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THE IMPACT OF DECREASED FUELWOOD AVAILABILITY ON NUTRITIONAL STATUS

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FUELWOOD AVAILABILITY AND NUTRITIONAL STATUS

I. INTRODUCTION

Since the creation of OPEC in the early Seventies, both the industrialized and the developing nations have been seriously affected by the continually increasing costs associated with petroleum fuels. This petroleum crisis has received particular attention as it strikes directly at the heart of the industrial world's productive economic base. However, the "energy crisis" is not simply a matter of more expensive oil, gas, and related products.

Another area of energy crisis is related to the decreasing availability and increasing cost to the purchaser of firewood and charcoal. The impact of this crisis in the developed world has been perceived and treated as considerably less important than the petroleum crisis. Although the increasing price of wood products, from newspaper pulp to construction lumber, is a widely accepted phenomenon, the fuelwood crisis has a limited impact on most citizen consumers and little or no impact on major industry. This set of circumstances thus allows the need for fuelwood to appear less significant than other energy needs to the people of the industrialized world, including the United States. To the people of the developing world, however, the fuelwood crisis is a serious, daily concern. For many of the poor of the developing world, this crisis is already upon them, forcing them to make difficult choices

in the daily expenditure of their limited resources in terms of time, effort, and money.

The purpose of this paper is to provide the reader with a brief review of the various nutritional problems that might arise from the fuelwood crisis and a discussion of recommendations for further study or amelioration of the situation.

II. THE LINKAGES BETWEEN FUELWOOD AND NUTRITIONAL STATUS

At first, it may appear that we are discussing two relatively disassociated factors: fuel and nutrition. We are actually discussing two very closely related factors. Both are directly concerned with energy consumption and utilization. Food is as much an energy source for human activity as charcoal or wood are energy sources for fires.

Very little of the world's food is consumed raw. Most foods must be cooked (by boiling, parboiling, frying, broiling, steaming, baking, and the like) to make them palatable and/or edible and thus require an energy source. Nutritional status depends, in great part, on food consumption which depends on food preparation which depends on an energy source.

For the bulk of the world's poor in developing nations, that energy source is fuelwood. Indeed, these people represent more than a third of the world's total population. Keith Openshaw found that 99% of Tanzania's population use fuelwood at the rate of 1.8 tons per person per year. This represents 96% of Tanzania's total

timber consumption. In Thailand, 97% of the population depends on fuelwood and use it at the rate of 1.1 tons per person per year, representing 76% of Thailand's total timber production. Although this is a lower usage than in Tanzania, Eckholm points out that Thailand's high population growth rate will rapidly render this situation extremely serious.

Specific national examples of the importance of fuelwood and the decrease in its availability abound. Some of these may be found in the individual papers attached to this report. Certain basic statements, however, are accepted initially by this paper:

- a large proportion of the world's total population and the majority of its poor depend to a great extent on fuelwood for food preparation and other energy requirements;
- a rapid population growth rate in many developing nations is significantly increasing the pressure on existing fuelwood resources;
- any attempt to remove fuelwood as an energy source would only require its replacement by another energy source; and
- nutritional status and energy for food preparation are intimately linked.

Potential Impacts on Nutritional Status

It must be clear from the onset that this paper must be speculative, to a great extent, in considering the potential impact on nutritional status of lessened fuelwood availability. The subject

area is comparatively new and not yet well documented. Indeed, very little has been written that directly relates to our concerns. Therefore, the following list of impacts must be regarded as "potential" until such time as adequate research provides sufficient proofs of their validity.

This paper is meant to be informational rather than scholarly. The evidence and justification for the assertions or suggestions made in this paper will be limited. More specific information will be found in the attached reports.

Procurement of Firewood

For most of the poor of the world, there are no firewood "deliveries." Wood must be found in its natural state at some point within the immediate environment. As growing populations increase the pressure on local wood sources, complications result for fuel gatherers that may have nutritional implications.

Fuel gatherers are walking farther to find sufficient wood, sometimes as far as 10 kilometers. The search for fuel may take as much as a full half day. In some fuel-poor areas, it is estimated that from 250 to 300 person days are required each year simply to meet a normal household's needs. Such circumstances might lead to any or all of the following potential impacts on nutritional status:

- As people spend more time looking for wood, they logically have less time for other activities that might produce income that could be essential in supplementing marginal

diets. As another example, increased agricultural production among traditional subsistence populations frequently requires increased time devoted to farming and/or gardening that may not be available as fuel gathering becomes increasingly time-consuming.

- Subsistence fuel gatherers themselves will require increased nutrient intake if they are to maintain their meager standard of living and also increase their fuel gathering activities. This has particular impact if the gatherer is a woman with young children or infants. Other concerns related to women are listed separately in this report; however, the impact on a pregnant or lactating woman whose nutritional requirements are higher than normal can be particularly harmful to both the woman and the fetus or child.
- Another potential nutritional impact is related to the frequency and palatability of child feedings. A rapidly growing child requires increased feedings that the child finds palatable and will fully consume. If a mother is spending up to half her workday locating fuelwood, feedings may not occur as frequently as desired. If the task of child feeding is left to an older sibling, the feeding may be inadequate or presented to the child in unpalatable form leading to insufficient consumption. The proper care and feeding

of infants and young children is a demanding exercise made more difficult by the poor living conditions often found among the rural poor. Increased difficulty in fuelwood procurement only further complicates a time in a young child's development when he or she is traditionally at risk nutritionally.

- For urban dwellers and some village people, fuelwood is simply not freely available in the immediate vicinity for collection. In some areas, two days are required for transport of fuelwood into urban areas. Fuelwood thus becomes part of the cash economy and, as resources dwindle, the price rises. Such rises are further exacerbated by the increase in gasoline costs for the transport of wood and charcoal. Although this may mitigate the negative effects mentioned above by reducing family labor input, new pressures are placed on family income which might otherwise be spent on food.

  A secondary effect of the financial expenditures required of urban dwellers is the potential for increased consumption of processed foods. Such foods may require little or no energy expenditure by the consumer, making such purchases more attractive where fuelwood is especially expensive. Combined with the added stress on living a "modern life" (which advertising usually suggests includes processed foods), the appeal is unquestionably present.

Although we may feel that the processed foods are too expensive for a poor urban dweller, they may not be considered so expensive in the face of high fuel costs, high labor input, and the desire for a different life-style. We cannot flatly state that the processed foods purchased are less nutritious than the foods replaced, but experience does suggest that this may frequently be the case.

Although the processed foods may represent only an apparently minor share of the diet, their potential negative effects are heightened when we are dealing with individuals whose traditional diet may be marginal at best or already inadequate. Even a relatively small change in diet among people at nutritional risk can precipitate severe nutritional deficiencies.

- It is possible that increased difficulties in fuelwood procurement may lead to at least two positive impacts. As fuelwood becomes more difficult to procure and/or more expensive to purchase, consumers may become more amenable to improved cooking equipment, such as stoves that are more fuel efficient. A second potentially positive impact might be an increased acceptability of and interest in alternate fuel sources such as solar power. A widespread and severe fuelwood crisis may encourage developing nation governments to give greater priority to innovative energy projects that otherwise might languish for lack of perceived need. It

should be remembered, however, that both of these potential impacts would require ample time for experimentation and replication. Although long-term benefits might be achieved, the short- and middle-term problems described before may be unacceptably serious.

Food Availability

Trees have a number of uses other than as fuel. At least four of these may have negative impact on food availability and thus on nutritional status.

- In many parts of the world, trees provide fruit, nuts, and berries to supplement diets. The number of such nutritionally useful trees is decreasing in areas where trees are felled in order to clear land for agricultural use or for their use as fuelwood. The edible portions of these trees are not only useful in normal diets, but also may serve as a source of income for food purchases, among others, or as a reserve for times of local food deficit. Thus, in using trees as an energy source, we often destroy a traditional food source or source of income for the purchase of food.
- Trees also serve as sources of forage for many domesticated animals, such as acacia trees in the Sahel. Forests provide an environment suitable to many species of wildlife that have traditionally been part of local diets. Studies have shown that up to 70% of locally consumed meat comes

from wild animals. This is not only true of land animals, but also of some varieties of fish that use forest swamp areas (e.g., mangrove swamps) as breeding grounds. The destruction of individual trees, stands, and forests can disrupt this traditional relationship with sources of animal protein.

- Finally, trees also play a role in maintaining land fertility. An obvious example would be soil erosion resulting from deforestation. This erosion may not only decrease land fertility, it may have other effects less obvious to the casual observer such as the silting of water channels in irrigation systems. In both cases, food production, and therefore food availability, is likely to suffer.

Another example of potentially negative impact relates to the substitution of certain fuels for scarce fuelwood. Dried dung is one substitute fuel. Traditionally left undisturbed on the land, dung provided an important natural (and "free") source of land fertilization. In many parts of the world, India being only one example, the dung is now being collected, dried, and used as a fuel source due to the absence or high cost of fuelwood. Thus deprived of a source of natural fertilizer, which is usually not replaced with another source, land fertility declines and with it, food production.

It was noted in passing above that the clearing of trees is often related to land preparation in order to increase food production. When properly undertaken, such clearing can obviously benefit food availability. The problem lies in the "indiscriminate" destruction of trees and forests. It is indeed an irony that efforts specifically undertaken in order to increase food production may only decrease that production over time.

Food Preparation and Preservation

The manner in which food is prepared has long been recognized as impacting on nutritional status. Fuel is essential to most food preparation and thus the decreased availability of fuelwood can be expected to be reflected in changed food preparation methods.

- Traditionally, when fuel is lacking, the number of times in which hot foods are prepared normally decreases. If this is only occasional, few effects are likely to be noted. However, when fuel is usually scarce, the practice of preparing food less frequently becomes common. A normal result is a decrease in cooking from twice a day to once a day. In other cases, food may be cooked only once every other day. By cooking food in larger quantities at greater intervals, a saving in fuel usage is accomplished.

  The problem often found with this practice results from the common lack of sanitation in many of the affected homes and the lack of refrigeration. A large quantity of food is

cooked and then set aside for later use. A combination of high temperatures and poor sanitation provides, as one of the paper's authors put it, "an efficient growth culture for a myriad of infectious organisms." This can lead to increased gastrointestinal infections which can be particularly serious for young children. The resulting diarrhea can put a child at nutritional risk or an undernourished child in danger of losing his or her life. Reheating already cooked foods can at least partially mitigate these effects, but such reheating is very likely not to occur if fuel is scarce or expensive.

Milk is frequently boiled prior to consumption in many societies. A reduction in fuel availability may lead to increased consumption of raw milk with the attendant dangers of an increase in the occurrence of tuberculosis and brucellosis (undulant fever). This is further complicated by the fact that milk is regularly marketed by weight. As a result, some producers add water to their milk in order to increase their profits. If the water is contaminated and the milk is not boiled, further negative health consequences, including typhoid and diarrheal diseases, may result.

- A lack of fuel could prevent the production of some preserved foods that require extended cooking and that provide significant nutritional benefits. One example is <u>ghee</u>

(clarified butter). Ghee is produced after milk has been churned and boiled for an extended period of time. Its primary convenience to the consumer is that it remains solid and does not become rancid at room temperature for long periods of time. Thus ghee avoids the problems of most dairy products that require frequent purchase in order to assure freshness. The fuel requirement, however, may so seriously interfere with its production that it becomes unavailable or so much less available that its important contribution to diets (in energy and essential fatty acids) may be removed without replacement.

Another example is the production of "oiled foods." Like ghee, this is a method of preserving food as well as preparing it for consumption. In this process, food is cooked slowly over time to remove as much of the food's water content as possible. The water is replaced with oil during the cooking. The resulting food is concentrated and can be kept for extended periods without spoilage. Again, a lack of fuel would lead to a drop in production of oiled foods, requiring that they be eaten fresh, not preserved.

A final example of food preservation that requires considerable amounts of fuel is smoked foods, such as fish. In many areas of the world, fish with its protein, vitamin, and mineral content must be preserved to be available at any distance beyond traditional fishing areas. A reduction

in the availability of fuel could lead to the disappearance of such foods in some areas or a large increase in the price, which could mean their disappearance from most diets, if not the market place.

All three of the above examples indicate the importance of fuel, and traditionally fuelwood, to the preservation of food. Beyond their convenience, these foods provide an important reserve in many areas when fresh foods are not available for purchase. The loss of these foods could have a very marked effect on diets and nutritional status for all age groups.

- Another impact may be a reduction in cooking time of some basic foods. One benefit of longer cooking time is the breakdown of fiber in cereals. This increases the availability of nutrients and improves the food's digestibility. Shortened cooking times meant to preserve fuel may negate these benefits.
- Nutritionists often encourage people living in areas with infected water supplies to boil their water before use, particularly before consumption by infants or small children. Experience suggests that this concept, even in the presence of adequate fuel stocks, is not easily transferred through extension and education. This difficult, but important, task can be rendered wholly impractical if fuel shortages make building a fire for water boiling highly

expensive either in money or in labor collecting fuelwood.

Many of the problems associated with contaminated water supplies are mitigated by the common custom of drinking hot tea rather than unboiled water. In the process of preparing the tea, boiling is often sufficient to decontaminate the water. Again, a decrease in availability of an increase in price may lead to less boiling of tea or the replacement of tea with unboiled water. This can result in a rapid increase in the incidence of water-borne disease.

- A potentially positive benefit of decreased cooking might be the increased consumption of raw foods or foods cooked for shorter periods, thus increasing the availability of nutrients that might be destroyed by prolonged cooking.

However, two caveats should be kept in mind. Many of the foods normally consumed in developing nations cannot be eaten raw, including most of the world's staples. Rice, corn, wheat, yams, cassava, millet, sorghum, and similar staple foods are not eaten raw or only partially cooked with the occasional exception, such as a staple flour used in an uncooked dish. Also, the loss of nutrients as a result of cooking may be expected to be offset by the benefits, such as in preservation techniques as described earlier.

Except in times of extreme need, food will normally not be eaten if it is not palatable. If a food must be cooked in order to be palatable, the only losses of nutrients with which we would be concerned would occur due to overcooking. With rare exception, these losses would be insignificant.

Finally, we cannot expect that those foods which people eat in raw form will replace the staples which require cooking. This would make little sense either in terms of traditional food consumption patterns or in terms of nutritional benefits.

Economic Considerations

Although many of the points already raised have their economic considerations, there are other related points that should be discussed as well that may not fall under earlier categories. These points also have nutritional implications.

- People living on subsistence incomes have little or no flexibility in their expenditure patterns. Housing, clothing, and food may be assumed to be of primary importance. After these expenditures, many families have little or no money left for other purchases. A dramatic rise in the price of one item (such as food with its attendant fuelwood costs) will require reductions in other expenses. For many low-income families, basic housing costs may be irreducible by action of the consumer. Clothing expenses may well be

minimal already. Increases in the price of food preparation may not be easily deducted from other costs, if at all.

The result will likely be a reduction in expenditures for food itself or for the fuel necessary to prepare this food. Either action can have negative nutritional implications. Since low-income people tend to already depend on a basic staple for their consumption, whose loss would lead to outright hunger, food costs are likely to be cut by purchasing less of additional foods which are often more expensive. These foods include meat, fish, dairy products, and some fruits and vegetables. As these foods are normally high in nutrients, their reduction in the daily diet can lead to severe nutritional deficiencies. Since many poorer people eat very little of these foods, such as meat, on a regular basis, any reduction in their intake may precipitate nutritional deficiency.

Should expenses be reduced by using less fuelwood, we again face problems such as those outlined in the section entitled "Food Preparation and Preservation." Although decreased fuelwood availability alone is not the only factor with which we must be ultimately concerned (food price increases being an obvious example of another factor),

in some areas, it may become the single most important factor or certainly one of the most important.

- Food preparation is not the sole use of fuelwood and thus must compete with other uses. Fuelwood is used for heating by some families who have other energy sources for food preparation. Small business, including some home industries such as baking, also may require fuelwood for their operation. This places another burden on existing fuelwood resources. On the one hand, somewhat wealthier elements in a society may "bid up" the price of fuelwood to a point that it is no longer affordable by the low-income consumer. On the other hand, denying fuelwood to small businesses could lead to their collapse and, with that, a loss of income that could itself precipitate nutritional deficiencies among the families that depend on these businesses for all or the bulk of their income.
- Fuelwood scarcity may reach such a point that it is simply unavailable. Consumers would be forced to switch to other forms of fuel, such as kerosene, which are expensive and prone to price increases themselves. As mentioned earlier, solar energy may be of some assistance (e.g., solar cookers), but it would be years before they were widely available to most of the people with whom we are concerned. The only cheaper forms of energy likely to be available immediately or in the near future to most of the affected

population would be sources such as dung or brush whose use has ecological and agricultural implications as discussed in the section entitled "Food Availability."

In brief, even if the cost of fuelwood rises to such a level that other, environmentally sound fuel sources are then cheaper, our basic problems nutritionally would not be eased unless there was an amelioration in other areas, such as increased family income.

The Effects on Women and Children

For a number of years, nutritionists and nutrition policy planners have been particularly concerned with the nutritional status of pregnant and lactating women and infants and small children. These groups have been identified as being especially vulnerable to malnutrition. Although some of the possible implications for these groups have already been mentioned, it is felt that the subject warrants separately consideration.

- In many parts of the world, women have been the traditional fuel gatherers. In others, where men have traditionally held this task, the scarcity of fuelwood has forced many women to become involved in gathering as well. When fuel is scarce, neither pregnancy nor lactation is likely to be viewed as sufficient reason to prevent women from gathering fuel. In many cases, there will be no choice if any reasonable amount of fuel is to be collected.

Gathering fuelwood in areas of scarcity is hard work. The resulting increase in caloric requirements resulting from this work combined with the higher requirements of pregnant/lactating women may pose severe difficulties to women who are normally undernourished or on the "borderline" separating good and poor nutritional health. If the extra caloric needs are not met, the results can include hunger, exhaustion, and illness.

- As mentioned earlier, the absence of the woman, normally the primary food preparer, can lead to inadequate feeding of infants and small children. A lactating woman may need to leave her infant behind while searching for fuelwood. This may require the extra expense of a "wet nurse" or the early cessation of breastfeeding. Weaning is already identified as one of the nutritionally most crucial periods in a child's development. Nutritional deficiencies and related high morbidity/mortality rates are common among children of the poor in the months following weaning. An earlier weaning will only exacerbate the problem. It may also be one more factor encouraging the extension of bottle-feeding into rural as well as urban areas.
- Whether due to death, infidelity, labor migration, or the military requirements of war or revolution, many families in the developing world have female heads of households. The result, in many instances, is the lack of an adult male

to assist with family labor requirements. Thus, regardless of the traditional role of women, they often find themselves bearing the entire burden of family support including farming, business, fuelwood gathering, child care, food preparation, and so forth. This burden can be intolerable. The ultimate result can be a severe negative impact on the woman's health and nutritional status or a forced reduction in her labor by necessity or both. If fuelwood gathering indeed takes up to half a day's labor, circumstances may force her to adopt alternative measures as have been outlined previously. A reduction in breastfeeding, the frequency of child feeding, cooking, and other impacts cease to be merely convenient, but become necessary.

III. SUMMARY

The above discussion of potential impacts on nutritional status of a decreased availability of fuelwood is not meant to be completely exhaustive. Individuals and groups active in international development may well identify other impacts, factors, and considerations not mentioned. One of the purposes of this paper is to stimulate such interest and concern.

In order to summarize the points presented so as to encourage further consideration of the total situation, the following table has been prepared.

POTENTIAL NEGATIVE NUTRITIONAL IMPLICATIONS OF DECREASED FUELWOOD AVAILABILITY

Area Affected	Nature of Change	Nutritional Implication
Fuelwood Procurement	Increased required time for fuelwood procurement	Less time for agricultural or income-generating activities
		Increased nutrient needs for gatherers
		Less frequent/less palatable child feedings
	Increased transportation expenses, thus increased fuelwood expense	Switch to less nutritionally beneficial processed foods
		Increased prices/less income available for other expenses including food
Food Availability	Trees destroyed for fuelwood or to clear agricultural land	Wild tree foods destroyed
		Forage for domesticated animals destroyed
		Habitats of edible, wild animal life destroyed
		Soil fertility adversely affected by erosion
		Fuelwood replaced by dried dung, brush which adversely affects soil fertility

Food Preparation/ Preservation	Cooked foods prepared less frequently	Leftover food becomes contaminated
		Contaminated water/milk adulterated with such water unboiled
		Preserved foods less often prepared or too expensive for consumer
		Reheating/sterilization of cooked foods less likely
	Food cooked for shorter periods	Fewer nutrients made available, food less digestible
Family Economics	Higher proportion of budget spent on fuelwood	Less money available for food purchases
	Competition for fuelwood for non-food purposes	Increased price for fuelwood for cooking
		Some families' income for food drops due to collapse of fuelwood-dependent businesses (baking, distilling, etc.)
	Fuelwood becomes more expensive than other energy sources	Low incomes prevent purchase of other energy sources thus not ameliorating basic food preparation problems
	Shift to less expensive foods to balance rising fuelwood costs	Concurrent shift to less nutritious foods

Women, Infants, Children	Increased gathering activity by pregnant/lactating women	Increased nutrient requirements of pregnant/lactating women
		Poorer quality child-care
		Earlier weaning
	Increased burden on female heads of household	Severe impact on woman's health/ nutrition status
		Other problems (early weaning, infrequent cooking or child-feedings, etc.) more likely to occur, more difficult to prevent

IV. CONCLUSIONS AND RECOMMENDATIONS

As mentioned at the beginning of this paper, the findings presented may be considered largely speculative as reliable data directly concerned with this subject is rarely available. Therefore, the conclusions and recommendations presented here have been prepared with this in mind.

In summation, it is concluded that a decrease in the availability of fuelwood, both firewood and charcoal, to those groups in developing nations most dependent on this energy source is likely to lead to complications in nutritional status among these same people. Negative nutritional impacts may be expected as a result, among other factors, of increased difficulty in the procurement of fuelwood, changes in traditional styles of food preparation and preservation, increases in expenses related to fuelwood, and changes in the burdens placed on family members, particularly mothers and female heads of household.

A factor complicating the entire situation is the limited number of alternative fuel sources available to the affected population. Coal, kerosene, butane gas, and similar potential alternatives are usually either unavailable or far more expensive than fuelwood. The use of dried dung or brush only complicates already-existing ecological and agricultural difficulties. The use of centrally processed products that utilize fuel more efficiently may only heighten the problem as these foods may be of less nutritional value or priced beyond the purchasing power of the consumer.

Without a reasonable alternative, we can expect people to continue to use fuelwood, but in different manners than in the past and with different implications for their health and nutrition status.

In brief, we find that fuelwood users in developing nations are trapped between two imperatives: they must cook much of their food with fuelwood if it is to be edible and palatable and yet they must find ways to lessen the amount of fuelwood they utilize in cooking. Should they maintain their fuelwood usage at the traditional rate, they will have to increase their labor or expenditures to an extent that may be insupportable over the long term. Should they significantly lessen their usage of fuelwood, they must do so in such a manner as to balance any negative nutritional complications. Should they be unable to accomplish either of these goals, their already limited "quality of life" is likely to deteriorate.

In light of the serious difficulties that might arise, it is important that nutritionists, nutrition policy planners, and members of the general international development community carefully monitor the situation in each developing nation. If indicators or observations suggest that problems are developing, appropriate interventions will have to be developed or existing and planned programs will have to be altered to take the changing circumstances into account.

While this paper attempts to be cautious in its conclusions, it ought to be emphasized that the potential dangers are real. Although all possible complications may not occur in any one given

situation, some of them are sure to develop in the absence of any remedies. The fuelwood crisis is well documented. Malnutrition and poor general health are already widespread among the people with whom this paper is concerned. Linkages between the two are logical and do not require torturous reasoning. A deterioration (or an improvement), therefore, in fuelwood availability can be expected to have an impact on the nutritional status of fuelwood users.

Considering the speculative nature of this paper, specific recommendations for interventions would be inappropriate. Nonetheless, some general suggestions will be presented for further consideration.

Above all, there is a clear need for scientifically acceptable studies directly concerned with the effects of lessened fuelwood availability on nutritional status. Such studies should take into account various environmental factors such as urban/periurban/rural differences, differences in staple diets, differences in income level and source; differences in local ecology, and other potentially significant factors.

Special consideration should be given to effects on the nutritional status of women, infants, and children. Attention should also be directed toward families with female heads of household as a separate group.

Agricultural production projects might give increased attention to the introduction of staple foods that require less cooking and thus less energy.

Trees should be given more attention as sources of food, as well as energy. Studies could concentrate on determining the proportion of current diets derived from tree crops and the proportion that might be feasible if tree crops were expanded.

The importance of tree crops should be incorporated in training programs for both agriculture and nutrition extension agents. A general attempt should be made to stress the importance of trees to food production both for their edible fruits and their impact on soil fertility and general agricultural productivity.

The implications of studies directly concerned with the nutrition-fuelwood relationship should be incorporated into nutrition education programs and projects.

As much as possible, the people affected should be brought into the discussion of these implications. We cannot expect people to significantly alter their habits as a result of simple fiat or recommendation. If the problems discussed are indeed significant, many of the necessary behavioral changes will have to occur at the individual and family levels. Successful interventions will ultimately require the comprehension, understanding, and cooperation of the people themselves.

FUELWOOD AND NUTRITION

Carol Dutton Stepick

I. INTRODUCTION

If present trends continue, both forest cover and growing stocks of commercial-size wood in the less developed countries (LDCs) will decline 40 percent by the year 2000. In the industrialized regions, forests will decline only 0.5 percent and growing stock about 5 percent. In the LDCs, people will forego the increased use of paper and other industrial wood products that might have been expected to follow increased GNP, and the effect on welfare will be negative but bearable. But industrial wood products are much less important in LDCs than charcoal and fuelwood used for cooking and heating, and poles used for framing structures for shelter. In the LDCs, 90 percent of wood consumption goes for cooking and heating. In short, wood is a necessity of life. Loss of woodlands will force many people in LDCs to pay steeply rising prices for fuelwood and charcoal or to spend much more effort collecting wood--or else to do without.[1]

Ninety percent of the population in LDCs currently depend on fuelwood for cooking, and shortages are already being experienced in many regions. As population increases and concentrates in new patterns, most notably in more and larger urban centers, the demands on fuelwood resources increase and change as well. According to a recent report,[2] this scarcity is primarily focused in rural areas where firewood has usually been a free good. This

report also contends that charcoal provides urban people, and especially the urban poor, with a large part of their fuel needs today. The anticipated increased demand will both drive up charcoal prices and tend to decrease the limited wood supplies now available to many rural communities.

The following discussion addresses the relationship between this growing fuel crisis and nutrition. There is little dispute that there is a relationship based on the usage rates of wood and wood products for cooking. However, the dimensions of a nutritional problem caused by a growing fuelwood shortage have yet to be determined. This paper offers a possible framework for defining, then measuring, this potentially devastating problem. Particular attention is given to measurement considerations and the confounding effects of exogenous variables.

Illustrations are drawn principally from Latin America and the Caribbean because of the author's familiarity and experience working as a nutritional anthropologist in that part of the world.

II. STATEMENT OF THE PROBLEM

POSSIBLE LINKS BETWEEN NUTRITION AND THE GROWING SCARCITY OF FUELWOOD

A conceptual problem facing planners is to determine what links exist between nutrition and a growing fuelwood scarcity. It is important to distinguish those factors which directly affect nutritional status or dietary practices from those, such as economics, which more indirectly affect them. When considering measurement efforts, policy formulation or intervention programs, caution is in order not to: (1) conclude that dietary changes are de facto changes in nutritional status, nor (2) attribute dietary or nutritional status changes only to fuelwood scarcity when, in fact, that scarcity is but one in a myriad of variables affecting life-style (such as changing ideas of prestige foods, nonavailability of staples, intervention programs, etc.).

Direct Links

The following speculations regarding diet changes are probable, but insufficiently documented, ways in which the nutrition of individuals, households, and whole communities may be detrimentally affected when cooking fuel becomes less available.

To conserve fuel, fewer meals per day may be cooked. This is a strategy I have personally observed during periods of prolonged unemployment among low income urban households which must buy their cooking fuel. With the associated reduced food intake for most or

all members of the household, particular nutritional risk may be assumed for pregnant and lactating women and young or ill children. If nutritional status was poor to begin with, then the likely consequences would be chronic low-grade malnutrition, such as retarded physical growth among young children, or more overtly dangerous conditions such as increased susceptibility to infection.

On the other hand, one cooked meal per day has long been a practice of many subsistence level agriculturalists. This is particularly the case in societies where women are away from the home for most of the day, during all or parts of the year, performing agricultural or herding activities. In such circumstances, the same or perhaps more quantity is consumed in the form of cold and raw food as when a regimen of, for example, three meals per day are cooked.

Mexican farmers and construction workers have told me it is unwise for them to eat a hot meal during midday (comida); because after working in the hot sun and becoming heated themselves, they will become ill by putting either hot or very cold foods (e.g., iced drinks) in their stomachs. Hence, in many circumstances, the precedent for deviation from an ideal number of cooked meals per day may already exist based on pragmatic considerations or health beliefs. The principal concern should be that where a fuelwood scarcity exists, a reduced intake of food does not also exist or result.

In addition to simply eating less overall, a household may choose to conserve cooking fuel by decreasing the amount of a long-cooking staple in its diet. Such a change in dietary practice might mean a shift from a nutritionally balanced diet to one low in or lacking one or more essential nutrients. This may prove to be especially critical for people whose diets are essentially monotonous and/or dominated by cereals.

An exemplary situation may be found in the rice-legume or maize-legume staple diet found throughout Central America and the Caribbean. The many varieties of beans consumed in that part of the world are prepared by boiling, usually over low heat for many hours. Simply reducing the amount of beans eaten per week may mean the difference between saving or expending substantial amounts of cooking fuel, but it may also mean the difference between obtaining a full complement of amino acids in sufficient quantity to avert protein malnutrition. The manifestations of such a dietary change on nutritional status would probably be very subtle, and symptoms would be low grade and chronic, rather than dramatic and immediately debilitating.

The potential also exists in households attempting to conserve fuel for a replacement of staples like beans with more processed foods requiring less cooking time. Such foods may be high in calories, less expensive per volume unit, more prestigious, and even seem more filling. However, the processed food is likely to be more expensive for the amount of nutrient value obtained. Take, for example, the substitution of wheat bread and pastas for legumes

which I have observed in many parts of Latin America. Wheat, corn, and rice are all low in the essential amino acid, lysine, which is provided in the traditional diet by beans. When substituted for corn, wheat products may have no effect on the nutrient adequacy of the diet, but when substituted for beans, the combination of foods eaten are no longer nutritionally complementary, and the risk of protein deficiency may become manifest in some individuals' nutritional status.

In some foods, decreased cooking time may actually enhance the availability of certain nutrients which are normally partially or completely lost during cooking. This is true for foods high in the heat labile vitamins like ascorbic acid and folate.

For other nutrients, however, cooking time has relatively minimal effect on availability, and palatability and germ contamination of foods are more important considerations. The major nutrient deficiency syndromes of the developing world are anemia caused by iron and/or folate deficiency, protein-calorie malnutrition, vitamin A deficiency, and goiter and cretinism associated with iodine deficiency. Iodine, iron, and vitamin A are all relatively unaffected by cooking methods.

In its discussion of iron availability, a World Health Organization publication[3] considered cooking methods and time relatively unimportant variables compared to the absolute amount of iron available in a person's diet or the presence of gastrointestinal disease which inhibits nutrient absorption.

Vitamin A, a fat soluble vitamin, and its major precursors are stable to heat, acid, and alkali, although unstable to oxidation. Thus, vitamin A is seldom lost in food preparation, except when fat becomes rancid.

For people with cereal or vegetable dominated diets, the limiting nutritional factor is most generally protein. Some investigations indicate that, besides the classical peptide bonds, some additional linkages are also involved in shaping and stabilizing protein molecules.[4] Some of the nonpeptide linkages are split by denaturation of the protein. A well-accepted example of this effect is that of heat which, by destroying such additional linkages, uncoils the folded proteins and exposes a larger surface to intestinal enzymatic attack. (That is, cooking enhances the digestibility of vegetable protein.) It should also be pointed out that excessive or prolonged heating during food preparation may sometimes form some extra linkages and thus decrease the digestibility of proteins. It was found, for instance, that toasting cereal products decreases the physiologic availability of lysine, tryptophan, and other amino acids.[5] It cannot be overemphasized that it is less a matter of the effect of cooking on nonpeptide bonds and more a matter of combinations and availability of foods that influence the protein adequacy of a diet.

Another consideration which must be mentioned and merits a more in-depth exploration is that cereal-based diets tend to be high in fiber content. Longer cooking serves to "break down"

fiber, increasing the digestibility and availability of nutrients.[6] This factor may be most important for weanlings and individuals with gastrointestinal disease.

The potential for reduced cooking or reheating time, caused by decreasing availability of fuelwood, certainly increases the potential for food-borne infection. The clinician and epidemiologist know that the 25-50 percent of children born in less developed countries who die before their fifth birthday, rarely die from uncomplicated malnutrition. Indeed, almost all these deaths are the result of the combined effects of malnutrition and infection, especially diarrheal disease. Due to deficient sanitation, crowding, poor housing, and chronic malnutrition, infection is present at all stages of human development, including the period of fetal growth. All infections, mild or severe, whether bacterial, viral, or parasitic, result in aberrations of nutritional balance with most notable effects on protein and nitrogen balance.

Numerous parasites are transmitted to man through ingestion of infected foods and water. The infamous Trichinella spiralis of pork is one of dozens of examples of serious parasites whose eggs, cysts, larvae, or trophozoites may be destroyed by the heat of thorough cooking. Initial cooking is critical to safeguarding against pathogens in infected foods. Also, foods that have been allowed to stand, have had infected water added to them or have been handled by unclean hands, may be decontaminated by reheating.

In many underdeveloped circumstances where sanitation facilities are rare and water scarce, fecal contamination is great and cooking and reheating of foods may be the only safeguard against food and waterborne infection.

With the demise of trees comes the potential for a decrease in the availability of wild and tree foods, thus reducing the variability in many peoples' diets. According to Sanjur[7] and many others, variation is one of the best predictors of the nutritional adequacy of the diet. For example, dietary studies conducted among the Yanomamo of southern Venezuela and Shuar of eastern Ecuador,[8] both preagricultural hunters and gatherers, reveal the utilization of a wide variety of uncultivated plants which contribute significantly to a nutritionally adequate diet. Further attention should be paid to ethnobotanical studies to determine the extent of wild food utilization in different peoples' diets.

Indirect Links

Increased caloric expenditure might be created by increased distances and difficulties in fuelwood gathering. This may be especially deleterious for already nutritionally vulnerable groups such as pregnant or lactating women, or in food shortage areas where caloric intake may be low. Models to predict the relationship between caloric expenditure, and energy input, including energy generated by fuels, have been designed in energy flow

studies for two Andean agricultural communities.[9] The energy flow models built from these studies indicate that in these traditionally fuelwood scarce areas there is a net loss of energy over a year's time when individuals stay at high altitude and do not practice vertical migration during the year.[10] The methodologies utilized in these studies may prove useful for further investigation of the energy expenditure problem associated with wood gathering.

Work done by INCAP in Guatemala and others in Brazil among cane cutters indicate that adult male laborers expended their full daily caloric intake during a day's work in the fields.[11] Such laborers who must also gather firewood for their homes might be at a nutritional disadvantage.

Increased time and energy spent gathering fuelwood may detract from other home and child care or money and food generating activities. Children who are breast-feeders or weanlings could receive less direct attention and actually less feedings by a mother forced to spend longer hours gathering fuelwood. Less time may also be available for attending an ill child or a home garden.

Other economic considerations arise when fuelwood or charcoal must be purchased. As with food, fuel expenditures may be relatively inelastic.

Shifts have been noted regarding changes in sex-related roles. When wood is no longer a free good, the gathering and/or marketing of fuelwood may shift from, for example, being a female task to

to being a male one. According to Hoskins, in most parts of the world where wood is the fuel, women usually "harvest," collect, transport and store their family supply, and may trade or sell any surplus. Women collect wood nearest their house first; and when the supply is depleted, they walk greater and greater distances, thereby spending more time and wasting greater amounts of energy carrying the heavy loads. When the distances become too great, they have to start buying wood from men who usually control carts and beasts of burden.[12]

The potential for a negative impact upon female-headed households appears great as new expenditures for fuel or decreased opportunity for trade or sale of gathered wood may decrease an already low-income base.

For home industry entrepreneurs (bakers, potters, distillers, smelters), increased prices of fuelwood cut into profits and the needed cash to buy raw materials and often food as well.

When fuelwood is no longer available or is an economically unviable choice, the necessity to switch to alternative fuel sources may exist. Such a switch may represent expenditures in the form of new fuels or heavier reliance on other traditional fuels. Increased use of dung or crop residues (e.g., corn stalks) may be less expensive than fuelwood, but is environmentally expensive when not available for fertilizer. Kerosene is never free. Any change in fuel, including changes to nontraditional forms such as solar or biogas, represents expenses in the form of new appliances, new means of fuel storage and transport, and ultimately, perhaps, new

foods. Loss of money spent on these aspects of fuel may also detract from other food and money generating activities.

In many parts of the world where cold storage of foods is unavailable, traditional forms of food preservation like smoking extend the availability of foods over time and distance. Throughout Latin America, smoking is very important for coastal fishing communities which must rely on often slow and difficult transport of fish and shellfish to inland markets. While economically vital to the fishing communities and marketers, these products also add important nutrients, notably protein and iodine, to the weekly or monthly diet of families who purchase them. In addition to smoking, meats (and some vegetables) are preserved by "oiling," i.e., replacing the water content of foods with oil. This process requires many hours of cooking over a low heat.

Summary

It is most important to note that the foregoing discussion is basically hypothetical. We have precious little empirical evidence relating decreased wood and fuelwood supplies to nutrition. My intent has been to focus attention on those relationships most likely to occur. The following summary lists the hypothesized relationships that could be addressed by the methodological distinctions outlined in the next section of the paper.

Direct Links:

-- Fewer meals cooked: reduced food intake.

-- Less long-cooking food prepared: abandonment of nutritionally important staples.

-- Substitution of shorter-cooking (more highly processed) foods for longer-cooking staples: an unbalanced diet.

-- Undercooking: increased exposure to infection.

-- Undercooking high fiber foods: decreased availability of some nutrients, especially among weanlings and individuals suffering gastrointestinal disease; decreased palatability.

-- Deforestation, reducing the availability of wild foods: decreased dietary variety and emergency food resource.

Indirect Links:

-- Increased effort spent gathering fuelwood: increased individual nutrient requirements.

-- Increased time spent gathering fuelwood: less time for other home and child care or food or money generating activities

-- Greater monetary expenditures on fuelwood: decreased amount of household budget available for food or money generating activities like home industry.

-- Decreased wood available for food preservation.

While not being an exhaustive list, these considerations are among the most critical of the nutritional problems related to the shortage of fuelwood.

Measurement Considerations

Three major categories of nutrition which may be affected by a growing scarcity of fuelwood are dietary status and practices and individual nutritional status. These categories are frequently interrelated but may also be mutually exclusive. Change in food preparation does not necessarily constitute a change in nutritional status. As the impact of fuelwood shortage on nutrition is determined, it is these categories which should be measured. Food-related beliefs is a fourth category of equal importance but requires a distinctly different measurement methodology which is beyond the scope of this paper.

Nutritional status (i.e., malnutrition) which is typically measured biochemically, by examination and/or by nutritional anthropometry, is the variable with which we are ultimately concerned.[13] The other nutritional categories may contribute to this state of health variable. Dietary status is another category of nutrition which may be influenced by fuelwood scarcity. Changes in dietary status cannot automatically be assumed to have a negative effect upon nutritional status. They may result from a variety of causes quite extrinsic to fuel supplies, e.g., changing concepts of prestige foods, increased exposure to urban lifestyles, intervention programs, etc. Taking this precaution into account, negative changes in dietary composition remain a highly probable adaptation to fuelwood scarcity for many.

Dietary practices, including food preparation, may be viewed according to whether they are detrimental, neutral, or beneficial to nutritional status. Increasingly, intervention efforts, including community nutrition education programs, are recognizing the irrelevancy, frequent futility and potential harm of attempting to change beliefs and practices just because they are traditional.

When measuring nutritional and/or dietary status, population samples may be distinguished as individuals, households, or communities. Special attention at the individual level might be paid to nutritionally vulnerable groups like pregnant and lactating women, young children and the elderly. When looking at the household, subclasses within communities become important, i.e., households headed by women or households with limited or no access to land in agricultural settings may be more nutritionally vulnerable because of their low economic base. DeWalt and Pelto have found in their studies in rural Mexico that the most powerful predictor of nutritional status is material life-style or general economic well-being of the family or household.[14] In many regions, communities have highly varied economic bases and therefore, varied levels of affluency. For example, I have found that children from a Mexican village with a mixed dairy and agricultural economic base displayed fewer signs of acute or chronic malnutrition than the children from a nearby village with an economy based solely on staple crop farming.

The Devres report makes the following generalization regarding firewood and different population samples.

The household is the usual center for the distribution of firewood, each household collecting for its own needs, according to ways laid down by custom and ecological dictates. Firewood scarcity does not necessarily lead directly to an alteration in household composition, and in accepted responsibilities, but scarcity of firewood is one of many factors that encourage the modification of rural households which in turn alters firewood distribution patterns.

In many areas, the process is one of shrinking size, from large extended households to smaller households based on a nuclear family. In this process, the socially marginal people such as the old, or handicapped, or unmarried mothers, are often left to fend for themselves; such people are often the hardest hit by the firewood shortage. Attempts to help resolve firewood shortages in rural communities should recognize the central place of the household in traditional firewood distribution patterns. They should also account for the special problems of weaker family members or nuclear families with respect to firewood supplies.[15]

Other Confounding Variables

The caveats which affect a discussion of the problem are numerous. The following are the most obvious mitigating variables affecting both the measurement of the problem and the generalizability of the results of any measurement attempts. Ideally these variables would be discussed in detail as part of a suggested research design. Since such an exercise is beyond the scope of

this paper, they are presented here in brief outline; but their importance to understanding the problem and planning for it remain significant.

Regionality

Certain areas of this hemisphere have traditionally been fuelwood scarce; for example, the altiplano of the Andes or desert regions such as the Atacama or the Mojave. Other areas are experiencing more recent shortages including many of the gallery forests of southern Brazil, the Chaco of Bolivia, the western mountains of Mexico or the hardwood forests of Belize. The nutritional impact of fuelwood shortage in an area like the Andes will have entirely different dimensions than in areas more recently dependent upon wood for a fuel.

Rural-Urban Distinctions

The availability of a broader range of foods exists in the urban cash economy, even though that range may not be available for economic reasons to a significant proportion of urbanites. Economic subsistence or marginality assumes different survival strategies for obtaining fuel in the two settings. Rural dwellers may have more access to more extensive wood gathering. In the city there may be a greater availability of preexisting fuel alternatives and nonfirewood cooking appliances.

In one squatter's community in Oaxaca, Mexico, I have seen households capable of utilizing kerosene, charcoal, or firewood for cooking depending on fluctuations in the price of each.

New fuelwood scarcity will have a different impact on the urban and rural environments, which will require different long-term environmental, industrial, and agricultural national policy planning. For example, the long-term viability of agricultural land will be detrimentally affected in the countryside by deforestation, and/or use of dung and crop residues for fuel instead of as mulch and fertilizer.

Dietary Regimen

Different kinds of foods or dietary regimen vary from region to region and from community to community. Assumptions regarding firewood and nutrition which are based on a staple diet for a country would simply be inappropriate.

Laws and Regulations

Law, regulations, and national planning policy as well as land tenure systems and the enforcement and enforceability of policies and laws affect the availability of fuelwood in general, both in terms of who has access to what exists and how well supplies are conserved.[16]

Alternative Fuels

Alternative fuel sources available may vary from oil, kerosene, electricity, or other "modern" and expensive fuel sources to animal dung or crop stalks. There is also a high variability in the pragmatic potential for the introduction of new, "appropriate" technology, e.g., solar energy, biogas, etc., and the new appliances and cooking techniques which are the requisite accompaniment to new fuel sources. The expense involved with alternative fuels

precludes utilization by many people in the LDCs and limits the spending capacity of others.

Behavior and Beliefs

Readiness or intransigence to change food beliefs and behaviors is both difficult to measure or to predict. Because some people have adapted to extremely difficult or harsh environmental niches (e.g., high altitude or arid desert), small changes in food preparation have the potential for profound changes in life-style; whereas, for other populations, dietary change requires a minimal adjustment or shift in a sliding scale of modernization.

Intervention

The presence of intervention programs might aggravate deforestation as when monocropping has been introduced.

Other Methodological Considerations

In addition to establishing that a population is experiencing a scarcity of fuelwood or other less direct effects of deforestation (e.g., unavailability of foods due to monocropping in a formerly diversified agricultural milieu), other information is necessary to delineate the problem. At a minimum, these would include dietary status, nutritional status, and ethnobotanical surveys. In some regions, such surveys are preexisting, reliable within easily recognized limits and adequate to serve as baseline data for further evaluations. In other areas, there is a virtual absence of such information and study is merited, especially if outside (national or international) development intervention is

being planned. Another critical area of investigation, which is poorly documented the world over, is concerned with cooking practices and food beliefs.[17]

III. CONCLUSIONS

The negative impact of growing scarcity of fuelwood on the nutrition of many people throughout the world is poorly documented. However, the anecdotal and educated speculation of many individuals does point toward a crisis capable of creating additional hardship, suffering, and unnecessary death among the world's poor and undermine the effects of numerous development programs.

In this paper, I have assumed that a true problem exists and have concentrated upon conceivable variables which might confound attempts to define the problem, measure its magnitude, and assess comparison from one population or area to another. Further refinement of the process begun in this paper is certainly warranted. An important contribution to the investigation of this problem would be the development of one or more research designs which account for the confounding variables mentioned in this paper.

Finally, support for further research, both in the literature and from informed individuals, and in the field also appears warranted in light of the cost in human suffering this problem may represent.

FOOTNOTES

[1]Figures presented in this paragraph were taken from: The Global 2000 Report to the President, The Technical Report, Vol. 2, Chapter 8, a report prepared by the Council on Environmental Quality and the Department of State.

[2]"Socio-Economic and Environmental Context of Fuelwood Use in Rural Communities: Issues and Guidelines for Community Fuelwood Programs," submitted to USAID Bureau for Program and Policy Coordination by DEVRES, December 10, 1979.

[3]WHO, "Control of Nutritional Anemia: with Special Reference to Iron Deficiency," report of an IAEA/USAID/WHO Joint Meeting, 1975.

[4]Robert S. Goodhart and Maurice E. Shils, Modern Nutrition in Health and Disease, 5th edition, Lea & Febiger, Philadelphia, 1975, p. 33.

[5]Ibid., Goodhart.

[6]Recently there has been renewed interest in the question of dietary fiber. There is some experimental evidence that dietary fiber plays a role in the prevention of cholesterol, gallstones, and in the control of obesity. Although many studies are currently underway, one thing that is known is that it helps prevent obesity because the high bulk plant materials, though comparatively low in calories, produce a feeling of fullness (Howard A. Schneider, et al., Nutritional Support of Medical Practice, Harper & Row, New York, 1977, p. 247).

[7]Diva Sanjur, J. Cravioto, A. VanVeen, and L. Rosales, "Infant Feeding and Weaning Practices in a Rural Pre-Industrial Setting--A Socio-Cultural Approach," Acta Pediatrica Scandinavica, Supp. 200, 1970.

E. Romero and D. Sanjur, "Nutritional Anthropometry, Diet and Health-Related Correlates Among Pre-School Children in Bogota, Colombia," The Ecology of Food and Nutrition, Vol. 3, No. 4, pp. 273-282, 1974.

[8]Elois A. Berlin and Edward K. Markell, "An Assessment of the Nutritional and Health Status of an Aguaruna Jivaro Community, Amazonas, Peru," Ecology of Food and Nutrition, Vol. 6, pp. 69-81, 1977.

F. W. Lowenstein, "Report on Nutrition Surveys in 11 Brasilian Amazon Communities Between 1955 and 1959," Atas do Simposio sobre a Biota Amazonica 6, 177-185, 1967.

[9]Communication with Dr. Jere Haas, Cornell University, Ithaca, New York, 1978.

[10]Vertical migration refers to the practice of Andean populations to up and down in altitude tending crops which are cultivated at different altitudes. Those individuals who remain at the highest altitudes (usually the site of a family's main house) are the ones at risk of expending more energy than they consume in calories.

[11]Personal Communication, Dr. Maartin Immink, Cornell University, Ithaca, New York, 1978.

[12]Marilyn W. Hoskins, Women in Forestry for Local Community Development: A Programming Guide, AID, September 1979.

[13]For methodological instruments for determining nutritional status, see for example: D. B. Jelliffe, The Assessment of the Nutritional Status of the Community, WHO, Geneva, 1966.

[14]Kathleen M. Dewalt and Gretel H. Pelto, "Food Use and Household Ecology in a Mexican Community," Nutrition and Anthropology in Action, Thomas K. Fitzgerald (editor), Van Gorcum, Amsterdam, 79-93, 1977.

[15]Ibid., DEVRES.

[16]Ibid., DEVRES.

[17]Three notable bibliographies have been compiled. However, they serve to indicate how much more investigation is needed in this realm:

C. Wilson, "Food Habits: A Selected Annotated Bibliography," Journal of Nutrition Education 5: Supp. 1:39-72, 1973.

C. Wilson, "Contributions of Nutrition Science to Anthropological Research," Federation Proceedings 37(1):73-75, 1978.

Merlyn Vermury and Howard Levine, Project on Beliefs and Practices that Affect Food Habits: A Literature Review, CARE, Inc., New York, August 1978.

TREES: FOUNT OF FOOD AND FUEL

Carol A. Ulinski

I. INTRODUCTION

"It costs almost as much to heat the pot as to fill it (Recent Sahelian saying)."

> Trees supply every nutritional need of human beings and animals as well as many other items of great commercial importance. There are trees that will supply fruit or nuts with the protein equivalent of the best quality meat or fish, tree-cereals, trees that provide edible oils, "milk," and sugars, and trees whose leaves or shoots are as palatable as those of conventional vegetables. By tree-farming, in fact, communities could supply themselves with all their dietary requirements of proteins, carbohydrates, fats, minerals, vitamins and other nutritional factors, as well as their basic needs of fuel . . . (Douglas and de J. Hart, 1976).

Global deforestation and the concomitant firewood crisis are now generally recognized as urgent problems deserving immediate attention.[1] Trees are being cut down at a much greater rate than they are being planted, especially where people are most dependent on wood. Firewood and charcoal are the major sources of energy for cooking (and to a lesser extent, heating) for 1.5 billion people (J. E. M. Arnold, 1978). Over the past several years, considerable literature has been written on the subject as government officials, scholars, technicians, and others concerned have attempted to quantify the problem and recommend ameliorative

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[1]For example, a recent government study estimates that the world's forests are disappearing at the staggering rate of 18-20 million hectares a year (which is equivalent in size to half the State of California), mostly in the humid tropical forests of Asia, Africa, and South America (CEQ, 1980).

actions. These have focused almost exclusively on reforestation. In the meantime, one cannot help but wonder how individuals in areas with fuel scarcities are coping on a day-to-day basis and if and how these shortages are affecting human health and well-being.

The purpose of this paper is to explore the impact of the firewood crisis on nutritional well-being--and more specifically on the quantity and quality of food intake. Unquestionably, the cost of traditional fuels--measured both in terms of time and money--has escalated and will continue to do so. It would therefore seem logical that people would be making some alterations in their consumption and living patterns to accommodate these costs.

The firewood crisis must be viewed against the backdrop of the larger problem of environmental malaise. Increasing population pressure (both human and animal) on natural resources is severely straining many regions' capacities to support these very populations. In some instances this situation is further exacerbated by climatic factors, e.g., drought in the Sahel. The causes of malnutrition are also many and varied and include: ignorance; local dietary habits, traditions and superstitions; and urbanization and modernization. Therefore, it would be naive in most cases to hypothesize changes in diet and cooking practices solely to the increasing scarcities of traditional fuels. To these reservations can be added the fact that there is almost no documentation in the literature on the relationship between the firewood crisis and nutrition.

Nevertheless, a number of important aspects emerged from this exploratory inquiry that point to the need for greater attention to this very immediate problem that affects literally millions of people:

- The poor are spending more of their income, time, and personal energy in obtaining fuel at the expense of other expenditures and activities, which may be food related.
- The diversion of agricultural residues and animal dung from the soil where they provide essential nutrients, to the hearth where they heat the cooking pot, will inevitably result in a decline of agricultural yields.
- Deforestation is eliminating a variety of foods naturally provided by forests and trees, such as nuts, berries, fruits, wildlife, and fish.

Most of the observations and information cited in this paper are from the Sahel region of West Africa, for the two reasons that this area has a serious firewood shortage, and it is the part of the world most familiar to the author. Therefore, conclusions of this paper are by and large specific to this part of the world.

Methodology. With the assistance of the Development Information Unit at AID, a literature search on firewood and nutrition was made.[2] A selection of nutrition surveys, and studies on household, fuelwood and food consumption were reviewed. Literature on the firewood crisis in the Sahel was reviewed, and personal

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[2]Several computerized data bases were explored, notably: Energy Line, Commonwealth Agricultural Bureau, and Agricola.

contacts were made with policymakers, technicians, and anthropologists for their observations and insights on the problem (see Appendix 1 for a list of persons contacted).

Organization. In the following section, data and observations on fuelwood scarcities are examined and discussed from the perspective of food availability, preparation, and consumption. This is followed by a review of the contribution of forests and trees to local diets, and the implications of the destruction of this resource for nutrition. Conclusions are summarized in the final section.

II. RISING COSTS TO HEAT THE POT

This section reviews some of the changes that are taking place locally in response to the firewood crisis. The situation in urban areas is markedly different from that in rural areas, both in terms of food and fuel consumption, and will therefore be treated separately below.

Urban Areas. Charcoal is the major source of fuel used by the urban poor, and purchases of this essential commodity account for an ever-increasing share of the family budget. A common saying in the Sahel these days is that it costs as much to heat the pot as to fill it. Three years ago, Bertrand estimated that a poor family in Ouagadougou, Upper Volta, was spending as much as 30% of its income to purchase enough fuel for cooking one hot meal a day; in Niamey, Niger, the percentage share was 25% (Bertrand, 1977). In Haiti, it is reported that purchases of fuel account for 40% of a poor

family's income (personal communication with Mike Benge), and as much as 43% in Bara, Sudan (Digernes, 1977).

Unlike their rural compatriots, city folk do not have the option of collecting firewood. Areas surrounding major urban centers in the Sahel are barren wastes, having already been picked clean of most woody vegetation suitable for burning. In Niamey, for example, wood is now coming from as far away as 150 km (personal communication with Robert Fishwick). The urban poor, moreover, cannot afford fuels such as kerosene and butane which are commonly available in the cities. Although modern fuels have greater thermal efficiency than traditional fuels, the initial investment required for the stove is prohibitive to those with limited incomes.[3]

Are people using less energy as prices of fuel escalate? The evidence suggests that they are not, or at least not by very much, given the increasing percentage share of energy in the typical poor family's budget. What is certain is that the urban poor are paying more, both in percentage and absolute terms, to meet their energy needs for cooking. What we don't know is how people are adjusting their household expenditures to accommodate this growing burden and what other goods or services are being foregone as a consequence.

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[3]The thermal efficiency of butane is 60% as compared to 8% for firewood and 28% for charcoal (Floor, 1977).

Food could well be one such expenditure. One could hypothesize that families are sacrificing food for fuel and are eating cheaper but less nutritious foods; however, other influences confuse this relationship.

Food consumption patterns tend to change as people move from the countryside to the cities. In Africa, for example, there has been a substantial increase in the consumption of processed foods which are mostly imported (personal communication with Carole Scherrer). However, although these foods may require less cooking time to prepare than the traditional fare, it is not possible to attribute change in diet solely to the desire to conserve energy. Other equally important factors influence these changes, notably: personal preferences, status/prestige, and convenience.

The fragmentary evidence presented here suggests that the urban poor are now using a very large share of their income to buy increasingly scarce, and more dear, firewood or charcoal. However, it is not clear that this has meant a reduction in food expenditures. Although no data or observations were encountered, it would be reasonable also to expect reductions in housing expenditures (improvements, new construction, payment of higher rents for better housing) and very probably in clothing.

The Countryside. In most rural areas, firewood continues to provide the major source of energy for cooking. Although it has been a "free good," normally collected by women and children, wood is becoming increasingly scarce in some regions of the world. The implications of this are discussed below.

The first indication of a fuelwood shortage is an increase in the time needed to collect wood. In some areas of the Sahel, women are walking further, sometimes as far as 5-10 kilometres, and are spending as much as half a day searching for fuel (CILSS/Club, 1978). In some wood-poor areas in Central Tanzania, it has been estimated that 250-300 person days each year are required to collect enough wood to meet a household's energy needs (Muzava as quoted by J. E. M. Arnold, 1978). Obviously, the ever greater amounts of time women spend looking for wood could be used in other, more productive ways--for example, gardening, or processing food, or perhaps on income-generating activities, such as spinning or weaving.

Women's nutritional needs will increase as fuel collection becomes more physically demanding. In some parts of the world, however, the additional energy required by women in the form of food may not be available to them. In a study by the Economic Commission of Africa, it was found that "in some African cultures, it is still considered ill manners for a woman to eat much of the more nutritious foods in spite of her higher physiological needs. Within households, women are likely to consume a lower proportion of their requirements than men, not to mention children, girls as opposed to boys" (ECA/FAO, 1974, as quoted in Cloud, 1977).

The era of "free" wood may be fast coming to an end in areas where shortages are most acute. As this essential commodity becomes more difficult to find, the tradition of each rural

household supplying its own needs is dying out. In Bara, Sudan, it is reported that most households are now purchasing wood and charcoal from vendors, with the exception of the very poor, who can't afford to buy it, and the very rich, who hire servants to collect it (Digernes). In parts of Niger, available supplies are so far away that overnight trips are necessary, at which point men assume the responsibility for collecting fuel. Some families are now specializing in gathering wood which they then sell to their neighbors, a new occurrence in the Sahel (personal communication with Fred Weber). As firewood increasingly becomes a good that is bought and sold in the marketplace, households will have to come up with funds for an item which has, until now, been "free." Again, one wonders what adjustments people will have to make to accommodate this new additional expense and what effect it will have on a household's access to an adequate diet.

In many parts of the world where firewood is no longer easily accessible, people are switching to other sources of fuel, primarily agricultural residues and animal dung. A fuel consumption study in two villages in Upper Volta found that millet stalks are the principal source of fuel during six months out of the year (Ernst, 1977). Although wood is still "available," women prefer the cereal stalks because they are readily accessible and can easily be collected as needed. Time which would otherwise be spent trekking long distances is instead devoted to other dry season activities such as spinning. However, in the Sahel where no

resource is wasted, millet and sorghum stalks have important alternative uses. During the dry season, they are an important source of forage for livestock, whose droppings fertilize the farm fields. Therefore, burning these agricultural residues deprives animals of a food source which they can transform into high quality protein (e.g., milk and meat) for human consumption. It also directly affects the availability or organic fertilizer which in turn affects soil fertility and agricultural productivity. In the Republic of Cape Verde, some women in rural areas are burning animal dung. The diversion of this valuable fertilizer from the farm fields to the cooking pot also affects productivity and thereby the availability of locally grown food.

As wood becomes more difficult to obtain, it seems logical that women will reduce the number of times they fuel the fire--cooking larger quantities at one time, and saving leftovers for another meal, to be eaten cold. It has been reported that in some parts of the Sahel, people are eating fewer hot meals than in times past. If this is occurring, this phenomenon could be influenced by the time of year and by family income, as well as by fuelwood scarcity. However, a recent report by an African anthropologist mentions the strong tradition for hot meals in the Sahel, a cultural value which may inhibit a reduction in fuel use. A wife who serves her husband and family a cold meal is apparently scorned by the community (Ki-Zerbo, 1979).

Changes in diet, such as eating more foods which can be cooked less or eaten raw, may also be occurring. In Guatemala, for

example, some of the old people are remarking that when they were young, they ate many tortillas; but now they mostly eat tamales. Tortillas are made over a very hot fire, which consumes a lot of wood; whereas tamales are steamed (personal communication with Ianto Evans). The Indians in the Guatemala highlands are reportedly eating fewer beans than before because of their long cooking time (Tinker, 1979). According to Tinker, the foods substituted are low in protein, which in turn has resulted in visibly lower nutritional levels.

In Nepal, people are also reportedly eating more foods in a raw state (Tinker, as quoted by Hoskins, 1979). In some cases, this will increase the value of nutrients absorbed by the body. Many fruits and vegetables are best eaten raw or partially cooked, as they tend to lose most of their nutrients during cooking. However, all the principal staples consumed in the tropics must be well cooked to be palatable and digestible.

One of the first ways to cope with a shortage is to cease wasteful practices and find ways to conserve the scarce good. In Senegal, women are now taking care to put out their fires with sand as soon as the food has finished cooking and saving the charred remains for preparing the next meal (personal communication with Ianto Evans). Another conservation measure with great potential is the more extensive use of stoves. The current widespread practice of cooking over a three-stone fire is tremendously wasteful and inefficient. There is considerable experimental work underway in

parts of Central America, Asia, and Africa to design and introduce stoves which can be easily and cheaply made, using local resources and skills. In Guatemala, the Lorena stove is made with clay and sand and reportedly uses only half the wood that is needed for the traditional method. The adoption and use of these stoves by large numbers of people in areas with fuel scarcities would represent a tremendous savings. Work is also underway to increase the efficiency of traditional charcoal-making techniques and charcoal-burning stoves.

In summary, fuelwood shortages are now affecting some rural areas; and firewood, once a free and abundant good, is now becoming a marketable commodity. For the poor, this new expenditure will undoubtedly place a strain on the family budget, although it is not clear what other basic needs (e.g., food, housing, clothing) will be foregone to accommodate this expense. The rural poor are also turning to other fuel sources, notably animal dung and agricultural residues; but the diversion of this organic matter from the farm fields results in declining soil fertility, crop yields, and food availability. To date, there is little evidence that people are significantly reducing their consumption of firewood and charcoal, although conservation measures are being more widely used.

III. TREES AS PROVIDERS OF FOOD

In addition to supplying fuel, natural forests provide edible fruits, nuts, and berries; furnish forage for livestock; and are a habitat for fish and game. These food sources are being threatened by growing pressures on the natural resource base--principally clearing of land for cultivation and removing trees and other woody vegetation for fuelwood. Ironically, these activities, which are supposed to increase the availability of food through more extensive agriculture, or supplies of fuel for cooking, are slowly destroying a major resource--the tree--which in part satisfies these very needs.

Trees are slowly but surely disappearing from many landscapes. There are already areas of desert around population centers in the Sahel. Marginal lands cleared for farming but not suitable for cultivation are also becoming treeless wastelands. In North Kano State in Nigeria, for example, there were an average of 15 trees per hectare in 1954; by 1971, there were only 6.5 per hectare, a reduction of more than 50% (personal communication with Robert Fishwick).

Food. In the Sahel, people are very much aware of the value of their trees and deplore their disappearance (personal communication with Fred Weber). There are a variety of tree crops--notably nuts, seeds, beans, and fruits--which are gathered by sedentary farmers and pastoralists alike (see Table 1 for a listing of some common uses of arid species). In addition to supplementing the local diet, they are a source of income, and a reserve during

Table 1

FOOD USES OF SELECTED ARID LAND TREES

Species	Part Used	Uses	Comments
Baobab (*Adansonia digitata*)	leaves	preparation of couscous; eaten as salad	
	fruit	drinks; powdered and mixed with milk for children	
Le Ronier (*Borassus aethiopium*)	sap	palm wine	
	fruit	grilled and prepared as gruel; fruit jelly eaten by children	eaten during times of food scarcity
	heart of palm	salads	
	seeds	boiled	
Le Nété (*Parkia biglobosa*)	fruit	pulp eaten by children	
	seeds	crushed and fermented; used in preparation of sauces	
Le dimb (*Cordyla pinnata*)	fruit	preparation of sauces; juices	high protein substitute for meat
Cashew (*Anarcardium occidentale*)	nuts	roasted	
	blossoms	nectar for honey	
Tamarind (*Tamarindus indica*)	pods	juices, confections, seasonings	rich in Vitamin C, minerals, and calcium
	blossoms	nectar for honey; seasonings	
	leaves	seasonings	
	seeds	livestock feed; pressed into oil for food and industrial use	
Mango (*Mangifera indica*)	fruit	juices	rich in Vitamin C
	leaves	eaten as green salad	
	seeds		
Algaroba or Mesquite (*Prosopis juliflora*)	pods/ beans	ground into flour; animal feed	cereal substitute; more nutritious than corn
	blossoms	nectar for honey	

*Acacia senegal**	seeds	dried and eaten as a vegetable	
	gum	used in food and beverage preparation	
	pods	animal feed	

**Acacia senegal* provides excellent firewood.

Sources: International Development Research Centre, "Le Role des Arbres au Sahel"; National Academy of Sciences, *Firewood Crops: Shrub and Tree Species for Energy Production*; J. Sholto Douglas and Robert A. de J. Hart, *Forest Farming: Towards a Solution to Problems of World Hunger and Conservation*; Food and Agriculture Organization, *Forestry for Local Community Development*.

times of drought and crop failure.[4]

Fruit in particular is much appreciated by local people and often ripens just before the harvest when food supplies are normally low. And it doesn't have to be cooked! Unfortunately, much of the fruit spoils, and there is a need for simple, inexpensive preservation techniques.

People usually take good care of their fruit trees. In northwest Cameroon, it is quite remarkable to see stands of papaya trees--perhaps the only noticeable vegetation more than a few feet high in sight--in village compounds. The introduction of fruit trees as part of tree-planting programs in Senegal and Pakistan has been very popular with the indigenous populations. In the area around Mbour, Senegal, for example, the survival rate for fruit trees is about 90%, as opposed to 25% for Neem, a fast-growing exotic planted specifically for firewood.

Leaves from some species, such as the Baobab, are used to prepare sauces which are a major part of the evening meal. In addition to furnishing vitamins and minerals, some leaves reportedly have a high protein content. In some places in the Americas,

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[4]The National Academy of Sciences has published several handbooks on trees and plants, notably, Firewood Crops: Shrub and Tree Species for Energy Production, forthcoming; Tropical Legumes: Resources for the Future, 1979; and Underexploited Tropical Plants with Promising Economic Value, 1975. Sylva Africana, a quarterly bulletin published by the Research Center for International Development in Nairobi, Kenya, contains useful information on forestry research in Africa.

the pods of the algaroba (Prosopis juliflora) are ground into flour and used as a cereal substitute. Claimed to be more nutritious than corn, it has a taste similar to maize meal.

In some parts of the world, trees are an integral part of the local agricultural system. In Indonesia, for example, the land surrounding a home, called the homegarden, is cultivated with a mixture of annuals and perennials. In addition to supplying 60-90% of the household's firewood needs, it provides other useful products, such as fruits, vegetables, spices, medicines, and construction wood. In one instance, a homegarden was found to have more than 200 species (Soemaroto, 1979).

Forests and trees are a source of cash crops. A visitor to a village market in Upper Volta cannot help but marvel at the variety of tree products for sale. Of special economic importance is the Kerite nut, which is made into shea butter and used in the preparation of sauces. It is also made into oil and exported. Other marketable items include cashew nuts, baobab leaves, and fruit in season.

In marginally productive areas, such as arid and semiarid regions, edible foods from trees and plants as well as wildlife are an important reserve during times of drought. Fred Weber, a prominent Sahelian forestry expert, warns against the destruction of what may appear to outsiders as "useless bush," because this would greatly increase the vulnerability of local people to the vagrancies of nature:

> The importance of gathering wild foods increases manyfold during years of crop failure . . . . Wild foods in time of stress provide a most vital reserve. . . . You have the flexibility of systems: if all goes well, people prefer a subsistence farming approach; but if the rains don't come the way they should, the system falls back into its original pattern: hunting/gathering. This, of course, is possible only if some of the traditional bush is available. Projects which eliminate "useless bush" on a grand scale can have terrible effects in that they eliminate the fallback reserve of the people. All too often, visitors see the bush as useless,but in reality there is scarcely a plant that is not used for feeding people or keeping them well (Weber, as quoted by Cloud, 1977).

A study of the Moshaweng Tlokwa, an agro-pastoral society living on the fringes of the Kalahari Desert in Botswana, found no evidence of malnutrition after a recent seven-year drought (Grivetti, 1978). This is in sharp contrast to the high loss of human and animal life which occurred during the 1968-74 drought in Sahel West Africa. The ability of the Moshaweng Tlokwa to survive has been largely attributed to their continued reliance on a diversified food production system based on agricultural/ horticulture, animal husbandry and hunting/gathering. When crops fail or domestic livestock perish, 250 species of local plants and bush meat provide the local people with a nutritous diet. This traditional system is threatened by probable changes in the agricultural system, e.g., clearing of land for cash cropping, which would markedly decrease the availability of wild plants and destroy the habitat of wild game (Grivetti, 1978).

Forage. The pods and leaves of some species are a major source of nourishment for domestic animals which provide man with meat and dairy products. In the Sahel, the pods of the *Acacia*

trees are much sought after by livestock and contain 15% crude protein. The leaves of other species, such as the Albizia lebbek and the Prosopis specifera contain as much as 20% crude protein (FAO, 1978).

Fish and Wildlife. Forests are a habitat for wildlife--mammals, birds, fish, reptiles, and insects--a source of protein upon which man has relied for years. In Ghana and Nigeria, as much as 70% of locally consumed meat comes from wild animals (FAO, 1978). The capybara, a giant rodent found in parts of South America, is hunted for its meat and hides and in some places is raised commercially (FAO, 1978). In parts of the Sahel, the addyx and oryx can survive long periods of drought, subsisting off scrubby vegetation which is considered unpalatable by domestic livestock. However, with the spread of deforestation, big game has in some cases disappeared altogether, and the smaller game is harder to find (Cloud, 1977). And finally, bees can produce abundant crops of honey--a valued sweetener worldwide--from the nectar of tree blossoms found in areas too arid or degraded for other agricultural pursuits (Swanson).

Mangrove swamps on tropical coasts provide an ideal breeding ground for fish, which are an important source of protein for the local population. Destruction of the mangroves will indirectly bring about a decline in this resource. In Senegal, mangroves are disappearing from a combination of natural and man-made causes (e.g., cutting wood for fuel and construction), and a decline has already been noted (NAS, 1980).

IV. CONCLUSIONS

Attempts to link increasing fuelwood scarcities to declining nutritional levels are confounded by other influences underlying dietary changes. Several aspects of the relationship between fuel and food, however, emerged from this study and deserve further consideration.

- Available evidence suggests that the demand for fuel is income inelastic, and there appears to be no notable decrease in levels of energy consumption in spite of rising prices. If people are spending more for fuelwood from limited or relatively fixed incomes, other consumable items will necessarily be foregone. Although the demand for staple foods is probably also income inelastic, more expensive but nutritious foods such as meat and fish may be eliminated from the diet.
- Firewood is becoming more difficult to find in rural areas and more people are naturally switching to other locally available combustible materials such as dung and agricultural residues. Soils deprived of this rich organic material will ultimately produce less food.
- Since the beginning of time, forests and trees have provided man with a rich variety of foods. Ironically, this valuable resource is being destroyed by man as he clears more land for farming or cuts trees for fuel. In regions such as the Sahel where the bush is a vital reserve in

time of crop failures, its destruction severely diminishes the capability of local people to survive drought.

The future availability of food and fuel--essential to supporting human life--is threatened by deforestation. The challenge facing us today is to provide people with the means to satisfy these basic needs. Part of the response is to cultivate trees for the well-being of mankind.

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THE FUEL WOOD CRISIS AND ITS IMPACT ON NUTRITIONAL STATUS
AN ASIAN PERSPECTIVE

David F. Williamson

An Anecdote

I can still clearly remember our monthly foray to cut firewood. My cook, Vishnu, his brother Shiva, and I would walk for half an hour up into the forest on the ridge at the top of the village. The two boys carried the axes and their tumplines while I carried the bare aluminum frame from my backpack. We would usually spend another two hours or so searching for trees of a reasonable size, felling them, delimbing, and then chopping them into chunks we could carry.

The boys carried the 60-80 pound chunks of rhododendron slung on a tumpline from their foreheads with the bulk of the load resting on their shoulders and backs. My American neck was not used to that kind of strain, so I would strap a chunk of wood onto my pack frame, with its padded shoulder straps, and make the slow painful descent down to my house in the village. There were three of us and usually six good size pieces of wood which meant a return trip to the forest and another fully loaded descent.

We now spent the next two hours splitting the chunks into pieces small enough to burn in my mud stove. However, before they could be burned, they had to be dried for at least a week. Another hour was spent neatly stacking the wood on my front porch in the form of a "breathable" lattice.

This monthly task took the better part of a day's labor for myself and the two brothers. Fortunately, my own needs for fuel wood were relatively small as I lived alone, but I knew of many families who were now spending one day in seven finding, cutting, carrying, splitting, and stacking firewood. The children, if they were old enough to maneuver the rocky paths unaided, would carry the smaller branches in their woven carrying baskets while the father and mother strained under the heavy chunks of freshly cut wood. Both the men and women were equally proficient in splitting and stacking firewood.

During the winter nights, when a frosting of snow covered the ground and I was thankful for my down jacket, I would sit in the main room of my house listening to my friends tell stories of the "old days." Then a man[1] needed only to take a short walk outside his house to the forest where he could leisurely chop and split all the wood he might want. The irony of the empty fire pit in the middle of the floor was lost on none of us, especially during the chillier nights when it seemed my hands had been cold for weeks.

Although this anecdote arose from my own experiences in a single village in Nepal, adequate documentation exists to indicate that the fuel-wood crisis is widespread throughout the Indian subcontinent and a majority of Asian countries.[2] The purpose of

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[1]Cutting firewood used to be an exclusively male job. Now due to the greater time involved, women are also active.

[2]Eckholm, Erik P. (1976), Losing Ground, W. W. Norton Co., New York, Chapter 6.

the anecdote is to draw attention to two manifestations of the fuel-wood crisis which can conceivably impact on the nutritional status of the more vulnerable members of the household.

Effects of Household Labor Reallocation

The first effect of the fuel-wood crisis on the household is the necessary reallocation of women's labor to aid in a task which is becoming increasingly more time consuming as the forest margin retreats. It is likely that labor time spent on meal preparation and feeding of infants and preschoolers will be reduced and/or more of this responsibility will be given over to a less experienced surrogate such as an older child.

Frequency of Feeding

In village environments where lack of sanitation and hygiene are major threats to child health, weight loss and reduced growth among infants and preschoolers can be due to both the infection itself and the concomitant anorexia. In order to maintain normal rates of growth it is important that the frequency of the child's feedings be increased and that the food is palatable to the child. Many weaning foods in Asia (as in other parts of the developing world) are bulky and a child's intake at a single meal is limited. By feeding the child more often, total food consumption can be increased. If the mother's time and physical energy are reduced, due to her added involvement in procuring fuel wood, the extra

feedings may not take place. Also, unless prompted to do so, many children will not eat the nutrient-rich greens and other vegetables added to the weaning food. It is a common sight to see a child's plate cleaned of all rice or corn porridge, but with the turnip greens left untouched on the side.

Under village conditions, extra effort is required by the mother to adequately feed her children; food must not be only barely edible but palatable. The fuel-wood crisis may compromise her time and energies so as to make this impossible.

Constraints on Breastfeeding

The above has referred to the nutritional effects of labor reallocation on weaned children; however, breastfed infants may also be affected. If a mother's contact with her child is reduced, the frequency of breastfeeding may also be reduced resulting in a decreased total intake for the infant. In areas where household food supply is a limiting factor, a mother who increases her energy expenditure to procure fuel wood may not be able to fill her caloric deficit by increasing her food intake. If she is lactating, this may result in a marked reduction in the quantity of milk supplied to her child.

To summarize, the forced reallocation of women's labor toward procuring firewood may well result in a reduction in the quality of child care especially as it affects the supervision of the child's feeding. This would be true for both breastfed and weaned children.

A review of published studies on labor allocation in rural households may be helpful in planning for future research and interventions.[3]

Effects of Limiting Fuel-Wood Usage

The second effect of the fuel-wood crisis is manifested in the household's rationing system for firewood usage. My village friends had already given up the convenience of a fire on a cold night. Another more serious outcome of household fuel-wood rationing is the reduction in cooking frequency and in actual cooking time. The inevitable outcome of this conservation strategy would be an increase in the prevalence of gastrointestinal infections, especially among the younger children, and a diet significantly altered in both nutrient composition and availability.

Food Hygiene

It is quite common in many southeast Asian households to prepare an entire day's allocation of boiled rice at one time, thus reducing the amount of labor time and fuel needed. Excess rice not consumed that day is then normally fried on the morning of the next day and eaten for breakfast. In all but the wealthiest households, sanitation is minimal and food set aside and allowed to cool can serve as an efficient growth culture for a myriad of infectious organisms. Frying the food before eating is an effective method of sterilization.

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[3]Hart, Gillian P. (1978), "Labor Allocation Strategies in Rural Javenese Households," Thesis (Ph.D.), Cornell University, Ithaca, New York.

A common practice in Thailand, Malaysia, and Indonesia is to serve all meals with a steaming glass of weak tea. Boiled tea is an excellent substitute for unboiled, possibly contaminated water. Fried rice and tea are but two components of the Asian diet which contribute to a reduction in the incidence of diarrheal diseases. The preparation of foods such as these which require extra cooking could easily be eliminated as the fuel-wood crisis becomes more severe.

Dairy Products

Dairy products are an important component of both child and adult diets in much of the Indian subcontinent. However, boiling is always required for their production. Ghee (clarified butter) is an excellent source of concentrated energy and essential fatty acids. It can also markedly increase the palatability and energy content of bulky weaning foods. Ghee is different from ordinary butter in that it will remain solid at room temperature and keep its freshness for an extended period of time. Ghee is produced by first churning milk and then heating the butter for an extended period of time at the boiling point. This has the effect of saturating the butter fats making them less susceptible to rancidity.

Milk itself is rarely consumed before being vigorously boiled. If fuel-wood usage is curtailed, raw milk consumption may increase. One would expect an accompanying increase in the prevalence of diseases such as tuberculosis and brucellosis.

Parboiled Rice

In much of south India and Sri Lanka, parboiled rice is preferentially consumed over regular milled white rice. Parboiled rice is rice which has been steamed while still in the husk. After husking the rice and milling away the bran, the final product is similar in appearance to regular white rice. However, parboiled rice has a significantly higher content of the B-complex vitamins than does white rice. The steaming process forces the vitamins from the bran into the kernel where they are protected from the milling process. In order to conserve fuel wood, the production of parboiled rice may be curtailed. This would result in a marked reduction in the B-vitamin content of the diet. One might also anticipate an increase in the prevalence of the thiamine deficiency disease, beri-beri, especially among those groups relying on parboiled rice as a major dietary staple.

Preserved Meat

The fuel-wood crisis may also have a negative effect on food preservation of meat which is cured either through smoking or fat replacement by prolonged boiling. Sukerti (smoked goat) is widely consumed in Nepal and Himalayan India. Small bits are broken off the bone and mixed with vegetables to form a relish. Randang is an Indonesian dish which is beef preserved by the extensive boiling with coconut milk. The boiling process continues until all the water in the beef is replaced by the coconut oil. Randang can keep for weeks in a tropical climate without refrigeration.

Because of the strong taste of most preserved meats, only small amounts are consumed at any one meal. However, besides serving as a source of high quality protein, their presence in a meal can greatly facilitate the absorption of vegetable iron (non-heme). It is now known that the presence of a relatively small amount of meat can as much as double the percentage of absorbed iron. Because most Asian diets are primarily vegetable based, they are low in readily absorbable iron. The addition of preserved meat can help maximize the availability of iron to young children and women of childbearing age, two groups at greatest risk of developing iron deficiency anemia.

Some Effects Related to Agriculture and Prices

The impact of the fuel-wood crisis on human nutrition is also mediated through decreased agricultural production brought about by deforestation and soil erosion. This is now especially critical in areas with extensive mountain-terrace agriculture such as Nepal, Luzon-Philippines, and Java-, Bali-Indonesia. Eroded soil can also cause blockage of existing irrigation systems through the silting of water channels.

The increasing use of alternative fuels can adversely alter soil fertility. Throughout India, the most common alternative to fuel wood is cow or buffalo dung. In virtually any Indian village, one can see the circular dung pies plastered against walls drying in the sun. This practice diverts critical supplies of animal fertilizer needed for maintenance of minimal soil fertility.

In Nepal, stalks left after the corn harvest are not plowed under in order to aid in replenishing the soil as is done in the U.S. Instead, the corn stalks are also "harvested" and, after thorough drying, they are used as a supplement to firewood.

Finally, for those living on subsistence incomes who are not able to cut fuel wood for themselves but must purchase it on the market, the continued increases in fuel-wood prices will bring about a decrease in the nutritional quality of diets. If one's income is fixed and the price of a necessary commodity goes up, other expenditures will have to be cut back. Usually the household will choose to either switch to a cheaper staple or cut expenditures on accessory foods such as meat, dairy products, and vegetables. If the former choice is taken, households will begin to consume coarser, less palatable, foods such as millet, sorghum, cassava, and bulgur. This will reduce the ability of the mother to provide a palatable weaning food. If the latter choice is followed, the availability of important sources of high quality protein, water and fat-soluble vitamins, and concentrated energy sources will be greatly diminished. It is important to stress that such nutritional insults arising from the fuel-wood crisis will be borne primarily by young children and women of childbearing age--two groups most easily ravaged by malnutrition.

Research Guidelines

This paper has suggested that the nutritional effects of the fuel-wood crisis will be felt most strongly by young children and

women of childbearing age. The paper has presented hypotheses concerning the nature of these nutritional effects. Research activities should concentrate on the verification of these hypotheses in these at-risk groups.

Although it is beyond the present scope of this paper to present a thorough catalog of applicable research designs, some general guidelines may be useful:

1. Observational studies with a strong anthropological component should be directed at determining whether or not women are increasing the amount of time spent on gathering fuel wood. Such studies should also reveal exactly how this allocation is taking place and the effects on other family members, i.e., are older siblings now taking a major responsibility for child care and feeding?
2. A dietary study, either as a component of the above or as a separate study, should be carried out to investigate household food preparation and consumption patterns, with special reference to children and pregnant/lactating women.
3. Such studies should involve a design whereby comparisons can be made among households in several different ecological zones, i.e., among villages experiencing different degrees of fuel-wood scarcity. As much as possible, households included in the different samples should be matched by socio-economic status and ethno-cultural makeup. Ideally they should only differ as far as the level of fuel-wood availability.

4. Such a design requires that studies be carried out within a single country. In Asia, a country such as Nepal presents wide variation in fuel-wood availability within many of its hill districts.

This writer recognizes that the only sensible long-term intervention, reforestation, will take many years and generations. However, appropriate nutritional interventions can help to minimize effects of the fuel-wood crisis for the present and succeeding generations until reforestation has been accomplished. although interventionm planning canbnot begin until after results of research are obtained, it may be helpful to briefly anticipate the possible nature of some interventions.

Like the effects of the fuel-wood crisis itself, any nutritional interventions should be targeted to the most vulnerable groups. If it is found that older siblings are now responsible for the majority of child care, then nutrition/health education programs may be directed to this group specifically. If time-allocation studies reveal that the energy demands on breastfeeding mothers have been drastically increased, then feeding programs may be redesigned to meet the caloric/protein needs of lactating women compatible with maintainingf useful quantity and quality of breast milk. If dietary studies reveal a decrease in the use of heat-preserved foods, then interventions may include instruction in laternative food preservation methods.