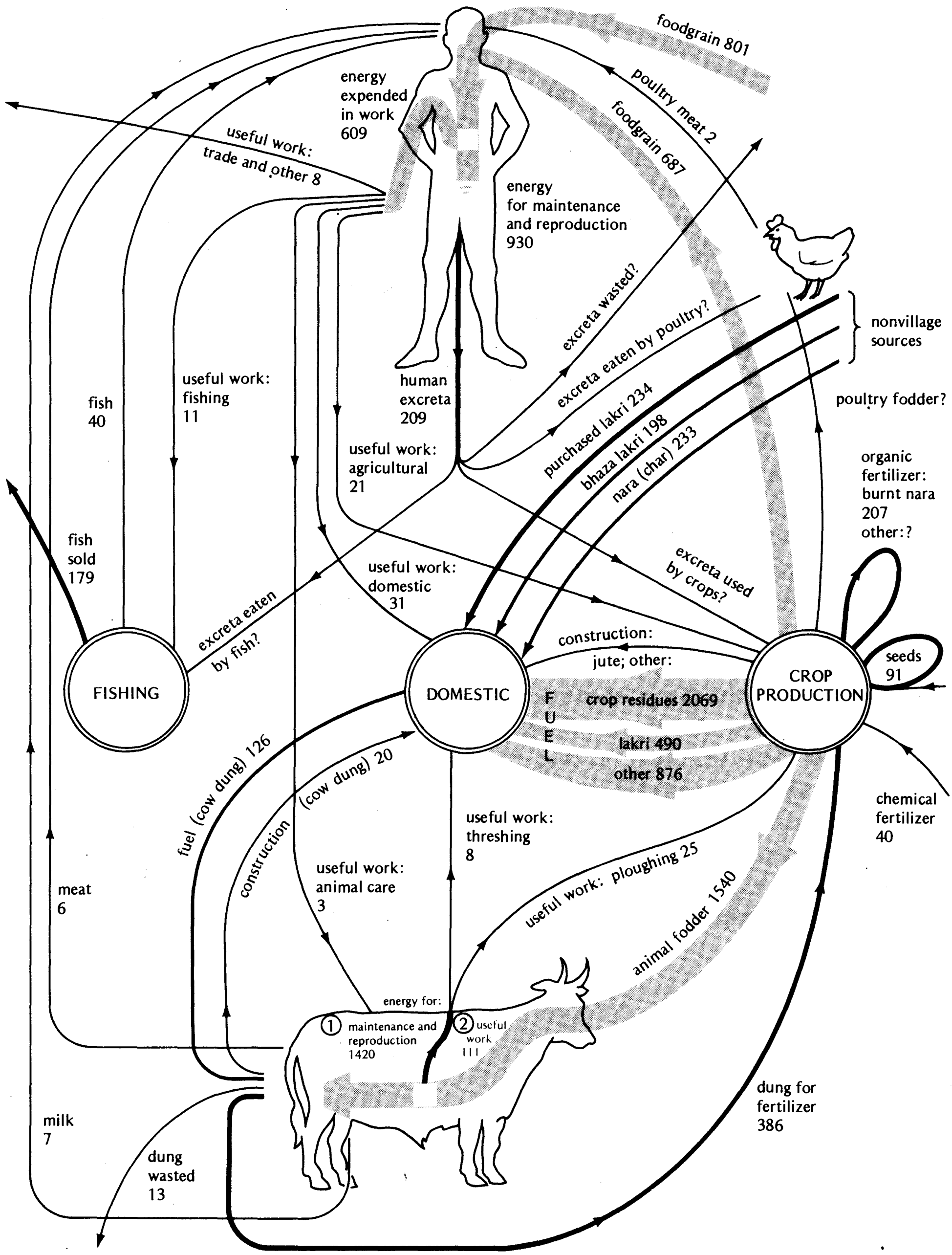
At the start of the study, information was collected from each study family on family size and composition, income and employment, animals owned, land owned, and land use. Estimates were also obtained of the production and distribution of crops and residues from the fields farmed by the family during the preceding year.[3]

The study design called for data collection for one full year, but due to unforeseen circumstances data were collected for only eight and a half months. Once every two weeks, detailed information on productive activities and the production and distribution of food, fodder, fuel, and fertilizer was collected from each study family. Primarily on the basis of direct measurement, estimates were obtained of the amount, type, and source of food eaten by the family's cattle over the previous 24-hour period. Similarly, the amount of dung excreted was estimated, and the use to which this dung was put recorded. The type and duration of agricultural work done by family members, on their fields and for others, on the previous day was recorded, as was the work done by others on the family's fields. Similar information was collected for the work of animals. Detailed information was collected on the planting, fertilizing, and harvesting of crops over the previous two weeks on the fields farmed by the families. On the basis of direct measurement, estimates were made of the production of crop residues. The names of the families using these residues were recorded, as was the use to which the residues would be put. Similar information was obtained on fuels collected from sources not owned by the family. On each working day precise measurements were made of the fuels used by a different study family for cooking their food and for parboiling paddy. The types and quantities of fuel used by each study family were thus recorded on a quarterly basis.

Patterns of Energy Use

Figure 1 illustrates the average daily flows of energy for the 330 people and 48 cattle in the study population. The detailed calculations behind these estimates are presented elsewhere;[4] in this section the methods followed in computing the most important energy flows—those of fuel, cattle, and humans—are outlined.

Figure 1
Daily Per Capita Energy Flows
in a Village in Bangladesh (in kcals)



Notes: The study included 330 people, 48 cattle, and 43 acres of agricultural land. The term useful work refers to actual mechanical work output, which is on the order of 10 percent of total work. The denominator for each estimate is 1 person X 330.

Fuel The quality of each type of fuel used for parboiling paddy and cooking food over the eight-and-a-half-month study period is estimated from the cooking fuel measurements. For the period during which data were not collected (February to mid-May) knowledge of the crops planted was used in conjunction with interview information about non-agricultural sources of fuel (such as water hyacinth) to estimate the types and quantities of fuel used by different groups in the population. For most fuel types, the estimates of total use obtained on the basis of measurements of cooking fuel were checked against information obtained on the production and distribution of crop residues. The aggregate annual fuel use in Ulipur is summarized in Table 1.

Table 1
Annual Use of Fuel in Ulipur

Fuel Type	Quantity of Fuel in 10^3 Kcals/Person/Year	Percent
Crop residues		
From village		
Amon nara	633	38.3
Amon kher	23	1.4
Aus kher	18	1.0
Boro kher	15	0.9
Grain husks	88	5.3
Jute sticks	32	1.9
Sesamum plant	48	2.9
Mustard plant	29	1.7
Chili plant	6	0.4
Total crop residues from village	891	54.0
Amon nara from char outside village	85	5.1
Animal residues		
Cow dung	46	2.7
Firewood (including twigs and branches)		
From village trees	167	10.8
From river (bhaza-lakri)	72	4.4
Purchased from bazaar	85	5.2
Total firewood	324	20.3
Other fuels		
Doinshah	81	4.9
Bamboo	60	3.6
Water hyacinth	27	1.6
Other crop residues and leaves	136	7.6
Total other fuels	305	17.7
Total, all sources	1,615	100.0

NOTE: The fuel used by the 330 people in the study population is estimated to be 545 x 10^6 kcals per year.

Cattle The useful outputs from cattle—work, dung, milk, and meat—are available only because of the food provided for the maintenance and reproduction of the entire cattle population. The average gross energy intake for the 10 bullocks, 20 cows, and 18 immature cattle is estimated to be about 10,600 kilocalories per day. Of the total intake, 54 percent is consumed by the 10 bullocks and 10 working cows.

Data were collected fortnightly on the activities of all cattle. For the nonstudy months, hours of work were estimated by comparing the intensity with which the animals were said to work during that period with the intensity during periods for which data were available. For the whole year, the 10 bullocks and 10 working cows worked an average of four hours a day for 150 days, 25 percent of the time being spent threshing paddy and 75 percent ploughing. In this wet area, unlike many other parts of the Indian subcontinent, cattle are not used for transportation.

The amount of energy expended in performing this work was estimated, following Revelle, by assuming that "a fully-employed bullock, like a human manual worker, utilizes about 43 percent of the energy it consumes in work."[5] Like other "machines," cattle are not perfectly efficient: the output of useful work is less than the energy expended in doing this work. Assuming, following Desai,[6] that the ratio of work to total energy consumed as work or heat is, as for human beings, about 25 percent, the useful work output is estimated at 2.8 percent of the net energy intake of all cattle, implying that the animals work at 0.43 horsepower.

The average dry-dung production is estimated to be 1.2 kilograms per animal per day. Seventy-one percent of the dung is used for fertilizer and 23 percent for fuel.

Humans In the absence of good data for the study population, the food consumption in Ulipur is assumed to be the national average of about 1,500 kilocalories per capita per day.[7] Muslim agriculturalists obtain 43 percent of their foodgrains from outside the village; Hindus obtain all their foodgrains from the market.

Recent data on the use of time by men, women, and children in rural Bangladesh show that villagers are neither un- nor under-employed: they do a great deal of work, but generally with very low return.[8] Using these data in conjunction with Revelle's estimate that Indian villagers expend 43 percent of their energy intake in work, the energy inputs into animal care, trade, fishing, agricultural work, and household work are estimated. Assuming that the average ratio of work to the total energy consumed as work or heat is about 25 percent,[9] it is estimated that about 10 percent of the total food intake of the population is accounted for by useful work. The most important sectoral activities are household work, agricultural work, and fishing, which account for, respectively, 45 percent, 28 percent, and 15 percent of the total output of useful work.

A Frugal, Inefficient System Although the energy system in Ulipur is frugal, with virtually all products and byproducts being used for some purpose, the use of energy is inefficient. In Ulipur, as in rural India, the energy input into foodgrain production accounts for over one-half of the energy output of the grain. This is slightly more than the energy input per unit of foodgrain output in energy-intensive US agriculture. Furthermore, the amount of food that has to be consumed by a person or a bullock to produce a unit output of useful work is very high. The efficiency of cooking, too, is very low, with about 3 calories of fuel used for each calorie of foodgrain cooked. This is substantially higher than the estimated US energy use for cooking and refrigeration combined.[10]

A Complex System Each crop in this village produces several products, each of which can be used for several purposes. Deep water *amon* paddy, for example, produces leaves, which are usually used for fodder but sometimes for fuel; grain, which is used for food; husk, which is usually used for fuel but sometimes for fodder; *kher,* the upper, tender straw, which is usually used for fodder but sometimes also used for fuel or as a compost; and *nara,* the lower, coarse straw, which is usually used for fuel but is also used for compost and occasionally for construction and animal fodder.

Patterns of landownership and tenancy are an important determinant of which organic materials are produced in the village. Decisions on cropping patterns are made by those who cultivate the land, not only on the basis of soil conditions and the prices of inputs and outputs, but also on the basis of the cultivator's need for primary and secondary products and possibly the needs of other people toward whom he feels responsibility.

So far energy use in Ulipur has been discussed as though the village were a homogeneous unit. Access to different types and sources of energy, however, is far from evenly distributed in the village: it varies with class and is largely governed by the social structure.[11] In the next section this social structure is described, with particular reference to the changing relations of production. Empirical and qualitative analysis are introduced to document the pervasive nature of the changes in social organization that the village is undergoing. The discussion provides the context for an examination, in the subsequent section, of the differential use of the largest component of energy use in the village—fuel.

Changing Forms of Social Organization in the Village

Equilibrium in rural societies such as that of Bengal has depended historically on a balance of transfers of peasant surpluses to the rulers in return for the provision of minimal security for the cultivators.[12] From the time of the Permanent Settlement of 1793, these patron–client relationships stemmed directly from the possession of differential rights in land. Landowners tended to become patrons for their tenants, servants, and laborers, and for members of the artisan and service groups.[13] Through these relationships landlords reduced their management problems and were ensured of a supply of labor during planting and harvesting. Clients also added to a patron's power in the endemic village factionalism and were helpers on ritual occasions and in times of crisis. For a poor villager, a relationship with a patron was advantageous because the patron provided work and income; he allowed the villager to collect fuel from his land, trees, and cattle; he interceded on the villager's behalf in village disputes and in contacts with government officials; and he helped with the education and employment of the poor man's children.

Evidence that changes are taking place in the forms of social organization in rural Bangladesh is widespread.[14] Where high-yielding crop varieties have been introduced, migrant workers compete with local laborers, and the traditional share system of payment has been partially replaced by the introduction of cash contracts and daily wages. Throughout Bangladesh, the market orientation of production units appears to be increasing. Concomitantly the gap between rich and poor has widened. According to the International Labour Office, in the decade since the mid-1960s, about 15 percent of households experienced rising incomes, while the percentage of landless to total households increased from 18 percent to 38 percent and the percentage of families consuming less than 80 percent of the required caloric intake rose from 5 percent to 41 percent.

Changes in the agricultural labor market have contributed to the tilting of the balance of reciprocity in the customary relationship against the poor. The demand for agricultural labor has increased more slowly than output, while the labor supply has increased rapidly both because population has grown more rapidly than output and because the number of people dependent on agricultural wage labor has increased drastically as the proportion of landless to total rural families has increased.

The interdependence between landowners and agricultural laborers has decreased as more government jobs have opened to Bengalis since Independence. In Ulipur, members of 43 percent of the study families have extra-village employment, the poor and landless working in factories, while the rich have desk jobs in the bureaucracy in Dacca. It is also the rich who have jobs in, and control of, the important local agencies such as the Raipur Thana Multipurpose Cooperative and the Ulipur Swarnivar ("Self-Reliance") Committee.

In Ulipur, as elsewhere,[15] the disappearance of slack resources such as fisheries and crop residues has forced poor peasants into the insecurities of cash economy. In the 1960s Ulipur Muslims seldom fished the rivers of the area. Fishing was considered exclusively a Hindu occupation, with the relationships built up during the sale of the catch forming the basis for the integration of the Hindus into the village society. When the Hindus occupied this niche they, like the poor Muslims, were allowed to collect the then-abundant crop residues from the fields of the landed villagers. As productive employment has become more difficult to obtain, as real agricultural wages have declined, and as the poor have become more impoverished, many Muslims have come to disregard their previous aversion to fishing. They now compete with the Hindus, albeit at a lower level of cooperation and using less complex equipment, for the produce of the waterways. Consequently, the rich inland fisheries are being overfished, with yields declining markedly over the past few years.[16] Furthermore, the Muslims of Ulipur now seldom buy fish from the neighboring Hindu fishermen of Jelepara. Since the Hindus no longer fulfill any essential productive function in the Ulipur economy, and since they now find themselves in conflict with the Muslims over fishing grounds, the few rights that they previously had as members of Ulipur society have all but disappeared.

Similar forces are at work within the Muslim society of Ulipur, too. The poorer Muslims meet their fuel requirements without being forced into the market only because there are still some surplus fuels in the village. With rising man–land ratios and static residue yields per acre, the day when the Muslim poor can no longer collect sufficient fuel within the village is not far off.

An Empirical Analysis of Changing Relations of Production In a "traditional" society, the process of accommodation centers around the sharing of access to land and labor. In such a society it is expected that landowners preferentially lease or sharecrop out their land to those who are poorer than they, and that the richer farmers preferentially hire laborers who are poorer and who depend most heavily on agricultural labor. As the patron–client system breaks down, "the levelling mechanisms of a community shuffle fewer resources, with the internal process of village sharing finally involving only marginal resources and opportunities."[17] Under these circumstances owners prefer to rent to tenants who are solvent, favor laborers from their own class when employment is scarce, and distribute fewer resources to poorer villagers.

Thus, the degree to which the traditional structure in Ulipur has been eroded can be determined by examining the classes of the families involved in transactions in land, labor, and crop residues and determining the relative importance of the traditional, "vertical" relationships, on the one hand, and the "horizontal" relationships between families of the same class, on the other.

Data on transactions in land, labor, and crop residues among Ulipur families are analyzed by comparing the classes of the giving and receiving families with the classes that would be expected under three social paradigms. The paradigms are: a "vertical" paradigm in which rich peasants preferentially allocate land, employment, and crop residues to those who are poorer and who are their clients; a "horizontal" paradigm in which families preferentially allocate land, employment, and crop residues to other families of the same class; and an intermediate, "class-neutral" paradigm in which there is no systematic class preference.

To illustrate, the data specify that 24 parcels of land were sharecropped in the village. Three hypothetical allocations of the 24 parcels are constructed to represent exchanges in land between different classes under the "vertical," "class-neutral," and "horizontal" paradigms. By comparing these allocations with the actual allocations that took place between classes, it can be determined whether the actual transactions are best characterized as "vertical," "class-neutral," or "horizontal."

Table 2 presents such comparisons for transactions in sharecropped land, mortgaged land, human labor, animal labor, kher, residues other than rice straw, and nara.[18]

For each of the transactions, there is a unique position for the "actual" vector that preserves the monotonic progression in the columns. For transactions in sharecropped land, mortgaged land, human labor, animal labor, kher, and miscellaneous crop residues, the mechanism underlying the observed transactions is more akin to that expected under a regime in which class cleavages are strong than under a traditional patron–client regime. In contrast to all of these commodities, the distribution of nara is still dominated by the patron–client type of relationship. It is most interesting that the distribution of one crop residue, kher, is similar to that expected under the "horizontal" paradigm, while the distribution of another, nara, is similar to that expected under the "vertical" paradigm. For the Muslims, the shortage in organic materials has been manifested first as a shortage of fodder and only subsequently as a fuel shortage. Kher is primarily used for fodder and nara primarily for fuel. On the few occasions on which these residues are sold, a kilogram of kher is sold for five times the price of a kilogram of nara. Therefore, the anachronistic distribution pattern of nara is not unexpected, since it is with respect to resources that have not become particularly scarce that the old forms of distribution may be expected to survive. The corollary

Table 2
Actual Number of Inter- and Intra-Class Transactions and Number of Transactions under Hypothetical Social Structures Compared

Resource	Paradigm of Social Structure	Richer	Same	Poorer	A Difference Statistic[a]
Sharecropped land	Vertical	14	0	10	25.5
	Class-neutral	10	8	7	3.6
	Actual	**8**	**12**	**4**	—
	Horizontal	6	15	3	1.5
Mortgaged land	Vertical	2	0	16	5.7
	Class-neutral	1	3	14	0.5
	Actual	**1**	**4**	**13**	—
	Horizontal	0	6	12	2.1
Human labor	Vertical	141	0	24	54.1
	Class-neutral	115	31	19	3.4
	Actual	**110**	**40**	**15**	—
	Horizontal	73	92	0	95.0
Animal labor	Vertical	21	0	29	58.8
	Class-neutral	12	19	18	7.0
	Actual	**10**	**27**	**13**	—
	Horizontal	2	43	5	20.8
Kher	Vertical	15	0	13	36.8
	Class-neutral	13	8	7	6.4
	Actual	**10**	**14**	**4**	—
	Horizontal	6	22	0	10.2
Residues other than rice straw	Vertical	1	0	16	∞
	Class-neutral	0	3	14	0.3
	Actual	**0**	**3**	**14**	—
	Horizontal	0	5	12	1.6
Nara	Vertical	6	0	26	4.7
	Actual	**6**	**4**	**22**	—
	Class-neutral	6	7	19	2.7
	Horizontal	0	22	10	93.5

[a] This statistic is a modification of the standard chi-square statistic. It gives a normalized sum-of-squares measure of the difference between the actual and hypothesized transaction vectors. When the value is high it means the vectors are very different; when the value is low the vectors are similar.

is that as the supply of nara, too, becomes scarce, the distribution of this material will evolve rapidly toward the pattern seen for kher and other scarce commodities.

A Qualitative Description of the Changes Taking Place These changes in social structure mean fundamental changes in the everyday lives and fuel collection practices of the villagers of Ulipur. A feeling for these changes is conveyed by brief descriptions of Sulaiman Majumdar and Ali Sardar, the two most powerful men in Ulipur.

Sulaiman Majumdar is the oldest son of Fakruddin Majumdar, the last Zamindar of Ulipur. Sulaiman is the biggest landowner in the village, with 10 acres of agricultural land. His status has declined and continues to decline relative to that of Ali Sardar, but Sulaiman is undoubtedly the most important village leader. Despite his interests outside of the village (he owns a "baby-taxi" in Raipur Bazaar and has a small construction business in a nearby town), the hereditary nature of his position in the village means that many of his relationships are those typical of a traditional "patron." He sharecrops out a substantial portion of his land; he has a house servant and a permanent laborer who have worked for his family for many years and who are treated paternalistically as "part of the family"; he has contributed heavily to public works like the village school and the embanked path through the village; he has acquired religious stature by going on a pilgrimage to Mecca, building a mosque in Ulipur, and employing an Islamic priest; he is the final authority in the mediation of most village disputes; he is the perennial Ulipur candidate for election to the chair of the local extra-village political body; and it is he to whom distinguished guests are taken when they visit Ulipur. In terms of energy distribution, too, Sulaiman behaves like a traditional patron by giving permission to many of the poor of his somaj to clear residues from his fields after the harvest has been reaped.

Ali Sardar represents a different type of village leader whose power does not emanate from hereditary status but from his ability to take advantage of the new opportunities that have accompanied the influx of foreign aid into Bangladesh. Ali is Chairman of the Raipur Multipurpose Cooperative, his brother Abu is Secretary of the Cooperative, and another brother, Asad, is Secretary of the Ulipur Swarnivar Committee. Because the basis of Ali's position is not the dispensation of patronage to the villagers, his relationships with the people of Ulipur are quite different from those of Sulaiman Majumdar. Ali gives no land to others to farm, but he leases 0.4 acres and sharecrops 0.6 acres for relatives who work in Dacca. He manages these lands and his own 3.1 acres himself; he employs no permanent laborers; he lends money for interest (usually at a rate of more than 10 percent per month); he makes no effort to appear to be a devout Muslim. Whereas a traditional landlord's pursuit of power may be veiled by a paternalistic concern for his clients, Ali is far more direct. During the study period, Ali wished to occupy a part of Jelepara so that he could establish a more spacious home and fruit orchard. First, by refusing to continue to lease to the Hindus trees necessary for fishing, Ali made it difficult for these fishermen to continue earning a livelihood in this area. He and his family subjected the Hindus to harassment. He expelled those Hindus whose land he wished to use and who were indebted to him. When the one Hindu in this part of Jelepara who was not indebted to Ali refused to sell his homestead plot, he was forced to do so when threatened with death by Ali's oldest son. Ali was unconcerned that the villagers, Muslim and Hindu alike, did not approve of his actions in this matter. In terms of energy distribution, too, Ali acts quite differently from Sulaiman Majumdar; it is not his habit to distribute scarce crop residues to poorer villagers.

The changes in Ulipur society that are reflected in the data in Table 2 and in the decline of the Majumdars and rise of the Sardars can be described, paraphrasing Marx, as the substitution of feudal, patriarchal exploitation by unqualified, direct exploitation.

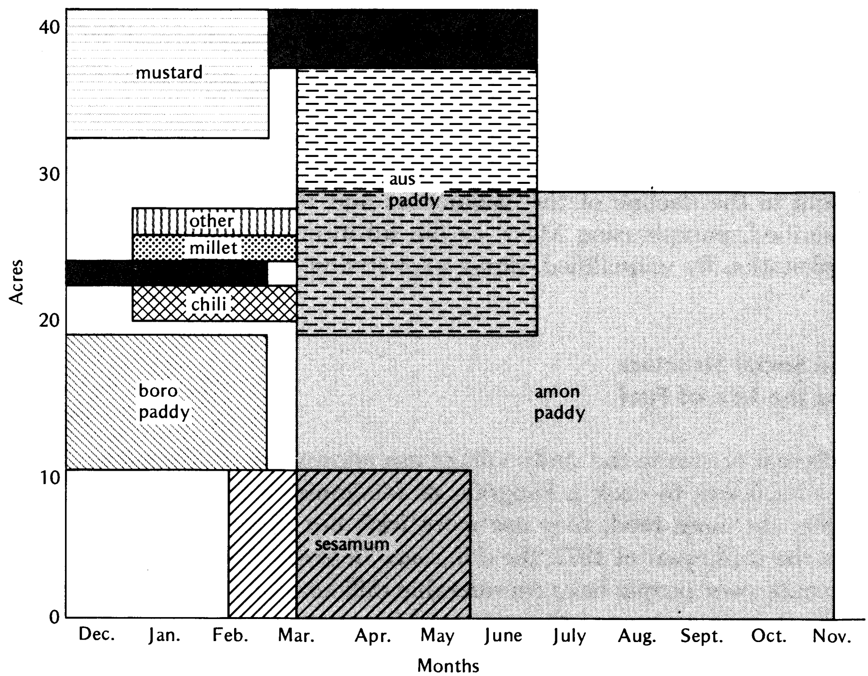
The Social Structure and the Use of Fuel

Different classes in the study village use approximately the same number of kilocalories to cook a kilogram of foodgrain. Because the richer villagers eat more food, they use more fuel, but in a relatively good year like the study year of 1977, the difference in overall fuel use is not great.[19] Because poor people have considerable difficulty obtaining fuels, particularly at certain times of the year, and because not even careful management can greatly increase the efficiency of the *chulahs* (mud fireplaces for cooking foods that are of a standard design throughout the village), the results of fuel crises are not that the poor use fuel more efficiently, but that they are forced to go to greater lengths, including stealing and buying fuel with money that would otherwise have been used for food, to acquire the fuel necessary for cooking. Thus, while the fuel needs of rich and poor are similar, the quality of fuel used and the costs, including the effort expended to obtain it, differ significantly.

Seasonal Factors in Fuel Availability Crop residues provide over 70 percent of the fuel used by the study population, and therefore the cropping pattern (see Figure 2) is the primary determinant of the seasonal variation in the fuel supply. Other fuels, such as *bhaza lakri* (the trees and branches recovered from the rivers and riverbanks after the monsoon) are available over longer periods of time, while still other fuels, such as cow dung and firewood from the village trees and the market, are available year round.

Because the technology available for preserving fuels is rudimentary, the patterns of fuel use often closely correspond to the patterns of fuel production. Fuel-drying is essentially limited to sun-drying in the courtyards, although occasionally villagers dry damp fuels by placing them

Figure 2
Land Utilization
in Ali Sardar Somaj



alongside the chulah. It is difficult for those villagers (particularly the Hindus) who live in the most crowded conditions, and therefore have little space between their houses, to use fuels like water hyacinth that require protracted drying periods. All families have difficulty drying fuel during the monsoon, since women have to bring the fuel inside repeatedly when it rains and lay it out again when the sun shines. An associated determinant of the temporal use of different fuels is the suitability of the particular fuel for storage. For example, firewood and rice hulls are dense and do not rot, while nara is bulky and susceptible to rotting. Poor people are often constrained by the lack of storage space.

The Determinants of Class Differences in Fuel Use The ownership of assets that produce fuel is highly concentrated. As shown in Table 3, 16 percent of the families own 80 percent of the trees, 55 percent of the cropped land, and 46 percent of the cattle. In this society the rights to the products of the land lie exclusively with the owner of the land. Thus, in theory, the landowner commands all of the residues produced on his land. In practice, actual command of these resources depends on the owner or caretaker's ability to enforce his rights to the fuel from his land.

Table 3
Ownership of Fuel-Producing Assets (per family)

	Hindu Fishermen	Muslims			
		Landless	Poor	Medium	Rich
(Number of families)	(8)	(14)	(11)	(8)	(8)
Land (decimels[a])					
Median	0	8.5	66.0	126.5	242.0
Mean	0.7	9.5	65.2	135.1	295.8
Trees					
Median	0	6.0	8.0	16.0	182.0
Mean	2.0	11.1	12.2	17.5	209.0
Cattle					
Median	0	0	0	1.0	4.0
Mean	0	0.3	1.3	1.3	2.6

[a] One decimel = 1/100 acre.

The owners of the alluvial char lands along the Dhanu River live far from their fields and would have to go to great lengths to prevent the removal of nara by others during the day. At night, protection of the nara would be virtually impossible. By contrast, since kher is carried to the bari with the harvested paddy, it would require desperation and audacity to steal it.

The importance the owner attaches to control of fuel also affects its distribution. A middle peasant who owns a distant plot of land lined with *madar* trees may be relatively unconcerned about pilfering of nara from this land; but if anyone were to chop down a tree of his or even break off a large branch, he would be most concerned because he planted the madar trees specifically so that his family could have more firewood. Because it is the landed people who assume responsibility for law and order in the village, the illegal chopping down of a tree would be considered a serious breach of village order. The vigor with which the offense would be prosecuted would depend on the social standing of both the owner of the tree and the pilferer. For the most marginal economic and social group in the village, the Hindu fishing people, the possibility of committing such a crime without being discovered would be slim because of their limited mobility within the village; and harsh punishment for such an infraction would be much more likely than it would be for any Muslim.

If a fuel is in short supply and can be easily protected, the owner of the fuel-producing asset controls its distribution, using much of it himself. Transactions in such fuels are likely to be predominantly between families of the same class. If a fuel is highly valued but difficult to protect, its use by different classes is likely to be more similar. Abundant fuels are likely to be the most equitably distributed among different classes; however, a difference in access between the landless Muslims and Hindus is to be expected because of the marginal position of the latter group.

Table 4 presents data on the types of fuels used by different classes in Ulipur.

Table 4
Fuel Use by Different Classes During the Study Period

	Percent of Total Consumption for				
		Muslims			
Fuel	Hindu Fishermen	Landless	Poor	Medium	Rich
Sesamum shrub	0.3	0.0	1.5	10.3	10.2
Hanza kuta	1.2	3.2	10.7	8.6	16.6
Grain husks	2.7	4.1	6.9	12.7	17.3
Ghoita	0.0	1.3	5.3	3.2	4.7
Jute-sticks	0.5	1.5	0.9	0.7	4.5
Doinshah	1.4	7.5	5.3	9.3	7.5
Nara	25.0	38.4	26.0	33.2	19.2
Lakri	46.9	26.8	31.1	9.0	10.8
Bamboo	16.6	3.1	1.2	4.8	1.5
Water hyacinth	0.0	4.8	1.7	1.8	1.8

a) *Sesamun shrub, hanza kuta, grain husks, ghoita, and jutesticks:* These agricultural byproducts are in short supply and are easily commanded by those who own the land and animals. They are used as fuel primarily by the landed classes, and mostly in the six-month period before the amon harvest when fuel is scarce for many villagers.

b) *Doinshah:* This annual leguminosa with tall, slender stems grows during the monsoon on the small ridges that demarcate the agricultural plots. It is a valued fuel, in short supply, but difficult to protect. The uniform use of doinshah by all classes of Muslims is not due to voluntary distribution of the fuel from the rich Muslims to the poor, but results from the fact that it is easy to steal and can be used satisfactorily over a fairly long period. Hindus use little of this fuel since they seldom go near the cropped lands and have few opportunities for pilfering it.

Despite the frequent pilfering of doinshah, farmers continue to grow the plant because, irrespective of who finally uses the stalks for fuel, doinshah fulfills other important functions. The stems provide a screen around the paddy field, preventing water hyacinth from entering and damaging the growing crop; the leaves are used for feeding cattle at a time when fodder is scarce; and the plant enriches the soil by fixing atmospheric nitrogen.

c) *Nara:* In the past there has been a surplus of nara after the amon harvest in November. But although the fields of the rich and middle peasants still generate more nara than these families use themselves, for the village as a whole there is no longer a surplus.

Since the larger landholders have an excess of nara, and since guarding of the harvested fields at night would be an onerous task, unauthorized removal of nara by poorer people of the village is common. Indeed, some degree of pilfering is "socially acceptable." The larger farmers also often give poorer "clients" permission to clear a portion of the nara from their fields. As was shown in Table 2, nara is the only residue that is still distributed in the "traditional," vertical manner; and Table 4 confirms that the use of nara does not increase with size of landholding. In fact, richer farmers use less nara than the poor Muslims because after the amon harvest the rich families have large amounts of hanza kuta, comprised mostly of kher at this time, available in their baris.

The Hindus use nara least of all. Because of their marginal status, they are never allowed to take nara from the fields of Ulipur farmers during the day. At night, when many landless Muslims steal nara from nearby fields, the Hindus are usually busy fishing and have no time to collect nara. In addition, the penalty for being caught removing *nara* illegally is much heavier for a Hindu than for a landless Muslim.

The "safety valve" for the Hindus is the char land between the village and the Dhanu River. The owners of the char lands have ample nara closer to their homes and do not care if the Hindus or anyone else takes the nara from the char.

d) *Lakri:* It seems surprising that, although the rich peasants own 80 percent of the 1,300 fruit and 800 firewood trees, it is the poor and landless Muslims who use the most lakri, or firewood. The anomoly is resolved when attention is paid to the types of lakri (which include twigs, branches, and logs) used by different classes and to the seasons during which most lakri is used.

Because the nara from the previous amon harvest is exhausted and the medium and rich peasants use all the residues from their dry-season crops, the six-month period between late summer (May) and the amon harvest (in November) is a time of acute fuel shortage for the poor and landless Muslims. The lakri twigs scrounged from beneath the trees of the rich and the small branches broken off the madar trees planted along the paths account for about half of the fuel used by the poor and landless Muslims during this period.

The medium and rich families seldom face any fuel problems and seldom resort to such inferior fuels. In pre- and early-monsoon months lakri accounts for only 5 percent of their fuel use. During the late monsoon months, before the amon harvest, firewood accounts for 28 percent of the fuel used by medium and rich farmers, but their primary fuels continue to be stores of crop residues.

The factors governing the high lakri use by the Hindus are quite different. When the monsoon waters start to recede in October, the Hindu fishermen recover trees and branches from the rivers and riverbanks. They continue to collect this bhaza lakri until mid-April. Bhaza lakri accounts for nearly 80 percent of the fuel used by the Hindus during November, falls to about 22 percent during the four months following the amon harvest, and rises again to about 50 percent during April and May. During the monsoon from mid-June through mid-September, when the Hindus have exhausted their store of bhaza lakri, they are forced to buy firewood from the market at Raipur Bazaar. During June, July, and August, lakri accounts for 55 percent of their fuel use, and in September and October its share rises to nearly 80 percent of the fuel budget.

e) *Bamboo:* All classes use this fuel during the pre- and early-monsoon months when other sources of fuel are scare. Bamboo is particularly important for the Hindus, accounting for 36 percent of their fuel use during this period. The Hindus take most of this bamboo from groves along the river.

f) *Water hyacinth:* Water hyacinth is available in abundance to all groups in Ulipur. Because the plant is 93 percent water, it has to be dried for long periods before it can be used as a fuel. The Hindus do not use water hyacinth because they have no open space for drying the plant.

The landless Muslims, like the Hindus, face acute fuel shortages, but they have more means for meeting their requirements. Poor Muslims frequently live in baris with some families who are better off than they, and since the courtyards are often used communally, space restrictions are less acute for the landless Muslims. Furthermore, in contrast to the Hindus, the landless Muslims are integrated into Ulipur society and therefore can use the sides of the village paths to dry water hyacinth.

As would be expected for an inferior fuel like water hyacinth, consumption of the fuel decreases with income: the landless Muslims use water hyacinth for 5 percent of their fuel needs, while the landed Muslim groups use it for less than 2 percent of their needs. When the latter use water hyacinth as a fuel, it is often a result of feeding water hyacinth to their cattle and using the part that the cattle do not eat as fuel, rather than deliberately collecting water hyacinth for cooking purposes.

Energy Use in Historical Perspective

From a Past of Fuel Abundance to a Present of Fuel Scarcity Assuming Ulipur to be typical of villages in the flooding plane of the Meghna River of Bengal in the nineteenth century, a picture of the use of energy in the village can be reconstructed from the remarkable statistical accounts of British administrator W. W. Hunter.[20] A hundred years ago, the 43 acres of land owned by the study population probably supported about 75 people. Fish were abundant, the farmers of this area grew more rice than they ate, and produced more jute, oilseed, and pulses than the land produces today. The number of cattle was probably similar to the number found today, but fodder was plentiful: a quarter of the area was forested, and there were substantial pastures and fallow lands. With the abundance of firewood and crop residues, there was no competition between man and animal for those residues that could be used as fodder. The cattle certainly ate neither water hyacinth (which was only introduced in the early twentieth century) nor other similarly unsatisfactory fodders.

Agricultural relations were typical of the patron–client relationships prevailing through much of the subcontinent. Sharecropping was common and wages were paid in kind. This form of agricultural organization, coupled with the abundance of organic materials, meant that no group in the population experienced any difficulties in collecting lakri or crop residues for cooking their food. The acquisition of fuel in rural areas was such a trivial problem that, in his exhaustive description of life in Bengal in the 1870s, Hunter does not mention what fuels were used.

A hundred years later the situation is strikingly different. Patron–client relationships have been largely superseded by market relationships, and over half the population is effectively landless. The human population has increased by 350 percent, while the production of foodgrains and other organic materials has remained more or less static. The increased cropping intensity (from 140 percent to 200 percent) has been accompanied by reduced yields and has been at the expense of forests and pastures. While those who own sufficient land produce the food needed to feed their families, the poor are largely dependent on sources outside the village for the production of the food they eat. Over half of the foodgrains eaten by the study population are imported.

Since cooking technology has not changed, the requirements for fuel have risen about as rapidly as the number of people. Competition for the organic materials produced by the land has become intense; the number of village trials arising from disputes over the ownership of trees and crop residues is large and growing. The marginal social and economic groups are denied access to organic materials on which they previously depended for fuel and are forced to purchase fuel from the market. Given the inflexible requirements for cooking fuel, animals are fed less and are fed inferior fodders (such as water hyacinth), and the amount of organic materials returned to the land is reduced. The consequences are that the animals are unable to plough as well, and the fertility of the soil is reduced, meaning that crop yields continue to fall.

The Future: More Energy-Intensive Agriculture Bringing Wealth for Some and More Acute Poverty for Most In Ulipur, the 43 acres cultivated by the study families produce 530×10^6 kilocalories of energy annually. Since the incident solar energy is 6.3x10^6 kilocalories per acre per year,[21] 0.20 percent of the incident annual solar energy is captured. Surprisingly, this efficiency is similar to that of agriculture in the Punjab and twice the average efficiency for Bangladesh.[22] This does not imply that Ulipur agriculture is "as good as" agriculture in the Punjab, for while food accounts for only 16 percent of the gross energy product in Ulipur (and residues the remaining 84 percent), food accounts for 30 percent of the gross energy product in the Punjab. Since a calorie of rice fetches about ten times the price of a calorie of firewood, Punjabi agriculture is much more profitable. The surprisingly high efficiency of energy fixation in Ulipur agriculture is the result of the high cropping intensity of 200 percent and the large contribution (43 percent of the total fuel used) of rice straw from deep-water amon paddy.

Each calorie of food eaten by the people of Ulipur requires 3 calories of fuel and 1 calorie of fodder for cattle. The ratio of residues required to food required has been substantially lower than the ratio of residues produced to food produced in Ulipur because deep-water amon paddy produces about 5 kilograms of straw for each kilogram of grain. Consequently, although the area stopped being self-sufficient in food in the late 1940s, the era of fuel self-sufficiency persisted for another 15 or 20 years. Today the land farmed by the study population provides only 46 percent of the food eaten by the population, but 75 percent of the fuel used and 100 percent of the cattle fodder.

Agricultural practices in Ulipur will change dramatically in the near future, since the Water and Power Development Authority (WAPDA) is constructing a major embankment in the area. The project is designed to provide flood protection and to facilitate better drainage and irrigation practices so that cropping intensity may be increased and high-grain-yielding crops cultivated. As is implicit in the comparison between agriculture in Ulipur and the Punjab, the effect of increasing energy and useful work inputs in Ulipur agriculture is unlikely to be an immediate increase in the total fixation of solar energy. Rather, the effect of improved water control and increased use of fertilizers will be a pronounced shift from the production of residuals to the production of food. The greatest single factor in this shift will be the replacement of deep-water amon paddy by short-stem, high-grain-yielding varieties once the WAPDA embankment is completed. Despite this short-term anomoly, there is no doubt that medium- and long-term increases in the capture of solar energy can take place only when there are substantial increases in useful work in the form of the appropriate use of irrigation water, fertilizers, pesticides, and improved draft power. These same changes offer the possibility of alleviating the unalloyed human drudgery on which the present agricultural system is based.

For those who have significant landholdings and access to credit, fertilizer, and other inputs necessary for "modernized" agriculture, the future looks bright. They are presently producing more crop residues than they need for their own purposes. Since there is no incentive for these farmers to produce fuels for the poor, upon completion of the WAPDA embankment scheme they will switch to crop varieties that produce more grain but that will still yield sufficient residues for their own use.

The effects of the impending changes on poor and landless people will be quite different. Analysis of data from other areas of Bangladesh and India where similar changes have taken place leaves little doubt about how the poor will be affected. The number of landless people will continue to grow as landholdings continue to become more concentrated; migrant labor working for cash contracts is likely to displace much village labor; the real wages of agricultural laborers will fall; relations between families will become more strictly economic; and class cleavages will become more pronounced. As is happening to the Hindus of Ulipur now, many of the landless will be driven out of the village because they no longer serve any useful purpose to those who control the resources.

The landowners have responded to the scarcity of crop residues by ceasing to distribute residues to the poor and by prosecuting those who illegally remove residues from their fields. The replacement of deepwater amon (with a residue to grain ratio of 5:1) by high-yielding varieties (with a residue to grain ratio of 1:1) will drastically reduce the amount of rice straw that is generated. Furthermore, all of the rice straw will be carried to the baris of the owners when the crop is harvested, making it impossible for the poor to continue pilfering straw.

The poor and landless Muslim agriculturalists will be forced to buy fuel from the market. In 1978 the price of husked rice was about Tk 3 per kilogram (100 takas = US$0.67) and the price of firewood between Tk 10 and Tk 18 per *maund* (37 kilograms) in rural areas.[23] Each day the average villager eats 1,600 kilocalories of food and uses 4,800 kilocalories of fuel to cook this food. If all food and fuel is purchased, in a year this would amount to Tk 474 for rice and Tk 170 for fuel. These large expenditures on fuel are already the norm in the hills of Pakistan and Nepal, where villagers spend one-quarter of their incomes on fuel.[24]

Poor families in Bangladesh typically spend about 90 percent of their incomes on food. If they had to purchase the fuel that they presently collect for nothing, with their incomes unchanged they would have to reduce their caloric intakes to below 1,200 kilocalories daily. For the Hindus of Jelepara this process is already well advanced. For every Tk 100 spent on food they spent Tk 10 to buy firewood. This phenomenon, of fuel shortages leading to reductions in food intake, will become a reality for many more poor Ulipur families within a few years. The actual situation may be even more desperate than depicted above, since concomitantly agricultural wages will probably continue to decline and fuel prices will rise as the demand for commercial fuels increases.

Policy Implications

In short, modernizing agriculture in Bangladesh is both essential and, *given the present social and economic structure,* disastrous for the majority of the population. Many poor people in rural Bangladesh are already suffering as a result of energy scarcities. This analysis suggests that many more are going to suffer, and that many will die from deprivation consequent to a further reduction in available fuel. Where suffering is acute, reforms designed to reduce this suffering seem essential. All reforms are not equal, however: reforms may be promulgated as measures designed for the poor yet end up serving the rich and powerful; reforms may provide small material improvements, while leaving intact the political and economic structures responsible for the suffering; or reforms may expose structural inequities and prepare the ground for changing these structures. This study provides information for assessing the nature of reform implicit in different energy programs.

The standard method of assessing energy problems in rural areas of poor countries has been to compare the projected aggregate supply of energy with the projected aggregate demand for energy.[25] This method implicitly assumes some type of homogeneous, harmonious, and cooperative village social structure in which those who own the means of energy production share the energy produced with those who own no energy sources.

The consequences of this "apolitical" approach to energy planning are illustrated by the experience of the *gobar* (cow dung) gas plant program subsidized by the government of India. Although this is a national program in which over 50,000 plants have been installed, the plants have been widely adopted only in "progressive" areas of Gujarat, the Punjab, and Haryana. These are areas where traditional agricultural relationships have been transformed, primarily as a result of adoption of the new seed varieties. Evaluations in Gujarat[26] have revealed the following effects of the program:

—The average gobar gas plant owner is literate, has 26 acres of land, 10 head of cattle, and an annual income of US$1,000.

—Among those who installed gas plants, 40 percent had subsidiary occupations such as business or government service, while none of the nonplant owners of equivalent social status had any such subsidiary occupation. This suggests the rich who have severed their traditional ties are able to mobilize their resources for their own use more easily than the rich whose relationships are more traditional.

A similar "apolitical" planning philosophy underlies the recommendations of the Bangladesh Energy Study for increasing the supply of traditional fuels by encouraging the planting of trees on unused land and expanding the program of seed distribution.[27] These recommendations overlook the fact that it is only the rich who have spacious homesteads and many trees—in Ulipur 16 percent of the families own eighty percent of the trees—while it is the poor who suffer from the scarcity of fuel. Such recommendations fail to distinguish between the effects of absolute pressure of people on resources and the effect of differential access to these resources. Ostensibly designed to help the poor, such programs end up reinforcing the structures responsible for their poverty.[28]

What alternatives are there? Although, given the present social relations of production, the alternatives are indeed limited, this study does indicate some energy-related programs that would benefit the poor.

It is the poor of Ulipur who are forced to buy fuels, and therefore it is they who would benefit most from a national policy that would lower the price of these fuels. Such policies could include the more efficient use of state forests for the production of firewood and subsidization of the rates at which that wood is sold.

Inexpensive solar dryers for drying fuels would benefit the poor, but it is equally clear that if these dryers were distributed through the regular channels (such as the "cooperatives") they would be more likely to benefit the powerful instead. The difficulty in bypassing the rural elite should not be underestimated. As has happened in many other Swarnivar villages,[29] the "landless" subcommittee of the Ulipur Swarnivar program was chaired by a member of the largest landholding family. As Ali Sardar's brother explained: "You know these landless people are illiterate and ignorant, they need an educated person to manage their affairs."

In the few cases where organized groups of the poor exist, bio-gas plants might also have a positive role to play, the Indian experience notwithstanding. A bio-gas program for the poor would stress communal rather than individual units and would recommend appropriate mixes of the raw materials that are available to the poor in different regions. In Ulipur the likely raw materials would be water hyacinth and the excreta of families using the plant.

A striking characteristic of the energy system in Ulipur is the central role played by women: the major use of energy is for cooking food, which is a woman's task in Bengal; it is women and children who collect most of the fuel; it is women who construct the chulahs. No program is immune to co-option by the rich, but, because the wealthy women of the village do not work, a takeover by the rich would be unlikely if an energy program were specifically designed for groups of rural working women. Again, specific attention needs to be paid to the problem of class. It is common in Bangladesh to have an elite city woman or even a foreign woman representing "the interests of women." It is essential that poor women themselves become directly involved in the planning and execution of such projects.

Because fuel for cooking is a major use of energy and because the efficiency of fuel use in chulahs is only about 15 percent,[30] analysts of rural energy use in the Indian subcontinent have advocated the use of improved stoves as a major energy conservation method. For 20 years the "Hyderabad chulah," reputedly giving efficiencies of about 30 percent, has been available and yet apparently is not widely used. A logical first step in trying to improve the efficiency with which fuel is burned in rural India and Bangladesh would be to evaluate the experience of the Hyderabad chulah, to determine how many people now use it, what the social and economic status of these people is, and why the use of a technology that is apparently such a boon has not spread rapidly.

The major obstacles to the success of the solar dryer, bio-gas plant, and women's programs outlined above are not only technical but also political. Because organized groups of poor people threaten the privileges of wealth and power of the dominant classes of society, these groups are suppressed and thus rare. Given the internal and foreign political basis of the government of Bangladesh, it is, the rhetoric of the government notwithstanding, highly unrealistic to expect the state to support such organized groups of poor people or to target programs to them. Consequently, such programs would be most successful when funnelled through the handful of progressive nongovernmental Bangladeshi organizations and necessarily would be very limited in scope.

One perspective on the problem of poverty in Ulipur is that the landless and poor households do a lot of work but with very low returns. To reduce this enormous drudgery what is needed is higher productivity of work, which can only be achieved when energy is used more efficiently. A large part of this change involves the substitution of inefficient human and animal energy with more efficient forms of energy. While a substantial part of these energy needs could eventually be met by the more efficient use of bio-mass and by the direct use of solar energy, energy derived from fossil fuels has a vital role to play in both improved agricultural productivity and in the equally important development of productive rural and small-town industries.

This energy could be provided by the substantial reserves of natural gas in Bangladesh. However, it is likely that much of the gas will be liquified and exported, thus benefiting only the urban elite and the developed countries on which the government of Bangladesh is dependent and strengthening those groups who oppose social change in Bangladesh.[31]

The effect of agricultural and other modernization on the poor depends on the social and economic structure in which the transformation takes place. In Indian villages, the poor have suffered further deprivations as a result of the "Green Revolution," whereas evidence indicates that in Vietnamese villages the benefits of modern agricultural technology have been much more widely distributed.[32] The lesson is that there can be a solution to the rural energy problems in Bangladesh, but only in conjunction with a resolution of the problems of inequity and power.

Notes

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1. On energy use in the Indian subcontinent, see Montreal Engineering Co., Ltd., Snamprogetti S.p.A., Meta Systems Inc., and C. Lotti and Associati, S.p.A., "Bangladesh energy study," for the Government of the People's Republic of Bangladesh, administered by the Asian Development Bank under the United Nations Development Programme Project, November 1976, Main Report; Roger Revelle, "Energy use in rural India," *Science* 192 (4 June 1976): 969–975; and R. Tyers, "Optimal resource allocation in transitional agriculture: Case studies in Bangladesh," Ph.D. dissertation, Harvard University, January 1978.

2. Colin McCord, "What's the use of a demonstration project?," paper presented at the Annual Meeting of the American Public Health Association, Miami, and reproduced by the Ford Foundation, Dacca, 1976.

3. In understanding how fuels are produced and how and why social relationships influence the production and distribution of energy in the village, an intimate, if informal, knowledge of village life was at least as important as the quantitative information collected. The author speaks Bengali and lived in Ulipur for one year, while his collaborator and principal field worker comes from a poor peasant family in Ulipur.

4. John Briscoe, "The political economy of energy in rural Bangladesh," Occasional Paper, Environmental Systems Program, Harvard University, August 1979.

5. Revelle, cited in note 1.

6. A. V. Desai, "India's energy consumption; Composition and trends," *Energy Policy* (September 1978): 217–230.

7. Institute of Nutrition and Food Science, "Nutrition survey of rural Bangladesh, 1975–1976," Dacca University, December 1977.

8. Mead Cain, "The economic activities of children in a village in Bangladesh," *Population and Development Review* 3, no. 4 (September 1977): 201–228; and A. Farouk and M. Ali, *The Hardworking Poor: A Survey of How People Use Their Time in Bangladesh* (Bureau of Economic Research, Dacca University, 1975).

9. Desai, cited in note 6.

10. Revelle, cited in note 1.

11. Beteille suggests the following framework for categorizing classes in a society like Ulipur: "In an agrarian society land provides an important basis for social cleavages. This is particularly true in those areas, like the region of wet paddy cultivation in India, where the agricultural population contains a large proportion of people who are landless. Those who own

land not only maintain a better standard of living than the landless, but the former can exercise a direct control over the livelihood of the latter because of the scarcity of land. In this sense the relations between the landowners and the landless are at once economic and political." Beteille has also suggested that class can be understood, not as an abstract and formal scheme, but as a system of social relations only by using the concepts and categories used by the people themselves. [See A. Beteille, *Studies in Agrarian Social Structure* (London: Oxford University Press, 1974).]

In Ulipur the Majumdar family alone is referred to as a Zamindari family. The bulk of the peasants are divided into those who own their land (*krisaks*) and the landless. Although a few families are sharecroppers only, most land that is sharecropped is sharecropped by landholding farmers. Landowners in Ulipur are described, by the people themselves, as *dhoni, majhari,* or *garib krisaks* (rich, medium, and poor farmers).

Although the dividing lines between rich, medium, and poor peasants are not precise, those that most closely correspond to the classifications used by the villagers themselves have been chosen. The 14 Muslim families who own less than 30 decimels of land are classed as "landless," the 11 families who own between 30 and 95 decimels are "medium farmers," and those 8 families whose landholdings exceed 2 acres are considered "rich."

12. E. R. Wolf, *Peasant Wars of the Twentieth Century* (New York: Harper & Row, 1969).

13. M. N. Srinivas, *The Remembered Village* (New Delhi: Oxford University Press, 1976).

14. Evidence of such change cited in the paragraphs that follow is drawn largely from E. J. Clay, "Institution change and agricultural wages in Bangladesh," *The Bangladesh Development Studies* 4, no. 4 (October 1976): 423–440; M. Alamgir, "Bangladesh: A case of below poverty level equilibrium trap," Bangladesh Institute of Development Studies, December 1976, mimeo; and A. R. Khan, "Poverty and inequality in rural Bangladesh," in *Poverty and Landlessness in Rural Asia* (Geneva: International Labour Office, 1977), especially pp. 137–160.

15. Government of British Burma, *Report of the Land and Irrigation Committee* (Rangoon: 1938), p. 51.

16. "Nutrition survey of rural Bangladesh, 1975–1976," cited in note 7.

17. J. C. Scott, "The erosion of patron–client bonds and social change in rural South East Asia," *Journal of Asian Studies* 32, no. 1 (November 1972): 5–37.

18. The detailed calculations are presented in Briscoe, cited in note 4. To illustrate the way in which Table 2 should be read, consider the case of sharecropping. Ignoring, for the moment, the "actual" vector, it can be seen that the elements of the columns vary monotonically as the paradigm changes from "vertical" to "class-neutral" to "horizontal." When the "actual" vector is compared with the vectors for the three paradigms, it can be seen that there is only one position in which the "actual" vector could be placed while preserving the monotonic progression in the columns. For instance, in the first column the monotonic progression now reads 14, 10, 8, 6. What this placement suggests is that the actual transactions in sharecropping land are as expected in a society in which patron–client relationships are weakened and "horizontal" transactions are most common. For each of the other transactions, too, there is a unique position for the "actual" vector that preserves the monotonic progression in the columns.

19. Desai has come to a similar, although slightly stronger, conclusion in a recent analysis of National Sample Survey data in India. He found that in both rural and urban areas the per capita consumption of fuel did not rise with the level of total expenditure except for the highest expenditure group. A. V. Desai, "India's energy consumption; Composition and

trends," *Energy Policy* (September 1978): 217–230.

In the Ulipur study, seasonal variation in fuel use was more marked than class variation. Thus, the amount of fuel used per kilogram of foodgrain cooked was lowest during the late monsoon period (September–November). In the period following the aus harvest (July–August) 20 percent more fuel was used per kilogram of foodgrain, and following the amon harvest (December–February) fuel use was 25 percent higher. These increases can be accounted for by the fuel used for parboiling paddy, suggesting that there are not major seasonal variations in the efficiency of the use of fuel for cooking.

20. W. W. Hunter, *A Statistical Account of Bengal, Vol. V, Dacca, Bakarganj, Faridpur and Maimansinh* (London: Trubner and Co., 1877).

21. A. K. N. Reddy and K. K. Prasad, "Technological alternatives and the Indian energy crisis," *Economic and Political Weekly,* Bombay, August 1977, pp. 1465–1502.

22. For the Punjab, see A. Makhijani and A. Poole, *Energy and Agriculture in the Third World* (Cambridge, Mass.: Ballinger Publishing Co., 1975). For Bangladesh, see Tyers, cited in note 1.

23. M. N. Islam, "Strategy for rural energy survey in Bangladesh," paper presented at the Institution of Engineers, Dacca, December 1976.

24. On Pakistan, see Roger Revelle, "Flying beans, botanical whales, Jack's beanstalks and other marvels," *The National Research Council in 1978* (Washington, D.C.: National Academy of Sciences, 1978), pp. 173–200. On Nepal, see Revelle, "Energy sources for rural development," paper presented at the Conference on Energy Alternatives of the UN University, East-West Center, Honolulu, January 1979.

25. See the sources cited in note 1.

26. Srinivas, cited in note 13.

27. Montreal Engineering Co., Ltd., cited in note 1.

28. Robert Cassen, "Welfare and population: Notes on rural India since 1960," *Population and Development Review* 1, no. 1 (September 1975): 33–70.

29. S. de Vyler and D. Asplund, "Contradictions and distortions in a rural economy," Policy Development and Evaluation Division, Swedish International Development Agency, Stockholm, 1979.

30. Briscoe, cited in note 4.

31. N. M. J., "Murder in Dacca: Ziaur Rahman's second round," *Economic and Political Weekly,* Bombay, 25 March 1978, pp. 1–8.

32. K. Gough, "The Green Revolution in South India and Vietnam," *Monthly Review* 29, no. 8 (January 1978): 10–21.