

# Domestic Fuel Shortages in Bangladesh: Causes, Consequences and Possible Solutions<sup>1</sup>

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Most of the energy consumed by rural people in the Third World is used for cooking, and nearly all of this comes from biomass — a general term covering trees, crop residues and animal wastes. In many locations the supply of these materials is being depleted, with potentially serious implications for large numbers of poor rural people. This article reviews the experience from four villages in Bangladesh, where shortage is already an established fact of life for most households. It explores the underlying causes of the problem, the adjustments which it has forced in the way in which fuel is used, and the feasibility of potential solutions.

## The Villages

All of the villages are in Mymensingh District, which is to the north of Dhaka. Two are close to the district town and have strong connections with the urban economy. The others are more remote and less subject to external influences. Each pair includes one relatively low-lying and flood-prone location where the greater part of the land area can only support a single crop of jute or paddy; and another on higher land where both jute and paddy, or two paddy crops can be grown in rotation during a single year. The contrast is significant in view of the importance of crop residues as a source of fuel.

Households in the villages may be divided into four broad classes according to their asset holdings and the economic relationships in which they engage:

- big farmers, who rely predominantly upon share croppers or hired labourers to cultivate their land; whose holdings often exceed 10 hectares in the less productive flood-prone areas; and who comprise no more than 10 per cent of the total number of households in any community.
- owner cultivators, who mainly rely for their subsistence upon the work which they perform on their own land; whose arable land holdings typically range in size from 0.5 to 1.5 hectares; and who comprise up to a quarter of all households;
- share-croppers, who rely mainly on land taken in tenancy from others; who work holdings which are generally less than 0.5 hectares in size; and who

generally comprise about 15 per cent of all households; — landless labourers, who at best own only a small area of homestead land; who rely mainly upon working for other households for their livelihoods, and who are the largest individual group — comprising at least half the total number of households in all communities.

The terms and conditions under which labourers work differ to some extent by time, place and according to whom is being employed. In the case of men, a combination of cash and meals is the most common system of payment, but sometimes they work exclusively for cash. On other occasions, uncooked rice or other forms of payment in kind are substituted for meals. Women are more likely to be paid in meals or in kind, but sometimes like men, will also receive cash. There are also a number of different types of tenancy arrangement. The most common require share-croppers to provide half of the material inputs needed for cultivation in addition to their own labour, in return for which they receive a 50 per cent share of the output.

There is a marked division of labour within households. The precise roles performed by men and women differ to some extent by economic class, and distinctions are, to some extent, blurred at lower levels, but the general pattern is for women to be confined to the homestead and for men to work alone in the fields. Men are responsible for the production or gathering of certain types of fuel — generally those which arise as by-products from agricultural production — but in cases where fuel collection becomes an activity which has to be carried out in its own right, then it is invariably women and children who are responsible.

Superimposed upon the pattern of economic relationships in the villages, is a patrilineal kinship structure. This often serves to link households of different economic status and to provide a degree of security and support for those who enjoy little independent access to assets. Connections also extend beyond village boundaries, with many households in the peri-urban locations in particular, finding employment for at least a part of the year in factories or brickfields, or working as self-employed boatmen, rickshaw pullers or traders.

<sup>1</sup> This article summarises the findings reported in: Michael Howes and M. A. Jabbar, "Rural Fuel Shortages in Bangladesh: the evidence from four villages" *Discussion Paper* 213, IDS, March 1986.

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## Fuel Consumption in the Mid-1970s

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Fuel consumption varies substantially by economic class, and households at different levels have been affected in different ways by recent changes in the organisation of agricultural production and village institutions.

About 10 years ago, big farm households obtained most of their fuel from fruit and other trees growing on the elevated plots of land around their homesteads. These would be felled by hired labourers at the end of their productive lives, cut into logs and then left to dry. This provided a fuel of relatively high density which was easy to store. It provided an intense heat, which meant that cooking could be completed quickly; yet, it burnt slowly, so that the fire could be left unattended for fairly long periods.

In communities where jute was cultivated, the sticks provided a supplementary source of fuel for the wealthier households. These had to be brought from the pond or river where retting (the removal of the fibre) had been carried out, and were bulkier than fuelwood. They were stored outdoors during the dry part of the year, and then used as soon as they were ready. The sticks burnt more quickly and gave a less intense heat than logs, but were still regarded as a good quality fuel.

Most owner-cultivators also relied mainly on fuelwood or a combination of fuelwood and jutesticks during this period. But their homestead plots were, on average, only half the size of big farmers', and in many instances, particularly where jute was not grown, the available supply of preferred fuels was not sufficient to last throughout the year. People were therefore obliged to turn to supplementary sources.

The most common of these were the inferior forms of paddy straw which were not required for fodder or roofing. Most of the straw, and the husks which were sometimes also used, was anyway carried back to the homestead prior to threshing, so no additional labour was required for gathering; but by comparison with fuelwood and jute, paddy residues still had major disadvantages. Their low density and bulk made them impractical to store for extended periods; the relatively low heat given out prolonged the cooking process; the speed at which they burnt meant that the fire had to be tended almost constantly; and the smoke which was produced could lead, with prolonged exposure, to eye and lung infections.

Sharecroppers had even less homestead land, were rarely able to satisfy more than a small proportion of their overall requirements from wood and jutesticks, and had to depend mainly on paddy residues in most instances. But since, in general, they had far less land at their disposal than owner cultivators, the yield of residues was often still not sufficient. Under these

circumstances, households would either have to seek permission to utilise the unwanted surpluses of big farmers or, failing this, to resort to collecting leaves, weeds or dung from their own or other people's land.

Leaves and weeds shared the undesirable characteristics of paddy residues, and took a long time to collect, imposing an additional burden upon the women and children who were required to perform this task. Furthermore, the bulkiness of these fuels, and the difficulty of storing them for more than short periods, meant they they had to be collected regularly, irrespective of what other work might need to be done at a particular point in time. The collection of dung and the work of preparing fuel by combining it with jute sticks or husks, was similarly time-consuming; and the end product was a fuel which was both smoky, and widely believed to impair the flavour of certain foods.

The fuel consumption of landless households followed a similar pattern, although the latter generally had to gather all of their fuel from other people's fields or the common land surrounding villages, and thus to devote more time to this activity than others. For the very poorest, it is possible that the burden which this imposed was so severe that the number of meals prepared each day had to be reduced from the normal three, to two.

The patterns which have been described were subject to certain local variations. There was a tendency for shortages of good quality fuels to be more acute in peri-urban locations, where competition for fuel from external consumers was far greater, as well as in flood-prone areas, where there was a greater degree of crop loss, and reduced availability of residues.

For all this, the overall situation remained quite clear. Relative poverty, in the form of limited access to land, and to the trees or crops which could be grown on it, led to the consumption of fuels of lower quality. And the use of these fuels, in turn, served to reproduce the poverty of the households in question by diverting women's labour from other productive activities and adversely affecting their health.

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## The Declining Availability of Fuel

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Developments taking place in the last decade have served to make the problem worse. The number of households using fuelwood and jutesticks has declined, and many more now use dung and leaves. The use of branches and paddy straw has also increased to some extent. There has been a process of downwards substitution, with the best fuels being replaced at the margin by those of intermediate quality in the case of wealthier households; and a corresponding shift from intermediate to inferior fuels in the case of poorer households. A similar process appears to have been at work as far as the use of fuel

for parboiling paddy is concerned, although the strength of this tendency varies substantially from one community to another.

In addition to substituting down to inferior types of fuel, most households have also reduced the quantity of fuel used. This is reflected both in reductions in the average number of meals consumed per day, and, by cooking once for two or more meals, in the amount of fuel used in cooking, per meal eaten. These reductions are particularly noticeable in the case of the poorest households. In all of the villages investigated, big farmers and owner-cultivators behave in much the same way as they did 10 years ago; and sharecroppers show only minor reductions in the average number of meals eaten. But with the landless, the average number of meals eaten has fallen by more than 20 per cent, and the frequency of cooking per meal consumed by almost 10 per cent. Landless households, in other words, are eating less and eating relatively fewer hot meals. In seeking to determine the full extent of the deterioration which has taken place, it should also be borne in mind that the landless now comprise a substantially greater proportion of the population than they did a decade ago.

It would obviously be wrong to attribute the changes which have been described to fuel shortages alone. A declining capacity to obtain food itself has also played a large part. But there can be little doubt that diminishing fuel availability has been influential, and that the effects of shortages have been experienced far more acutely by the landless than by any other class.

It would also be wrong to suppose that aggregate figures tell the whole story, since it is certainly not the case that all poor households are worse off than they were 10 years ago. A minority has been able to secure larger landholdings, more work, or higher incomes, and this has generally been reflected in better access to fuel. But for each such individual example, it is possible to identify another at the other extreme where something approaching catastrophic decline in economic status and security has taken place. For the majority of landless households between these extremes a gradual worsening of economic status has been accompanied by a secular decline in availability of access to and quality of fuel. The overall picture thus remains one of general and disturbing decline.

This is true of each of the villages, but the extent of the problem, and the rate at which deterioration is taking place, vary substantially. Leaving aside the effect of the elimination of jute from the cropping system in one village, the rate at which rich households have had to substitute out of good quality fuels for cooking is more rapid in the case of the peri-urban communities. So too, at the other end of the spectrum, is the rate at which the poorest households are substituting into the least preferred fuels.

No clear picture emerges from the comparison of

flood-prone and flood-free locations, but if it had not been for the construction of an embankment in the case of one of the flood-prone villages, then it is likely that these would also have shown higher rates of downward substitution.

Changes in fuel use for parboiling paddy have followed a similar pattern particularly in the peri-urban villages which show marked tendencies for substitution out of the best quality, and into the inferior fuels. Remote villages, on the other hand, appear far more stable, retaining much the same pattern they had a decade ago.

It appears, then, that growing shortages have affected all levels of society, but that the problem is more severe for landless households, with those who live close to towns and in flood-prone locations carrying the heaviest burden. The gender division of labour, whereby women and children carry exclusive responsibility for the gathering of lower quality fuels, has persisted, with the result that they have suffered to a disproportionate extent.

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## The Causes of Shortages

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In order to assess the possibilities for arresting the process of decline, it is important to understand why it has come about.

The major proximate cause may be located in rapid population growth, and in the interaction between demographic pressure and the structure of agrarian relations. This has had a number of more and less direct effects.

Extra people have created a demand for extra housing, which has had to be built on homestead land. In principle, this demand might have been satisfied by constructing new homesteads on land which was previously used for growing crops, but because crop land itself is in short supply, this has only happened in a very small number of cases. This means that more houses are being built on existing homesteads, and that less land remains on which to grow trees. The first major consequences of population increase has therefore been a sharp reduction in the quantity of fuelwood at the disposal of rural households.

The second has been a reduction in the per capita availability of crop residues as average land holding sizes have declined; often reinforced by otherwise beneficial changes in cropping pattern, which have involved the introduction of higher food- but lower fuel-yielding varieties. This has been seen most clearly in one of the flood-prone villages, where the introduction of an irrigated HYV *boro* crop has entirely eliminated jute. In another case, the long-strawed broadcast *amon* paddy crop has disappeared from the rotation as a part of a series of changes set in motion by the construction of an embankment, although, in this instance, the extended possibilities of

double cropping serve to compensate for the reduction in residue availability from individual crops.

The sub-division, through inheritance, of land owned by rich households has reduced the biomass surpluses which would formerly have been available for redistribution. At the same time, there has been a corresponding increase in the number of households moving towards the brink of landlessness, and being forced to liquidate assets in order to repay debts, or to satisfy short-term consumption requirements. Under these circumstances, trees are frequently cut down and sold, often before the point has been reached at which the best economic return could be achieved.

The progressive sub-division of the largest holdings has been reflected in a reduction in the amount of land allocated to sharecroppers, thus denying them automatic access to crop residues. And in those instances where land is still made available to tenants, the stronger bargaining power of the landlord, and the growing scarcity of biomass, have led to the modification of arrangements, whereby the tenant now has to surrender half of the residues, as well as the customary half of the crop. Grazing land has also been placed under pressure, leading to a reduction in the cattle population and the supply of dung; this has been counteracted to some extent by the emergence of new forms of animal sharing arrangements where the person responsible for looking after the animals assumes a right to the dung produced.

The increasing numbers of households which have been forced into landlessness have lost all independent access to fuel, other than that which they can obtain from their homesteads. Their consumption-related fuel requirements may have been reduced by the transition to the status of labourers insofar as they now receive cooked meals as partial payment for the work which they perform for others. But landowners who hire labour, faced with fuel problems of their own, are now becoming less inclined to provide cooked food, preferring to switch to a simple cash payment system, or at most to provide uncooked rice. This may mean that the long-term landless now require more fuel than before, although their overall position depends partly upon the amount of work available. Although employment opportunities have been reduced by growing competition from the new landless, increasing opportunities have, at the same time, been generated by changes in cropping patterns in certain locations.

Accompanying these economic factors are a series of broader social changes, which have also proved influential. Quite extensive, kin-based support systems continue to function, providing, for example, small interest-free loans of residues to households who had lost a crop as a result of flooding; but this kind of support is now offered less frequently than in the past.

The supply and use of fuel has also been influenced by

changes affecting the other purposes for which biomass is required. Formerly, when the pressure of population was less acute, poorer land would not be cultivated, but would be left to a high quality grass called *san*, which could be used for thatching houses, cow sheds and outhouses. Now that this land has been brought under cultivation, the grass is no longer available. For similar reasons, fodder is in far shorter supply than hitherto, and prices have risen sharply. In both of these instances, paddy straw, which would previously have been available as fuel, is now required as a substitute. At the same time, rising bamboo prices have forced many poorer households to use jute sticks for house construction, progressively squeezing out another important source of fuel.

The rapid growth of urban centres in the recent past has helped to exert further pressure. Most urban households still require fuelwood, as do tea shops and restaurants. Increasing quantities of wood and bamboo are now also needed for the construction of buildings and for furniture, and there has been a particularly rapid expansion in demand for bricks, and hence for fuelwood to make them, which has been reflected in a tripling in the number of brickfield in the Mymensingh area during the last 10 years. As a result of all these changes, the rate of tree cutting in villages has increased, further reducing fuel supplies for rural households.

It should not be assumed that the effects of these changes have been wholly negative. The growing trade in fuel has created a certain amount of employment. Landless women and children gather, or sometimes purchase, small branches, which they then sell at daily or weekly markets. Small numbers of men are also able to make a living by contracting with owners to fell trees, which are then chopped up and sold locally. But the net effect of these new opportunities only goes a small way towards compensating for the problems created by growing shortages.

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## The Search for Solutions

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If biomass energy shortages are a function of poverty, and if the increasing scarcity of fuel is no more than a symptom of the underlying economic forces and demographic pressures which are making that poverty worse, how can the problem be overcome? A permanent solution would almost certainly have to entail the creation of new livelihoods for the landless and near landless. This, in turn, could only be achieved through the redistribution of existing assets or the creation of new ones, which would enable the poor to produce for themselves the fuel which they require, or to exert effective demand for it in a market place.

But is the domestic energy problem also amenable, to some extent at least, to narrower, but perhaps more readily implementable, technical solutions? In

principle, a number of options are available here. They fall into three broad categories.

### — increasing biomass supply

Possibilities exist for increasing the supply of biomass from homestead, crop and public land.

Homestead land does not fall neatly within the conventional boundaries defining the professional interests of either foresters or agricultural researchers, and has, as a consequence, tended to be ignored by both. Relatively little, therefore, is known about the way in which richer and poorer households manage this resource in different locations. Questions need to be asked about the multiple end uses which homestead products serve, the relative priorities which are attached to these under varying circumstances, and overall management strategies.

Only with this basic information to hand will it be possible to determine whether scope for improvement might exist through the incorporation of new trees and plants into existing systems, or through changes in the use of elements already present. Given the complexity of homestead management, all that can be said at this stage, is that any potential which may exist will be realised only through forms of research and development which involve rural people to a much greater extent than has normally been the case in the past. This is an area in which substantial progress may well be achieved, but only in the medium-to-long term and with the commitment of a considerable research effort.

The situation with regard to the potential of crop land is, in some respects, similar. Although a great deal of research has gone into the subject of individual crop improvement in recent years, and although this has been successively broadened to encompass cropping, and now farming systems, the use of residues for fuel has still not become established as an item on the research agenda. This deserves to take its place alongside food, fodder and other end uses in the determination of priorities, so that trade-offs between different end uses can be explicitly considered, and proper assessments made of the costs and benefits of alternative courses of action. Attention should also be given to the distribution of costs and benefits, since an innovation offering increased grain production to a fuel surplus household might, at the same time, create or deepen problems for dependent fuel deficit households elsewhere in a community.

Existing research institutions are capable of dealing with these issues, and the additional burden on extension services would not be very great. This suggests that progress on this front should be relatively easy to achieve. Consideration might also be given to the possibility of introducing crops intended primarily for use as domestic fuel, although the widespread use of jute, and the common practice of growing *dhoincha* on field boundaries, suggest that

cultivating households already have means at their disposal to pursue this option, should they find it desirable to do so. More important would be broader research initiatives, which incorporated homestead land into the farming system, and sought to develop comprehensive packages for the satisfaction of the fuel and other needs of different types of rural household.

The prospects for significant progress on communal land are less favourable. Relatively little is available, and where experimental programmes have been initiated using roadsides or embankments, these have generally failed through the lack of a clear system of responsibility for protecting trees from animal and other damage.

Social or community forestry initiatives also raise potentially complicated questions of ownership and access, and will often require substantial institutional innovation if they are to succeed. By contrast with other possibilities of increasing biomass supply, which at best offer indirect benefits to the landless through increasing fuel production on other people's land, these options do, however, hold out some prospect of direct assistance to those most in need. As such, it is desirable that they be pursued further, at least on an experimental basis, where a capacity for the necessary institution building exists.

### — improving conversion efficiency

The efficiency with which existing supplies of biomass are utilised could be improved through the introduction of biogas plants or improved cooking stoves.

Biogas allows dung to be converted into methane and fertiliser. It appears particularly attractive under circumstances where increasing quantities of dung, which would previously have been available as fertiliser, are now being burnt as fuel, and where smoke in the cooking environment is a growing problem. But there are a number of drawbacks. An initial investment of at least 3,000 taka (\$95) is well beyond the means of all but a handful of individual rural households, and would only be feasible for those already in fuel surplus. About five cattle are needed to supply the amount of dung required to operate the smallest economically viable unit, which would again rule out the great majority of people if individual ownership and operation were assumed. Substantial maintenance is also required, and the technology is unlikely to function successfully in the longer run unless back-up technical support is available to users.

Each of these problems could be overcome. A bank has indicated its willingness to provide credit to cover initial capital costs, and there is no reason, in principle at least, why institutions allowing the collective ownership and/or operation of the units should not be developed. Taking account of these factors and of the potential contribution which biogas could make, not only to fuel availability, but also to improved health,

there does seem to be a case for experimental programmes. But the available evidence suggests biogas is unlikely to have much impact for the foreseeable future, and that the prospects for bringing direct relief to those most in need are not particularly good.

The picture is rather more optimistic as far as improved cooking stoves are concerned. Stoves of the kind presently in use typically have an efficiency in the range of 8 to 10 per cent; and against this base, there is now evidence to suggest that fuel savings equivalent to up to 30 per cent of present consumption may be possible. A voluntary organisation has already introduced new designs into one of the villages studied, and these appear to be popular with the landless in particular. It is relatively easy to train people to make the stoves, and they can be installed at a cost of about 30 taka (\$0.95). This still represents a sizeable investment for landless people, but subsidies for large numbers of households could be provided at modest overall cost. Once the stove has been installed maintenance requirements are minimal, and easily carried out by household members.

Unlike any of the other options, improved stoves therefore hold out the prospect of directly easing the fuel constraint of households most in need, without either high initial investment costs or the need for institutional innovations which may be difficult to implement. Provided further research takes proper account of user needs, and is not unduly laboratory

centred, then progress may be anticipated on this front, particularly in areas of acutest shortage, where growing numbers of people are forced to purchase the fuel they require.

### — fuel substitution

Apart from producing more biomass for fuel and utilising existing sources more efficiently, there may also be scope for relieving shortages by encouraging the use of alternative fuels. Direct substitution by rural users themselves does not appear to be very promising. Increasing numbers of villages will be electrified in the course of time, but electricity will be many times more expensive than biomass and quite infeasible as a source of heat for cooking for the great majority of rural households. The same will be true of kerosene, unless very heavily subsidised. But the prospects for less direct forms of substitution seem rather better. Supplying gas connections or cheap coal to brickfields might well prove feasible, and would very substantially reduce pressure upon woodfuel resources in peri-urban villages in particular. There may well be scope also for using similar methods to reduce biomass consumption by urban based domestic consumers.

Whilst not directly addressing the underlying causes of fuel shortage, a carefully designed package of measures, drawing on the range of possibilities and targetted on poor households in peri-urban and flood-prone locations, could go a long way towards dealing with its most immediate and pressing consequences.