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Wood Energy, Women and Health

Contents

Colophon

Project Information

The Regional Wood Energy Development Programme in Asia (RWEDP) aims to assist 15 developing countries in establishing and strengthening their capabilities to assess wood energy situations, plan wood energy development strategies and implement wood energy supply and utilization programmes. The programme promotes the integration of wood energy in the planning and implementation of national energy and forestry programmes.

Wood Energy News

The programme's newsletter, *Wood Energy News*, which is published on a regular basis, addresses a wide variety of wood energy issues, such as woodfuel resources, woodfuel flows, wood energy planning and policies and wood energy technologies. Its purpose is to share information on wood energy with its subscribers. Suggestions, reactions or contributions are more than welcome, and don't forget to share your own experiences.

Those wishing to obtain *Wood Energy News* can write to the RWEDP secretariat at:

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Editorial

"The kitchen kills more than the sword" is an ancient proverb quoted by Prof. M R Pandey in this issue of *Wood Energy News*. Prof. Pandey's own research has shown that today, the hazards of kitchens continue to affect many millions of people, largely in the form of smoke from improper cooking devices used in poorly ventilated areas. Yet, in spite of the numbers being affected, the problem of indoor smoke pollution has as yet received relatively little attention from governments and international agencies. The victims are mainly women and small children, as they spend many hours in these unhealthy environments.

Wood and other biomass still dominate as domestic cooking fuels, especially in the kitchens of the region's poor, and this is likely to remain the case for a long time. But blame for the harmful indoor pollution should not be directed at fuel. Technically, it is a relatively simple matter to reduce emissions from biomass stoves, applying the fuels in a clean and safe way. Why, then, is so little being done and with so little effect? This is a simple question, but there are no simple answers – socio-cultural, socio-economic and political influences are all at work and must be recognized and accounted for. As it is women in particular who are at risk, these influences are inevitably gender-related and must be analysed in order to obtain better understanding of the problems. The gender aspects then need to be incorporated into policies, projects and related interventions if they are to meet with success.

Biomass energy presents more causes for concern than just domestic pollution. The whole cycle of activities related to supply and use of these fuels implies serious health hazards. Again, it is mostly women who are at risk, and so gender aspects must be major considerations in addressing the problems involved in gathering, transporting, processing etc.

Household energy programmes have been and are being undertaken for a combination of different reasons. Amongst them are considerations of resource management, environment and energy efficiency. These objectives are still valid; however, awareness is also growing that improving the quality of life of half the world's population, through much needed upgrading of health conditions, must be of prime concern.

Front page: In Asia, most woodfuel users are women

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Women, Wood Energy and Health

M R Pandey

More than five million children under five years of age, most of them in the developing world, die of pneumonia every year. Studies have shown that indoor air pollution is an important risk factor in pneumonia. Also, as well as mortality, pneumonia is also responsible for a good deal of morbidity. For instance, in adults, chronic bronchitis and chronic obstructive lung diseases are highly prevalent, especially in the hilly regions. These ultimately lead to heart damage (*cor pulmonale*) caused by chronic lung diseases. This latter fact obviously has great socio-economic importance, as the diseases cannot be cured, and the best medical science can do is to prolong a miserable existence at considerable cost to all.

There is definite evidence that tobacco smoking and indoor air pollution are both important risk factors in chronic lung diseases. In the developed world, chronic bronchitis is overwhelmingly a male disease. But in the developing world, in spite of much heavier tobacco smoking by men, both men and women are equally affected. Why is this so? It is because of domestic smoke pollution caused by the use of biomass fuels for cooking and heating.

Obviously women who do the cooking are exposed to this smoke. But so also are children, particularly infants and young children, who spend most of their time around their mothers.

Taking all the above factors together, the effects on children and on women, we can grasp the truth of the Latin proverb: "The kitchen kills more than the sword". That there is an ancient proverb to this effect shows that, in some sense at least, the problem of indoor air pollution (and of disease-carrying water) was recognized even two thousand years ago. Yet, in spite of millions being affected, the problem of indoor smoke pollution has received relatively little attention from national governments and international agencies. Even the Indoor Air Group of international scientists in world conferences pays very little attention to this problem and concentrates on relatively minor matters, like "sick building syndrome" due to emissions from paint, furniture, etc. combined with inadequate ventilation.

We spend more time indoors than outdoors. Yet, outdoor air pollution gets so much attention, while indoor air pollution is rarely even mentioned in passing. This lack of attention from policy makers and scientists at national and international levels, may be due to the low status of women in developing countries, especially the poor women who are the worst affected by this problem. These are people with little political or economic clout.

Despite the important role of biomass fuels in the economy of the developing countries, there are no occupational health standards for domestic cooks. Is this because domestic cooking, which is done by women, is not even recognized as an occupation?

Why was I, a cardiologist, drawn to study the question of indoor smoke pollution and its effects on women? After 20 years of working in hospitals in Kathmandu, I was disheartened to see so many *cor pulmonale* cases, most of them women. All we could do, after intensive therapy, was to save their lives for the time-being, while the symptoms persisted. These women would come back every few months, especially in winter, eventually dying after a couple of years.

An analysis of Kathmandu hospital statistics in the second half of the 1970s revealed that 15 per cent of deaths were due to heart disease, and of them, 46 per cent were caused by *cor pulmonale*. When a small trust we founded began to work in the villages of Nepal, we found a correspondingly high incidence of chronic lung diseases and *cor pulmonale* among the women there. So we began studies to investigate the root cause of the problem and found it to lie in the exposure of women and children to smoke pollution from the use of biomass fuels in cooking and heating. We found that chronic lung disease and the resultant heart damage hit women after a period of exposure, affecting them between the ages of 30 and 50, which should be the most productive period of their lives.

Health Effects of Domestic Smoke Pollution

The main health effects of domestic smoke pollution are:

1. Respiratory diseases and *cor pulmonale*;
2. Adverse pregnancy outcomes (stillbirth, neonatal death, low birth weight);
3. Cancer;
4. Eye problems.

Domestic smoke pollution is an important contributing factor for three major classes of respiratory diseases: acute respiratory infection (ARI) among infants and children; chronic obstructive lung disease (COLD) in adults; and interstitial lung disease.

Acute Respiratory Infection (ARI) Among Infants and Children

Out of about 15 million children under years of age who die in the world each year, approximately one third die from ARI. Most of these deaths are caused by pneumonia. The overwhelming majority occur in developing countries. It can therefore be concluded that passive inhalation of smoke may contribute to respiratory infection in infants and children.

Professor M R Pandey is a Royal Cardiologist, founder and chairman of the Mrigendra Medical Trust, and president of the Nepal Heart Foundation. He is based in Kathmandu, Nepal

Don't blame the photographer - it's the smoke!

A South African hospital-based study of 132 infants with severe lower respiratory tract disease found that 70 per cent had a history of heavy smoke exposure from cooking and/or heating fires (Kossove, 1982).

A Nepalese study examined 240 rural children under two years of age for six months for incidence and severity of ARI. A strong relationship was found between the maternally reported number of hours per day the children stayed by the fire and the incidence of moderate and severe ARI cases. If possible confounding factors are discounted, extrapolation shows that by moving all children into the lowest smoke exposure group, as much as 25% of moderate and severe ARI could be eliminated (Pandey et al., 1989).

In a study of 500 children in Gambia, girls under five carried on their mother's back during cooking (in smoky huts) were found to have six times higher risk of ARI: a substantially higher risk factor than parental smoking. There was no significant risk, however, in young boys (Armstrong and Campbell, 1991).

Most studies provide extremely suggestive indications that exposure to wood smoke is an important risk factor in pneumonia. But to give a final answer to the question "How much can we reduce ARI by reducing indoor air pollution from biomass combustion?", longitudinal intervention studies (taking the situation before and after an intervention) are needed. A recent editorial in *The Lancet states,* "The results of Pandey et al. suggest that the need for these studies is now urgent, so that the national ARI control programmes underway in many countries can consider whether they should add improvement of the domestic environment to their control strategies" (1992).

Chronic Obstructive Lung Disease (COLD) in Adults

Chronic bronchitis and chronic obstructive lung disease (COLD) present general practitioners all over the world with some of their most frequent problems. An early study in Papua New Guinea (Anderson, 1979) showed a possible relationship between domestic smoke pollution and chronic bronchitis. A definitive study was conducted in Nepal (Pandey et al., 1988) to determine the distribution and magnitude of these diseases in different geographical regions of the country and to identify factors responsible for them.

An interesting aspect of the latter study is that there was a similarly high rate of prevalence of chronic bronchitis in women and men. This contrasts with the findings of most other studies, which show a lower prevalence rate for women. Despite being non-smokers or smoking less than men, women in Nepal had a prevalence rate similar to that of smoking men. This can be explained by the fact that a significantly higher proportion of women than men in the study were exposed to domestic smoke pollution, and for longer hours.

As with the Nepalese studies, an Indian study (Malik, 1985) shows that even non-smoking women who have cooked on biomass stoves for many years exhibit a higher prevalence of chronic bronchitis than might be expected in similar women who have made less use of biomass stoves. Indeed, in rural Nepal nearly 15 per cent of non-smoking women (20 years and above) had chronic bronchitis, a high rate for non-smokers.

COLD leads to pulmonary hypertension and cardiac enlargement, which ultimately cause *cor pulmonale*. Both old and new studies have shown a relationship of cor pulmonale with domestic smoke exposures (Pandey et al. 1988; and Sandoval et al. 1993).

Adverse Pregnancy Outcomes:

The effects of indoor smoke pollution on birth weight have not been assessed directly in human populations. There is, however, substantial theoretical and indirect evidence to suggest a significant impact. It is proposed that the major effect operates though increased carbon monoxide content in the indoor environment, which limits oxygen delivery to maternal and foetal haemoglobin, and by shifting the oxygen haemoglobin dissociation curve to the left, inhibiting the release of oxygen from maternal haemoglobin in the placenta. Given the well documented effects of maternal cigarette smoking on foetal growth and risk of pre-term delivery (Kramer, 1987), carbon monoxide is most likely to have the biggest of all the impacts from biomass smoke on foetal growth, leading to still birth, neonatal death or low birth weight. Only one, unpublished, study has addressed the question, and it reports an 85-gramme lower average birth weight in infants born to mothers using unventilated wood fires in rural Guatemala compared to those born to mothers using propane stoves. A study from Ahmedabad, India, showed a significant increase in stillbirth (OR = 1.5) in those women exposed to domestic smoke during pregnancy compared to those who were not (Mavalankar et al., 1991).

Cancer

There are many chemicals in biomass smoke which are known to cause cancer in laboratory animals and are found in mixtures known to cause cancer in humans. A recent study in Japan (Sobue, 1990) found that women cooking with straw or woodfuel when they were 30 years old had an 80 per cent

increased chance of developing cancer in later life.

In contrast to biomass, there have been many studies of the indoor air pollution levels and health impacts of cooking with coal on open stoves, almost all done and published in China, where coal use for cooking is quite common (Hong, 1991). A range of effects has been found, including quite strong associations with lung cancer.

Health Effects of Carrying Wood Loads

Domestic fuel-related work is done by women. In Nepal, rural women are so busy with their daily chores that they are forced to give some local beer to their children so as to keep them quiet while they get on with other domestic work. This fuel-related work of women has one major effect in the incidence of chronic lung disease and resultant heart damage. But it has yet another, little-known, effect. All over the world, lung function is correlated to height. But in rural Nepal we found that for women, it is better correlated with arm-span. This may be because Nepalese women in hilly villages carry firewood in a big bamboo basket carried on the back, held by a strap around the forehead. Probably the excessive weight lifting on the back causes flattening of the intervertebral discs.

Another ongoing study on women's reproductive health being conducted by us, among the Tamang women of Nepal, has shown a high incidence of uterine prolapse. The Tamang women start working from the third day of delivery onwards because of their tradition, culture and male domination. One of their main tasks is to collect and carry heavy wood loads, and it is felt that this carrying of heavy loads from the early post-partum period may be responsible for the high incidence of prolapse.

In Conclusion

There is no international or national organization addressing the issue of indoor smoke pollution. It is only now that the issue of indoor air pollution is beginning to be discussed in forums like this one. The WHO held a consultation on this issue in 1991 and published the papers (WHO 1992). The Household Energy Development Organizations Network (HEDON), initiated by the WHO, has been meeting periodically. The World Bank has declared indoor air pollution one of the five major environmental problems facing the world. It was only in the recently held Seventh International Conference on Indoor Air Quality and Climate (Japan, July 1996) that the issue of indoor air pollution in developing countries was discussed for the first time. The initiative taken by RWEDP in organizing this workshop on Gender and Health Issues in Wood Energy is very commendable and I hope it will result in further initiatives by FAO-RWEDP in the area of effects of smoke pollution on women and children.

Woodfuel kitchens needn't be unhealthy

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Health Hazards in the Woodfuel Cycle

W S Hulscher

Present concerns about woodfuel and health focus primarily on the effects of emissions from burning the fuel. However, the whole cycle of activities from production to harvesting or collection, processing, transportation and combustion of wood and other biomass fuels involves a variety of health hazards. These are summarized in the table on the back page of this issue.

The incidence of risk depends on the safety of specific tools and equipment used, for instance in harvesting and cutting fuelwood. Oversized tools and lack of protection in the form of boots and gloves are commonly observed. Also, general working conditions matter a lot. Unfortunately, prevailing conditions and equipment are often quite poor, not only for sawing and cutting wood in forest areas and around wood-processing industries, but also in activities such as charcoal production. This sometimes takes place inside sheds in a very dark, smoky and disorganized environment.

The right tool for the job?

He needs some help too!

Equally worrying are surveyors' reports stating that for transporting fuelwood, headloads of up to 20 kg are carried by women and children over long distances, leading to severe fatigue and backache. Furthermore, with traditional practices for domestic stoves and combustion, adverse ergonomic effects can result in arthritis. This is commonly taken for granted though, in fact, it is not acceptable at all. In an unknown but undoubtedly large number of cases, incidents caused by unsafe or unstable stoves are responsible for burns and fires.

All these health hazards come on top of the widespread unhealthy effects of smoke and other emissions from stoves, but they have not yet been systematically researched. Valid research should put the risks in perspective, that is, compare the woodfuel cycle with accepted health and safety standards and with alternative fuel cycles. At present, it is hard to say whether kerosene and gas stoves cause more fire incidences than wood stoves and hence, where the priority should be for interventions aimed at improving public health. Similarly, common work in coal mines definitely generates serious health risks, but that does not justify simply accepting the health hazards of woodfuel production and processing.

Industrial energy-related activities in the formal sector are at least subject to government laws regarding labour conditions and safety, which are increasingly being enforced. However, the numerous women involved in informal woodfuel businesses and domestic activities have to carry the burden themselves, without any legal or institutional protection. When we learn that woodfuel use is generally unsafe and unhealthy, the solution is not to move away from wood energy. We know that in most countries the use of wood and other biomass energy is still increasing in absolute terms, and there is no possibility of its being substituted in the foreseeable future. The answer to the challenges can only be to introduce improved technologies and practices for wood energy, for the benefit of the numerous people who depend on it.

Environmental Conditions of Urban Poor Communities in Asia

Effects of Indoor Air Pollution on Infants in Delhi and Manila

Debarati Guha-Sapir

The problem of pollution as a risk to human health remains of serious concern in most cities of Asia. Children, in particular infants, are the most immediate and most vulnerable victims of toxic pollutants of the type seen in many metropolises in developing countries. While major environmental action to reduce levels of pollution is critical in the long run, it remains expensive, relatively difficult to implement and frequently of low priority, especially in poorer countries. However, with respiratory infection being a principal cause of death among infants in developing countries, air pollution needs serious consideration as a risk factor in child survival. Unfortunately, there are few studies from developing countries that demonstrate a link, and robust, quantitative environmental and epidemiological evidence from different samples is rare. Thus, policy makers remain unconvinced and unprepared to take major action on reducing household air pollution.

This study therefore attempted to maintain high quality, accurate data collection, from both environmental exposure monitoring and medical examinations of infant cohorts. In both Delhi and Manila, the project followed some 600 infants of less than a year old living in slum households where cooking was done using kerosene or wood as fuel. Medical teams followed these children for four months, paying twice-weekly home visits to monitor respiratory illness status. Appropriate treatment was provided.

Of the 1,200 homes, 60 in Manila and 80 in Delhi were selected for environmental measurements. A team of environmental engineers measured respirable suspended particulate matter smaller than 10 microns (PM10) over 24 hours, using cyclone pumps and filters placed at one metre distance from the cooking source. A social scientist collected time-budget data on the presence of the child in the cooking area and the exact timing of cooking periods during a typical 24 hours. Total daily exposure of the infant to the pollutant was then calculated.

The average indoor pollution levels of PM10 were lower in Manila than in Delhi (221 mg and 318 mg per m^3 respectively), though both were three to four times higher than the norm of 70 mg per m^3 set by the WHO. In Manila, the levels of particulate pollution were significantly correlated to housing volume and ventilation area, indicating that smaller spaces and bad ventilation are major determinants of pollution. Fuel used and total daily cooking time showed no correlation. However, in Delhi, wood-burning homes had pollution levels 50 per cent higher than those using kerosene. The incidence densities of acute lower respiratory infections among infants at risk were 17.2 episodes per 1,000 child-weeks in Manila and 34 episodes per 1,000 child-weeks in Delhi.

The studies found non-significant correlation between ambient and indoor levels of pollution. In both cities, medium ambient pollution level areas turned out to have the highest indoor air pollution. This indicates that the indiscriminate use of outdoor pollution measures for policy decisions can be seriously misleading as an indicator of indoor air pollution and in the estimation of its impact on people who stay indoors.

Though detailed analyses are now in progress to confirm the initial findings and examine more thoroughly the implications of indoor air pollution, especially for child health, the main policy and programme implications of this study can be summarized as follows:

- Level of indoor air pollution is significantly correlated to respiratory infection in infants;
- Ambient air pollution levels may not be an adequate proxy for indoor air pollution;
- Fuelwood and ventilation systems are the main determinants of pollution;
- Smoke is not perceived by the mother as a risk factor for infants with respiratory disease;
- Awareness of indoor air pollution and of the need for ventilation is low among mothers;
- Cooking sources are often used for indoor heating at night, contributing substantially to indoor pollution.

Findings not within the original objectives of the study but noted were:

- Detection and primary treatment of ARI symptoms and of pneumonia in infants can be satisfactorily handled by health workers with short training;
- Absence of breastfeeding is a significant risk factor for ARI in children.

One short-term option to address the immediate problem of child mortality due to air pollution would be to try to reduce exposure times. This could be done while working on longer-term solutions for pollution control. In view of the policy goals of this study, a pilot initiative to estimate the cost-effectiveness of interventions aimed at reducing infant exposure to cooking fumes would be a necessary and practical follow up to it. The two intervention types suggested by the field experience are i) a maternal educational and awareness campaign, and ii) improving ventilation systems.

Copies of the full draft final report can be obtained from the author.

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Gender, Biomass Energy and Health

Christina Aristanti

Biomass, which includes wood, crop residues and animal dung, is used by approximately half of the world's population as cooking and/or heating fuel. These fuels are handled and combusted primarily by women, who are largely responsible for reproductive chores such as cooking and are often involved in any household industries which involve cooking, such as food processing. Women and children generally have the main responsibility for collecting fuel. In Asia, acquisition and use of biomass fuel may take up anywhere between three and nine hours of a woman's day, depending on the availability of biomass resources. In Lombok, Indonesia, women spend about three hours each day cooking and four hours each week collecting dead wood or agricultural residues to be used as fuel. In areas of Kenya, women spend seven hours a day on the same tasks. Needless to say, as biomass resources become more scarce, women's workload increases. More time and energy must be spent in fuel collection, processing and use. Besides the time and energy spent, this daily dependence on and use of biomass has a number of negative health effects.

Unfortunately, precise correlation between the use of biomass fuels and health consequences has rarely been pinpointed. This is due to large numbers of confounding factors and the modest resources available for such research (Braakman, 1996).

When we first think of negative health effects connected to biomass fuel use, we invariably think of smoke. Indeed, smoke is a health problem, but this is not only because biomass is being used, it is also due to the stoves used to combust it and the often poorly ventilated environment where the combustion takes place. However, we should examine the entire *fuel cycle* to get a more complete picture of the health risks related to fuel. The table on the back page of this issue of *Wood Energy News* is an overview. Some of the health and other issues are expounded below.

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Collection

As biomass becomes more scarce, women collectors have several options. They can spend the extra energy and time necessary to obtain the same quality and quantity of biomass as before, or switch to lower-quality fuels, change cooking practices, change hygienic practices, sacrifice other functions of the stove such as space heating and household industry, or buy fuel. But what might these changes actually mean?

Spending Extra Energy and Time

Obviously this first choice increases women's workload, but it also might increase others' workloads. Frequently, time pressures force women to keep their children (read: daughters) away from school, to help them with fuel collection.

Using Lower Quality Fuels

Using lower-quality fuels often means using softwood instead of hardwood, or switching from wood to agricultural residues or animal dung. Softwood burns faster, leaves less charcoal and produces more soot and tar. Agricultural residues are bulky and thus mean more inconvenience in collection and transport of fuel. Use of animal dung brings with it hygienic concerns. From the point of view of combustion, cowdung cakes heat very slowly, taking a long time to ignite. During this time they smoke extensively. Also, the use of cowdung as fuel rather than as fertilizer may mean decreased soil productivity.

Changing Cooking Practices

Cooking less often is an increasingly common strategy to minimize fuel use. What this usually means is that where once a family could expect two or three hot meals a day, this is reduced to one or two. Food cooked in the morning stored without refrigeration until the evening is susceptible to contamination by bacteria and fungus. Ingestion of bacterial and fungal growths can be the cause of severe gastrointestinal illness. (Braakman, 1996).

Another strategy is cooking for shorter periods of time, which often leads to substantial declines in nutritional levels, as many of the staple foods consumed in poor households, such as rice, beans and cassava, cannot easily be digested without prolonged cooking (ibid.).

Diets may be changed in order to save fuel. More and more raw foods can be introduced into the menu. In Sri Lanka, where rice is the staple food, many poor landless families are gradually replacing at least one of their rice meals with bread. In this case the bread is made from white flour with a lower nutritional content than the traditional rice dish (ibid.). Or in other cases less water is boiled. Such changes lead to higher susceptibility to diseases and, in the case of unboiled water, more and more serious gastrointestinal diseases such as diarrhoea and decreased personal hygiene.

Finally, where biomass is commonly gathered for livestock fodder, shortages mean that domestic animals are given up (such as has been reported in Africa) and a source of protein disappears from the subsistence economy (ibid.)

Sacrificing Other Functions of the Stove

In cooler regions, less fuelwood will be used for space heating and heating water for bathing purposes. This means negative hygienic and health consequences, especially for the elderly and sick. Household industries such as food processing represent one of the few opportunities for women to earn cash income for their families. Since cooking

meals takes precedence, in times of biomass scarcity such small-scale industries are the first to be sacrificed. With this, women's control over income is also sacrificed. Since women, more than men, use their money to benefit their family, this can also bring negative health effects.

Buying Fuel

A change from fuel collection to fuel purchasing means an added living expense and less control over fuel as a resource. Whereas biomass and other forest products may have provided a limited source of cash, especially for landless families, a switch to fuel purchasing means that other added income is also lost.

Transportation

While the International Labour Organization (ILO) regards 20 kg as the maximum permissible weight to be carried, women often carry loads of up to 35 kg over long distances.

Combustion

Combustion of biomass produces harmful emissions. Proximity to the source of emissions, and frequency of starting a fire (when emissions are highest) are the most important factors governing the concentrations inhaled (Smith, 1996). The ventilation of the space where combustion takes place, often the kitchen, is also important. Those most vulnerable to the health impacts of indoor smoke emissions are women – who are responsible for cooking and are in the kitchen for the longest periods of time – and their small children, who spend most of their time at their mothers' sides.

Biomass smoke contains respirable particulates, carbon monoxide (CO), nitrogen oxides, formaldehyde, and hundreds of other simple and complex organic compounds. In many parts of Asia, these pollutants are released from stoves in fairly unventilated homes or in enclosed courtyards. As has been shown in a growing number of air pollution monitoring studies, the resulting human exposures to the pollutants often exceed recommended World Health Organization (WHO) limits by factors of 10, 20 or more (Smith, 1987; Pandey et al., 1989).

Because of these high concentrations, and the large population involved, the total human exposure to pollutants is much more substantial in the homes of the poor in developing countries than in the outdoor air of the cities in the developed world, which has received the vast majority of attention in the form of air pollution research and control efforts. What health consequences does this pollution bring?

Acute Respiratory Infection (ARI)

ARI is one of the two top killers of children in developing countries. At five million deaths per year, in many developing communities it is the primary cause of infant death. Some studies have been conducted on the relationship between indoor air pollution and ARI. One of the most interesting studies was carried out in Nepal, where 250 children under one year of age were examined each week for six months. A strong relationship was found between the maternally reported number of hours per day the children stayed by the fire and the incidence of moderate and severe ARI cases.

Adverse Pregnancy Outcomes

Women are more biologically sensitive to carbon monoxide (CO) emissions. During pregnancy, excessive or prolonged exposure represents an even more significant hazard. CO interference with the oxygen-carrying capacity of the blood contributes to increased rates of low birthweight or stillbirths. Foetuses are extremely sensitive to CO, as it remains longer in foetal blood than in maternal blood. Depending on the frequency of meal preparation or other stove-related activities performed by women, CO may not have left the foetal blood before it starts accumulating again in the next cooking session (Smith, 1996).

Low birthweight, a chronic problem in developing countries, is associated with a number of health problems in early infancy, as well as other negative outcomes such as neonatal death. Several risks are associated with low birthweight, most notably poor nutrition. Since active smoking by the mother during pregnancy is a known risk factor, there is also cause to suspect biomass smoke, as it contains many of the same pollutants. Under particular suspicion is CO. Studies in India showed that women cooking with biomass had substantial amounts of carbon monoxide in their blood and had almost 50 per cent greater chance of stillbirth (Mvalankar, 1991).

Chronic Obstructive Lung Disease (COLD) and Cor Pulmonale

Chronic obstructive lung disease, for which tobacco smoking is now the major risk factor in the developed countries, is known to result from excessive air pollution exposure. It is difficult to find conclusive evidence of a direct causal relationship, because the exposures which cause the illness occur many years before the symptoms are seen.

In Thailand, most food vendors are women

Nevertheless, several studies have shown that non-smoking women who have cooked on biomass stoves for many years exhibit a higher prevalence of this condition than women who have had less contact with biomass stoves. Indeed, in an area of rural Nepal, nearly 15 per cent of non-smoking women had chronic bronchitis, a high rate for non-smokers. *Cor pulmonale* (right-side heart failure) has been found to be prevalent and to develop earlier than average in non-smoking women who cook with biomass in India and Nepal (Pandey et al., 1988).

Cancer

Because cancer usually takes many years after exposure to develop, the relationship between the use of biomass and the risks of cancer is not yet clear. It is known that many chemicals in biomass smoke are found in mixtures known to cause cancer. On the other hand, some of the lowest lung cancer rates in the world are found in non-smoking women in developing countries. Nevertheless, a study in Japan found that women cooking with straw or woodfuel when they were 30 years old had an 80 per cent greater chance of having lung cancer in later life.

Many studies of air pollution levels and health impacts of cooking with coal on open stoves are published in China. A range of effects are found, including strong associations with lung cancer. In summary, there is growing scientific evidence to support the numerous anecdotal accounts relating high biomass smoke levels to important health effects. More research is sorely needed, however, before meaningful quantitative estimates can be made of how much ill-health would be reduced by smoke-reducing activities such as the introduction of improved stoves.

Kitchen and Stove

Dependence on biomass is only one factor which determines the severity and frequency of the health effects outlined above; it can't be said that biomass fuel is solely responsible. In reality, we can't stop at the fuel cycle, we must look further into the stove used, and the kitchen where it is used.

The kitchen has been called the engine of the household. It is where most of a household's energy is consumed. Not only that, but the kitchen is a multi-functional space, where cooking, dining, resting, sleeping, family gathering, small-scale industry, drying crops and fuel, storage of fuel and food and sheltering domestic animals such as cows, goats or chickens, can all occur.

The use of biomass within the kitchen environment is also related to the following health problems:

Movement and Ergonomic Problems

A poorly laid-out kitchen means added stress and strain on the body, and fatigue. Poor positioning of furnishings such as the stove means ergonomic stress on the body, which often leads to arthritis and degenerative bone diseases.

Safety Problems

Poor lighting in the kitchen may lead to cuts and falls, in addition to eye irritation.

Hygiene Problems

A damp kitchen environment encourages the growth of mould. For Asian countries, where humidity can be very high, moulds can be a big problem. Many moulds are allergenic and a food supply for house mites which are in themselves potential allergens. Prolonged exposure to such allergens leads to respiratory diseases such as bronchial asthma, skin diseases, gastrointestinal allergies and allergic conjunctivitis. Mycotoxins ingested through eating food containing moulds are highly toxic and should not be used in family housing (Smith, 1996).

As has been seen, various health hazards are related to biomass use. Women are the first and most direct victims, but eventually this is followed by deteriorating health for children and other members of the family.

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Table 1: Emissions from traditional stoves in grammes per kg dry fuel used

Fuel	n	Carbon Content %	CO_2	CO	CH_4	TNMOC	TSP
LPG	2	87	3190	25	0.01	3	0.10
Kerosene	7	86	3050	39	0.90	14	3.00
Charcoal	6	80	2570	210	7.80	4	1.70
Wood	9	50	1620	99	9.00	12	2.00

TNMOC = Total Non-methane Organic Compounds; TSP = Total suspended particles; n = Number of data points

Source: Smith et al., 1992

Table 2: Adverse health effects and emissions of stoves relative to traditional wood stoves

Fuel	ηst.	CO	CH_4	TNMOC	RSP	Health
LPG stove	0.70	0.02	neg.	0.02	0.01	0.01
Kerosene stove	0.50	0.05	0.01	0.13	0.17	0.16
Charcoal stove	0.30	0.73	0.30	0.10	0.25	0.22
Improved wood stove	0.25	0.20	0.20	0.20	0.20	0.20
Traditional wood stove	0.15	1.00	1.00	1.00	1.00	1.00

ηst. = overall stove efficiency

Source: ibid.

Reducing Emissions from Stoves

Auke Koopmans

Over the last two decades, improved stove designs have been introduced in several countries for a variety of reasons. While at the start most of the improved designs were introduced solely for their fuel-saving capacities, this has changed over time and present stove programmes often have many additional objectives, e.g. reducing smoke, saving money and time, improving the status of women, generating jobs and income, and environmental considerations.

While all of these objectives are important, the reduction of smoke seems to stand out, as it has many positive side effects, such as improved living/working conditions and improved health. At the same time, improving the combustion characteristics of the stove, which reduces the smoke produced, also has positive environmental effects. It is generally believed that smoke pollution from wood and other biomass fuels is only felt locally, i.e. in the kitchen, and that there are no global implications. This is based on the fact that, if wood or other biomass fuels are managed sustainably, the same amount of carbon being burnt is taken up by new growth, making the net contribution to the greenhouse effect zero.

However, in practice, the burning of biomass often releases other substances besides CO_2: products of incomplete combustion, or PICs. Measurements in homes around the world have shown that health-impairing concentrations of PICs are often found when people use wood or other biomass for cooking or heating in poorly ventilated spaces (Smith, 1987). And we should remember that cooks, who are mainly women and children, are after farm workers the second largest occupational group in the world.

A small study carried out in Manila measured emissions from stoves of more than 80 greenhouse-related and health-related gases (mostly non-methane hydrocarbons, NMHCs). The tests included traditional cookstoves burning wood, charcoal, kerosene and liquefied petroleum gas (LPG), which together account for the majority of cooking in developing countries. Although only a few stove/fuel combinations were included, with the result that no statistically valid conclusions can be drawn, the measurements shown in Table 1 (page 10) are quite suggestive.

The PICs have many negative effects. Most, in particular TNMOC, CO and CH_4, have a greater global warming potential than CO_2. There are also negative health impacts. Add to these the fact that, as the name suggests, the presence of PICs means that more heat could have been produced from the same amount of fuel. Clearly, reducing PICs would have many beneficial effects.

Assuming eating habits do not change and people are well versed in the operation of their stoves, there are basically two ways to reduce PIC emissions from biomass-fired cookstoves: change the fuel or change the stove. The Manila study indicates that a switch to LPG and kerosene could have a positive effect. This would mean encouraging people to move up the energy ladder sooner than they otherwise might, which could be achieved via fuel and stove pricing or other means of making new stove/fuel combinations relatively more attractive.

Based on the results of the Manila study, the effects on health and the global environment of alternative fuels and stoves have been calculated relative to traditional wood stoves, as shown in Table 2. This indicates that fuel switching has positive effects. From a health standpoint, a shift from wood to LPG reduces the overall health impact by a factor of 100. Likewise, a shift to kerosene results in a reduction by a factor of six. A charcoal stove results in an improvement by a factor of more than four. These fuels would also have positive effects on the global environment, judging by the reduction in PICs relative to wood.

The same table also shows that improved wood-burning stoves have a distinct advantage over traditional wood burning stoves, both with regard to health and to the global environment. Improved stoves use 40 per cent less fuel (25 per cent versus 15 per cent efficiency) and release fewer PICs. With regard to the latter, it is important to recognize that the overall stove efficiency, hst, is a function of two internal efficiencies: the combustion efficiency, hcmb, which is the amount of chemical energy in the fuel that is converted to heat; and the heat-transfer efficiency, hhte, which is the amount of heat that reaches the food cooked on a stove. In general, emissions of PICs and CO_2 from a stove are an inverse function of overall efficiency: all else being equal, the less fuel used for a given cooking task, the less PICs will be released.

However, changes in stove operation and design can affect both internal efficiencies. In particular, heat transfer efficiency can be increased at the expense of combustion efficiency. For example, a popular way of reducing fuel consumption of traditional cookstoves is to reduce the airflow by enclosing the fire. This increases the heat transfer efficiency to the pot, but may lower combustion efficiency. Thus, improvements in stove design and use can reduce fuel utilization, and so reduce CO_2 emissions, but may at the same time relatively increase PIC emissions, and with them, increase adverse health and environmental impacts.

From the above it is thus clear that while improved stoves may have obvious benefits, the same improvements may also produce hidden negative impacts due to increased emissions. At the same time, it is also clear that much more work will be required to validate the results of the Manila study and to get a better understanding of the interaction of the two internal efficiency factors.

(references on next page)

The Fuel Ladder, Stoves and Health

W S Hulscher

A common concept in household energy analysis is the 'fuel ladder'. The concept implies that with socio-economic development, the fuel used by a household will change. To the fuel-users concerned, the top of the ladder looks more attractive, which can mean more convenient, more prestigious, more modern, more efficient, or more of some other preferred quality. For instance, in South Asia, climbing the fuel ladder generally means stepping up from dungcakes to crop residues, wood, kerosene and gas, finally to electricity. In many parts of South-East Asia, charcoal has a place on the ladder, and that very high, even at the top. Climbing up the fuel ladder also implies climbing up a health ladder, given present technologies for stoves and combustion commonly in use in Asia. Generally, wood does not cause as much smoke as crop residues or dungcakes, and gas and electricity do not cause smoke in the kitchen at all.

Various factors will determine whether or not the household is able to move up its preferred ladder. The main factors (as were documented by Gerald Leach as long ago as 1987), are household income and size, availability and cost of the fuels, availability and cost of the required appliances, climatic factors, settlement size, and culture and tradition. These factors may be easy to label, but they hide a variety of user-specific values and judgements which often remain implicit. Users make their own choices based on their own perceptions with regard to fuels, stoves, kitchens and related issues.

A few examples from stove programmes may illustrate the point. In urban Sri Lanka, an improved woodstove could not successfully diffuse until the stove was modified in such a way that the buyer could carry it home from the market with one hand only, leaving the other hand free to carry other shopping. At Lombok, Indonesia, an improved stove had two potholes located behind each other, but the women would accept it only when the two potholes were placed next to each other, as they were used to. In Cambodia, many households want a shallow structure attached to the stove so as to contain the ashes from the fire in order to keep the kitchen clean. And in Bhutan, people prefer wet wood for space heating during the night, because 'it burns longer', which means the user does not need to wake up to tend the fire.

Fuel users generally do not perceive health effects as being related to cooking practices. For this reason, health aspects are not naturally part of their considerations in choosing, accepting or simply sticking to a particular fuel or stove. In India, an essential component of the improved *chula* programme is the chimney for healthier working conditions in the kitchen. However, users' acceptance has proven not to be as good as the programme designers would have wished. Probably, there are simply too many factors influencing the users. Some of these factors are not even known or well understood, while others are beyond the range of interventions as formulated in the programme.

Unfortunately, many of the factors which determine the ability to climb up the ladder are largely beyond the scope of specific energy development programmes. Among these are household income and size, climate, settlement size and – let's be realistic – culture and tradition to a large extent. Traditions change slowly, over much longer time periods than any development project has, and cultural aspects are functions within a much broader horizon. What are at least partly within the scope of wood energy development are the availability and cost of fuels and the introduction, design and dissemination of improved appliances. Developing wood energy resources can help people to move away from inferior fuels, and the improved appliances which could be introduced include stoves which are more convenient, more efficient and above all more healthy.

However, in order to be more effective on the domestic health scene, wood energy development should go along with programmes aimed at increasing appreciation amongst stove users of the adverse health effects of present combustion practices.

In the 1980s, it was still believed that nationwide energy transitions away from wood and biomass were an option in developing countries. We now know that that is not realistic for the larger part of Asia's population. Even climbing up the fuel ladder is feasible only for limited parts of the population. In the domestic sector, every effort should be made to improve health conditions. This will need policies and interventions which are coordinated amongst at least the public health sector, extensionists, educationalists and energy technologists. Several experiences have shown that an isolated project, focusing on stoves or fuels only, can hardly be effective in the longer term.

(from previous page)

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Gender Training Workshop, Kanchanaburi, Thailand

The end of October last year saw a sub-regional training workshop on the topic of Wood Energy, Women and Health, the first regional forum to discuss the effects of woodfuel use on women's health and the second sub-regional training workshop on the issue of gender in wood energy organized by the RWEDP. The workshop, in Kanchanaburi, Thailand, brought together government specialists in the forestry, energy and health sectors from nine countries, along with several NGO representatives and specialist resource persons, in order to raise awareness and understanding of this important subject, which affects millions of women and children but is just beginning to gain international attention. The countries represented were: China, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand, Vietnam and Cambodia.

Women were well represented at the workshop, making up 14 of the 24 participants. In order to get an idea of the participants' pre-training knowledge and perceptions of the topic, a brief questionnaire was filled out early on in the workshop. All the delegations made presentations about biomass fuel use and related health issues in their respective countries, from which it was clear that biomass fuels are widely used and that the health issues are not sufficiently well understood or researched in any of the countries represented.

The inaugural address of the workshop was delivered by Mr P Tesha, Chief of FAO-RAPR, who emphasized the economic, social and environmental importance of woodfuels. Dr Hulscher of the RWEDP explained the rationale behind the workshop and then outlined the major health risks in different stages of the woodfuel cycle.

The keynote address was delivered by Dr Pandey, a prominent cardiologist from Nepal who is one of the world's leading researchers in the field of the health impacts of domestic biomass fuel use. He stressed the importance of addressing the problems of indoor smoke pollution, and presented evidence that women and children are the main victims of health problems caused by smoke, asking whether it was due to the low political and economic status of women that this widespread problem receives so little attention. Dr Pandey stressed the importance of adequate interventions to secure better working conditions for cooks and better space-heating practices; and pointed out that improved stoves and better-designed kitchens, not just fuel-switching, could substantially reduce the adverse health impacts of smoke emissions from woodfuel use.

Delegates Statement from the Workshop

The delegates from the RWEDP member countries in South-east Asia, meeting at Kanchanaburi, Thailand in October 1996, having considered current practices concerning wood and other biomass fuels in households in the region, conclude that many of such practices have widespread adverse health impacts, particularly for women and children. The delegates recommend that health departments in their respective countries bring these problems to the attention of the World Health Organization and strengthen joint efforts to improve the situation.

Christina Aristanti discussed the nature of kitchens and their design in the region, and pointed out that they are generally poorly ventilated and dingy. In a second paper, Dr Pandey discussed in detail the main health effects of woodfuel use. Dr Dev Nathan set out the concepts of gender analysis and the main gender analysis tools. He also discussed the nature of the household, variations in household decision-making structures and the importance of decision-making by women. He pointed out that the low value given to women's labour meant that household cash was generally not spent on reducing it, and argued that this was an important factor retarding the spread of improved stoves. The various gender analysis tools were applied in a kitchen exercise, based on a case study from Indonesia conducted by Ms Aristanti. She highlighted the role of cultural factors in the design of stoves and kitchens, showing that successful interventions need to take account of the cultural factors and involve women in the design of both improved stoves and better kitchens. The papers led on to lively discussion, and stimulated the delegates to prepare actions plans for follow-ups in their own countries (see centre pages). Many stressed that they would like to organize national workshops, and sought the RWEDP's help in providing materials for conducting such workshops. Participants were invited to review the draft of a module on Gender Issues in Wood Energy, which the RWEDP is preparing. They suggested that it should contain more material on women's health issues related to woodfuel use, a good indication of the workshop's success. Finally, the participants unanimously adopted a statement particularly addressing the health sector (see box, above left).

Special credit is due to the advisory group which assisted the RWEDP in developing the concepts of the workshop, comprising of Dr Pandey; Dr Govind Kelkar of the Asian Institute of Technology, Thailand; Dr Choo Yuen May of the Palm Oil Research Institute, Malaysia; and Dr Revathi Balakrishnan, WID Officer at FAO-RAPA.

A report on the workshop will be available from the RWEDP.

Overleaf: Country action plans drawn up by delegates at the Kanchanaburi Gender Training Workshop

Country Action Plans Drawn up by Delegates at the Kanchanaburi

Country	Objective	Actors to be involved
Cambodia	To raise awareness among the people of the impact of kitchen pollution on health; and to persuade women to use new stoves: less biomass, less smoke.	MoH, MoAFF, MoR, MoWA, NGOs, International Organizations.
China	To identify the impacts of fuelwood afforestation, stove improvements, women's participation in existing projects and health; to formulate promotion measures to encourage women's participation in wood energy projects; and to integrate the results of case studies in an ongoing wood energy project.	International: FAO/RWEDP, for technical backstopping. National: MoF, MoA, MoH and National Women's Federation, for coordination and supervision; CAAERP and CAF for implementation. Local: farmers, rural energy office of the country, forest bureaus, women's unions and health bureaus.
Indonesia	To identify rural household energy consumption patterns; identify and analyze role of women in relation to wood energy activities; and identify and analyze the impacts of energy use on health and environment.	Directorate General of Electricity and Energy Development, Ministry of Forestry, Ministry of Home Affairs, local government and the local community.
Laos	To decrease mortality in children and women, and women's drudgery.	Dept. of Hygiene and Prevention, MoPH; Dept. of Agriculture and Forestry, MAF; Lao Women's Union; and foreign agencies through cooperation.
Myanmar	To improve health conditions of women and children; to take measures on medical problems in the woodfuel cycle; and to educate women and children in the rural grass-roots.	DoH personnel; village administrative organs; elders; VLORC; monks; NGOs: Red Cross, Solidarity and Development Association, and Maternity and Child Welfare Association; and departments concerned with training and workshops, e.g. Forestry Dept; Education Dept.
Malaysia	R&D/awareness: to investigate and raise awareness of impacts on women's and children's health from biomass-based industries. Dissemination: to improve women's and children's health through training, workshops, publications, publicity etc.	Forestry, Energy, Health, Education and Human Resources departments; rural development agencies; NGOs; etc.
Philippines	To raise awareness and promote appreciation of the importance of gender and health considerations in the national wood and biomass energy programme.	National Wood Energy Committee (DOE, DENR, DA, DAR, DOST); DECS and ACADEME; DOE; GAD; focal points/NCRFW; DOH; and media.
Thailand	To manage natural resources in CF sustainably; to generate income for the communities; and to enhance organization of the people.	Gos: RFD, DEDP, DoH, RECOFTC; NGOs: PDA, WFT; and NEPO.
Vietnam	Helping the people to understand the interrelationships between: fuelwood development and women's health; the important role and responsibilities of women in sustainable woodfuel development; and the impacts on women's health from using fuelwood and other biomass resources.	Institute of Energy; Ministry of Agriculture and Rural Development; Ministry of Health; Women's Association; Hanoi Architectural Inst.; and Ministry of Science, Technology and Environment.

Gender Training Workshop, 28 October to 1 November 1996

Strategy	Action to be taken	Means and Resources
Assessment; extension; and training.	Assessment: survey, PRA; extension: introduce new stoves, discussion meetings, broadcasts, posters, and pamphlets; and training: stove enterprise and health workers.	Extension workers in health, agriculture, community development; community clinics; local stove enterprise (clay); and international agencies.
Improving coordination between and seeking support from different sectors; pay information suppliers, especially women, in order to encourage their participation; increasing opportunities for women to gain access to training and community activities; and involving more women in wood energy project planning and decision making.	1. General review of country situation: social, economic, culture and natural resources. 2. Identification of villages for case study. 3. Questionnaires to each household: cultivated land, income, division of labour etc. 4. Sampling survey of households: fuel, stove, role of women, health. 5. Analysis and modelling. 6. Report. 7. Introduce results of study to existing wood energy project as a follow-up.	Human resources: project officials, technical experts, consultants (international, and national), and farmers. Financial resources: FAO/RWEDP, other donors, and national counterpart fund.
Approaches to relevant institutions; gathering of primary data; and gathering of secondary data .	1. Determination of methodology: training, questionnaire etc.. 2. Selection and determination of samples. 3. Approach to local government. 4. Field observations. 5. Data collection. 6. Data processing and analysis. 7. Reporting.	Regional data and statistics; government funds; and the Local Government Development Programme
Committee to support network project at various levels; training on concept, planning and management for staff responsible; sampling survey of households; and organizing training and meetings for the people.	First year: project implemented in two pilot districts in two provinces; Second year: expand to other provinces.	Finance from government; cooperation with foreign projects; popular participation; technical: from government; raised awareness in rural areas; and extension staff.
1. Meeting with authorities concerned. 2. Village-level workshops (stove handling, placement, use and storage of biomass, healthy kitchen etc.). 3. Meetings with women and children (ask about diseases, sickness, difficulties, problems to solve and overcome).	Disseminate and distribute improved stoves and methods; distribute medicine and first aid boxes; women need breathing exercises for respiratory tract infection; meetings according to situation; five-day workshops every two months; and first aid training for trauma, burns, scalds, snake-bite etc.	Popular participation; medicine, aid first aid boxes; training materials; incentives – subsidies if possible; extension facilities; finance; and support from organizations like WHO, FAO, RWEDP and UNICEF.
Dissemination of avilable information through the media, Information Ministry workshops and training seminars; initiating R&D efforts; and awareness compaigns.	Survey; collection of data; data analysis; dissemination of results; raise awareness and maybe adopt a village as model; dissemination of information through training seminars, workshops (technical and non-technical). Time: two to three years.	Govt: Finance, logistics, access, dissemination of information; NGOs: publicity, awareness; and RWEDP/ international agencies: information, finance, training etc.. Financial requirement: US$ 250,000 per year.
Dissemination of information at national, regional and provincial levels, through: meetings, seminars/workshops, and consultations/dialogues.	1. Convene NWEC/NWEG and DOH to discuss proceedings of sub-regional workshop on wood energy, women and health. 2. Issue policy statement at NWEC level on need for information dissemination. 3. Encourage NGOs to join in information dissemination. Time: 1997	Budget requirements by implementing agencies/NGOs; Gender and Development focal point allocations may be tapped; government and NGO personnel to be involved; information materials from the media.
Integrating gender in all activities under the project.	1. Select target area. 2. Meetings and training courses on gender in project cycle, sustainable natural resource management, wood energy, women and health, marketing of NTTFP, etc.. 3. Monitoring and evaluation. 4. Reports.	For budget: FAO and NEPO; for budget, personnel, equipment etc.: RFD, DEDP, DOH, RECOFTC.
Involving the entire community; and encouraging women to participate in wood energy development (planning, dissemination, improved stoves).	Distribution information to all actors; national training workshops on Gender and Woodfuel Development; surveys; data collection and processing; gender analysis; developing improved stoves; social, economic and environment studies; projects; dissemination of improved cookstoves in a few rural villages; sample rural energy planning for a few districts with large household biomass energy use; and small plantation project.	Human resources: institutional staff, technicians, local committees. Finance: Gos, NGOs, FAO, ACCT and SIDA.

Economic Factors in the Adoption of Improved Stoves

Dev Nathan

Indoor air pollution due to the burning of biomass fuels has been shown to be an important factor increasing the prevalence of acute respiratory infections in infants and children, and chronic obstructive lung disease (COLD), often leading to heart damage (*cor pulmonale*), in adult women. Studies undertaken by Dr M R Pandey and his colleagues (1996) also show that exposure to harmful indoor air pollutants, and thus the morbidity and mortality it can cause, could be significantly reduced by installation and use of improved stoves.

Improved stove programmes have rarely had an explicit health focus. The exception is, perhaps, the early Indian smokeless *chula* programme. Improved stove programmes have almost all been promoted in order to reduce the use of wood for fuel and thus reduce deforestation. But these programmes have met with varied success. China is the main success story. By 1991, some 150 million, or 70 per cent, of farm households in China had adopted improved stoves sold to them at commercial prices. In India, on the other hand, only about 15 per cent of farm households had adopted improved stoves by 1992, even though the improved stoves were offered at highly subsidized prices.

Why is there such a marked difference in the performances of China and India in the dissemination of improved stoves? In examining this question, we will look at the role of economic factors, in particular the lack of value generally placed on women's labour, in affecting the rate of dissemination of a technology that would benefit women by reducing the labour time they spend in gathering and using wood as fuel, and have significant health benefits both for women and for infants and children who spend a lot of time around their mothers.

In considering the various factors in household energy use (as, for instance, in Kirk Smith et al., 1992), the most important is held to be the level of household income. This, according to the above-mentioned article, explains China's relative success in disseminating the 150 million improved stoves, while India has managed little more than a tenth of that number. From such an analysis would follow the policy prescription that a key factor in the adoption of improved stoves or in moving up the "energy ladder" (i.e. moving from the non-commercial to commercial fuels) would be an increase in household incomes.

"The transition away from reliance on collected wood as a fuel and toward increased purchase of commercial (often fossil) fuels tends to occur as people's standards of living improve." (Smith et al., 1992)

The question we need to ask is whether the model of the household as a unit possessing a certain aggregate amount of resources, land, labour and capital is sufficient to explain the nature of woodfuel demand and supply. Or do we need to carry out a gender analysis of labour availability in the farm household in order to understand the woodfuel market? The point is not to introduce gender for the sake of complexity – complexity is not a virtue if it does not increase explanatory power – let us just see what difference is made by a gender disaggregation of the farm family's labour availability. Table 3 highlights the imbalance in domestic labour time between the genders in four developing countries.

Significance of Differences in Urban and Rural Patterns

Rural use of woodfuel differs significantly from urban use. In urban areas, it is a commodity, sold and purchased on the market. There is very little collection of wood for self-use. Consequently, in urban areas, woodfuel is compared with all other fuels, and its sale and purchase are subject to the same forces as the supply and demand of other fuels.

In the rural situation, on the other hand, woodfuel is not produced as a commodity (i.e. it is not produced for sale). It is largely collected by farm households for self-consumption. A study in Pakistan (Ouerghi, 1993, 71) showed that 69 per cent of woodfuel was collected and therefore considered financially free.

What the rural household expends is labour time in collecting the woodfuel. Thus it is through the labour necessary for appropriation and processing that wood as energy relates to the rest of the farm economy. But not all labour time is valued in the same way. There is first of all a distinction between the technical concept of *effort* (or energy expended) and the economic concept of *work*. For instance, the effort involved in childcare or healthcare is not regarded as work, but as a service: a service performed by a woman for her family.

But a distinction does exist between work that provides or brings in cash income and work which does not. A notion also exists of the other earnings possible with the available labour time: the opportunity cost of labour in terms of alternatives forgone.

What empirical studies do show is that the collection, processing and use of woodfuel are largely activities undertaken by women and, to an extent, by children. Men, on the other hand, tend to dominate in waged and other monetary income-earning work. There are some differences in this pattern, as will be discussed later, but even in matrilineal communities like the Khasi in Northeast India or the Mosuo in Yunnan, China, men dominate the external economic sector, the sector involving cash relations. It is women's unwaged labour that is the main factor in the collection

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and use of woodfuel. Thus, the extent to which an attempt is made to economize on women's labour in woodfuel collection depends on the alternatives available for its use.

Opportunity Costs of Women's Unvalued Labour

The use of improved stoves is one example of a way of economizing on the labour of fuel collection, since less fuel is needed for their operation. For the farm household, it is not the fuel comparison that is important, but the labour comparison, and that the comparison of women's labour time. Will money really be spent in acquiring (or maintaining and subsequently replacing) an improved stove in order to economize on labour that does not produce monetary income (i.e. does not produce marketable goods and services), or where the saved labour cannot be used to produce such marketable goods and services? What would be the opportunity value of the improved stove, in terms of other income that could be earned or production that could be increased, if more commercial uses for that labour were available?

Regarding the role of women's income-earning opportunities in determining the adoption of labour-saving innovations like improved stoves, we can make an inter-country comparison: China's "best" rural areas, where the improved stove programme has been successful, have a high level of village-level industry and commercial production of livestock and vegetables. In these income-earning activities, there is substantial participation by women, which does not even fall during the child-bearing years. This high degree of participation by women in the income-earning labour force must be reflected in a strong drive to economize on their labour in fuel collection and use, resulting in the high rate of adoption of unsubsidized improved stoves.

In contrast, rural areas in India show low participation in money-earning activities by the women of farm households: "If women are involved in income-generating activities which will value their time and make it more profitable to purchase firewood than collect it, improved stoves will have higher chances of success. Households will be motivated to use more efficient stoves because of the direct financial impact." (Ouerghi, 1993).

Whether a farm household seeks greater efficiency in fuel use (an improvement which will cost some money) depends on the opportunity cost of labour in woodfuel collection and cooking. The lower the income or production lost by women spending more time in collecting, the less will be the incentive to adopt improved stoves, or to switch to more efficient commercial fuels.

The labour time we need to consider is not only that spent in collecting, but also that spent in cooking, including fuel preparation. As shown in Gerald Leach and Marcia Gowen (1987), rate of fuel collection can be converted into a monetary value, using the existing price of woodfuel, in order to give a cash measure of the opportunity cost of woodfuel collection. In a Mexican example cited by the authors, the rate of wood collection was 6.2 kg/hour, while the local market price of wood was Mn$3.00 per kg. This gives a "value" to woodfuel collection of Mn$18.60 per hour. The minimum labour wage was at that time Mn$27.50 per hour.

Obviously, *if employment were available*, it would be preferable to earn cash as a labourer and buy wood, rather than collect it. But the absence of adequate employment or other income-earning opportunities would mean that the above substitution would not take place. There would be no incentive to save labour time in collecting woodfuel or in cooking with it. This lack of incentive would almost certainly affect the farm household's decisions regarding use of improved stoves, regardless of the gender of the household's decision maker. If women have no alternative income-earning opportunities for the potential labour time saved by improved stoves, then even if they are the household decision makers (as they are in a number of matrilineal societies), they will not decide in favour of spending cash to acquire the improved stoves. This might explain why, even in matrilineal communities like those in eastern Bhutan, stove programmes have failed.

The above analysis of the effect of the lack of value placed on women's labour time holds good even for the labour of children, girls in particular. To the extent that the education of girls is not valued (which is at least somewhat, because they would leave the community and the investment in their education would be

Table 3: Women's greater workload

Activity		Number of hours spent in activity per day			
		Indonesia	**Burkina Faso**	**India**	**Nepal**
Firewood collection	*Women*	*0.09*	*0.10*	*0.65*	*2.37**
	Men	0.21	0.03	0.65	0.83*
Water hauling	*Women*	*0*	*0.63*	*1.23*	*0.67*
	Men	0	0	0.04	0.07
Food processing	*Women*	*2.72*	*2.02*	*1.42*	*0.70*
	Men	0.10	0.17	0.27	0.20
Cooking	*Women*	*-**	*2.35*	*3.65*	*2.10*
	Men	-*	0.01	0.03	0.38
Average total work per day	***Women***	***11.02***	***9.08***	***9.07***	***11.88***
	Men	**8.07**	**7.05**	**5.07**	**6.53**

* For Nepal, firewood collection includes grass and leaf fodder collection; for Indonesia, cooking is included in food processing
Source: E W Cecelski, *From Rio to Beijing*

lost to their own parental families), there would again be no pressure to economize on their labour, which also contributes to woodfuel collection.

From the above, it also follows that pressure to economize on woodfuel use would increase if women were to become more involved in money-earning activities, particularly those outside the homestead. Most of the activities reserved for women, either socially or in projects, tend to be physically located in and around the home. This results in a simple increase in the workload of women. The intensity of work increases, with more tasks having to be performed at the same time. On the other hand, if work taken up by women were of a type that took them outside the homestead, it is likely there would be greater pressure for economizing on their labour time.

This could be through the adoption of labour-saving innovations, or through men taking on some of the responsibility for child care (as is seen among some swiddening communities, where women and older children go to the swidden fields, leaving men and younger children at home), or even through more social provision of these necessary functions (as through childcare centres at Food for Work sites). And there would be a definite increase in the demand for labour-saving food-processing methods, to reduce time spent in collecting fuel and in cooking itself.

The above analysis holds for farm households that collect their own fuel. It does not hold for farm households that buy fuel or engage paid labour to collect it for them. These would also be households which attach considerations of prestige to not having "their women" working outside the homestead. At the same time, these are also the households that would have considerable crop residues and animal dung for use as fuel, more than would be needed as organic manure for the fields. The availability of other "free" – that is, unpriced – fuel sources would reduce the pressures for reducing fuel use, and there would be little pressure to reduce women's cooking time.

Even in households that collect their own fuel, a reduction in wood availability is not likely to trigger fuel substitution in favour of commercial fuels. Rather, as has been observed, the same free labour would be used to collect other "free" fuel sources, like shrubs, dung cakes and crop residues. "This [the availability of unvalued women's labour time] explains why fuelwood transition [to more efficient, modern fuels] is not linked to income level and is not happening in rural areas [in Pakistan]" (Ouerghi, 1993, p. 77).

The experience of improved stove programmes has repeatedly shown that subsidies lead to the adoption of the improvements only so long as the subsidies are in place. A sustained change in patterns of fuel use cannot depend on continuous subsidies. The expenditure pattern resulting from women's unpaid labour cannot be successfully changed by subsidies. What is required is change in the role of women's labour.

Thus, the primary emphasis in attempting to bring about an increase in fuel efficiency or in fuel switching should be on increasing the possibility of women's income-earning opportunities, and those outside the homestead. The experiences of both South Korea and China show that this is the main factor in inducing greater fuel efficiency or fuel substitution. This is not an intervention in what is regarded as "energy policy". But there in no *a priori* reason why an important effect on energy use should come from within what is considered the field of energy policy, which deals with the availability and price of different fuels. The availability and opportunity costs of different kinds of labour, of women and men, can be seen to have a major effect on the pattern of fuel use. Increasing women's income-earning labour relative to the amount of unpaid labour itself means a change in women's role in the household. This is a change in gender relations, and has further implications for other aspects of gender relations.

Discrimination in Provision of Leisure

But is the non-adoption of devices that save women's labour time only a reaction to its low opportunity cost? Even in the absence of increased income-earning opportunities, the possibility of increasing leisure still exists.

Given the fact that women routinely work a few hours more per day than men in most regions of the world, it seems clear that increasing women's leisure time is important. But then the factor of the gendered control of household income comes into the picture. If it is possible for some income to be spent on leisure, rather than in the expectation of a monetary return, then it is men's leisure time and related activities that are likely to be given priority. For instance, in a village of the Hani people in Yunnan, we observed that money was spent on acquiring cassette players, with which men could listen to music in their substantial leisure time, rather than in getting piped water or improved stoves, both of which would have reduced women's working hours.

What this means is that the sustained under-investment in devices that save women's labour time, which would also save fuel, is not only a function of the relatively low opportunity cost of women's labour time compared to that of men, but also of the systematic male bias in favour of their own leisure time over that of females.

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Woodfuel Interventions with a Gender Base

Dev Nathan

It is now well established that, in much of the developing world, wood energy is set to remain one of the prime energy sources, especially in poor rural communities. It is also well known that there are several problems associated with its collection and use as a household fuel. A number of options exist for interventions aimed at offsetting these problems, and as women are most often at risk from the adverse effects of woodfuel use, it makes sense that considerations of gender should be a major factor in the design of these interventions. This paper attempts to examine some of the options for interventions with a gender base.

One of the major concerns of wood energy policy has been to induce the adoption of more fuel-efficient stoves. These improved stoves, as the studies of Dr M R Pandey and his colleagues show [see Dr Pandey's article, p. 3), can also reduce indoor air pollution. Reducing this would have an impact on the incidence of acute respiratory infections in infants and children, and of chronic obstructive lung disease (COLD), which often leads to heart damage, in adult women. But how can we ensure that households actually adopt these fuel-saving and health-improving stoves?

Gender analysis has shown that economizing on woodfuel, which is largely a collected fuel, is a question of reducing the availability of the labour required for its collection. This labour is largely done by women and children, particularly girls. A gender-disaggregated analysis of household labour time leads to the conclusion that it is the availability or otherwise of women's unpaid labour time that is the crucial factor determining the extent to which a household economizes on woodfuel use. Rural patterns show that even where household income increases, without any reduction in the availability of women's unpaid labour there is unlikely to be a reduction in the use of woodfuel, either through the use of more fuel-efficient stoves or through moving to other fuels. Gender analysis has also shown that sustained under-investment in devices that save women's labour time is also partly a function of the systematic bias of male household heads in favour of their own leisure time over that of the women in the household.

Thus, the primary emphasis in policy to bring about an increase in fuel efficiency or in fuel switching should be on increasing opportunities for women to earn income, and those should be outside the household. Economic policy then needs to be directed towards increasing these opportunities.

Empirical evidence from many countries shows that income-generating activities controlled by women have a further desirable effect: they increase the proportion of income spent on both women and children, and thus have a greater impact on total household welfare than where additional income goes to the men. Thus, both in order to induce the adoption of more fuel-efficient stoves and to make a greater impact in poverty alleviation, the design and implementation of projects in the woodfuel sector need to target women as the main recipients of extra household income.

As well as being an essential household commodity, woodfuel is also a source on income for the rural poor, with women, as head-loaders, being the main workers in this sector. But the open-access state of forests means that the price of woodfuel is regulated only by the costs of extraction. This in turn leads to a very low income for the producers and encourages the over-exploitation of the resource. Secure property rights for the communities of the woodfuel producers would both encourage sustainable use of the forests and increase the incomes of forest-dwellers.

While securing the communities' rights, it is also necessary to see that women within them are represented on community committees and have relevant property rights. Given the general gender division of household responsibilities, where women have the primary responsibility of provisioning the household, the absence of women in decision-making at both community and household levels leads to a one-sided emphasis on certain types of wood investments, like timber in wood lots. In order to get a sustainable mix of activities that will increase productivity, it is necessary to take account of women's specific concern with quick and regular returns, and to enable women to participate in decision-making on these matters. This involves ownership of land and participation in village or user councils by women.

The move away from woodlots towards agro-forestry has brought a renewed international interest in home gardens, which are a repository of much knowledge in agro-forestry, and which are a special ecological niche of women. Along with the home garden, swidden is another area of multi-tier, multi-crop cultivation that is a "female farming system". Rather than start from the false position that men are the "farmers" and thus that they alone need to be consulted in any scientist-farmer interaction, it is necessary to investigate in each location the specific tasks that women and men perform, and thus give full scope to the knowledge that women and men have of the specific processes.

Micro-enterprises that use wood as fuel are largely operated by women. Little attention has been paid to their technological advancement, and this could form the basis of a set of interventions, specifically, the development of adequately scaled improved burners would probably reduce the labour time involved in processing many foods, such as fish, and could substantially increase productivity in these enterprises.

In addition, the provision of cleaner fuels needs to be adopted as a goal of energy policy so that women's and children's health will not be adversely affected by the various dirty fuels now widely used for domestic energy purposes, particularly in the rural areas of Asia.

A Stove Project with a Gender and Health Orientation: Bedugul, Indonesia

Christina Aristanti

The village of Bedugul is located about 10 km from the provincial capital city of Mataram on Lombok Island. It is less than five km from Swete, the largest market on Lombok. The village has 130 households. The entire population is of Sasak ethnicity and Islamic in religion. Houses are made of bamboo or bricks with thatched roofs. Floors are dirt or cement.

As with many volcano islands, Lombok has a wet and a dry side. Bedugul is on the wet side, and this part of Lombok is known for its abundance of water. Rivers, streams, irrigation canals, wells and springs abound. The rainy season is five months of the year. Due to this favorable condition and the rich black soil, it would be possible to harvest three rice crops each year; however, the government regulates farming activities, so that each year there are two rice crops and one dry crop. Dry crops in Bedugul include chilli pepper, corn, tobacco, soybean, cassava and other beans.

Over 75 per cent of the working population is involved in farming activities. A majority of families have a small amount of land, about a quarter of a hectare, and it is usually owned by the men. Many men and women work as farm labourers or tenants for those who own bigger plots of land. Although this work can be termed seasonal, because there are three crops a year, the off-season is very short.

Men commonly take care of ploughing, buying seeds, building fences and fertilizing. Women are responsible for harvesting dry crops and weeding. Both men and women are involved in planting, harvesting rice and processing the harvested crops. These roles are slightly flexible, as is the case when an older man harvests dry crops or a woman prepares land for planting. For these activities, labour is paid a daily wage or 1/11 of the crop they harvested. Tenants are paid with a third of the rice harvest and all of the dry crop harvest. Wages or money from selling surplus rice or dry crops are used to buy food and snacks, pay for schooling, medicine, household needs and clothing.

In general, daily household purchases are decided upon by women. Livestock and fowl are also important assets in this community, including cows, goats, chickens and ducks, which are raised at home. Men look after (i.e. collect fodder), and decide on the purchase and sale of, livestock. Both women and men tend fowl. Livestock and fowl provide fertilizer, cash income and food.

A few men and women run small shops. Collecting sand from the nearby riverbed is an available source of wages for men and women. A few men are wood workers, horse cart drivers or find labour work outside of the village.

Women are responsible for drawing water, most often from a well, and collecting biomass fuel. The biomass comes in the form of coconut leaves, dead soybean, tobacco, beans or chilli plants and dead wood, twigs and leaves gathered from the fields or yards. Depending on the time of year, biomass might be collected as often as every two days or every two weeks (after the tobacco, chilli or soybean harvests for example). There is also a person who sells fuelwood in Bedugul. A bunch of firewood of about 0.10 m^3 costs Rp 1,500 and can be used for two or three days There does not seem to be a scarcity of biomass fuel and collecting fuelwood takes from one to two hours for one bundle carried on the head.

Problems arise during the rainy season, when most biomass fuel is wet. At these times, some women turn to kerosene stoves, while most dry wood as best they can on racks above the stove. Women here like to use biomass if they need to cook quickly. They also enjoy the taste it imparts to the food.

Cooking meals—which is most commonly done twice a day for two hours a time—and chopping fuelwood are primarily done by women. Other daily chores, such as washing clothes at the well or river and caring for children, are also the work of women. General gender divisions of economic and reproductive responsibilities are included in Table 4.

There is a government primary school within walking distance and most children do attend, although they may not

Table 4: Responsibilities of the Bedugul men and women

Bedugul men	Bedugul women
Tending animals	Cooking twice a day (two hours a time)
Preparing fields for planting, ploughing	Washing clothes
Buying seeds	Drawing water from the well
Building fences	Care of children
Fertilizing fields	Gathering fuel
Planting	Shopping
Harvesting rice	Planting
Constructing/maintaining the house	Weeding
Processing of crops after harvest	Harvesting rice and dry crops
	Processing of crops after harvest

finish all six years. Horse carts provide transportation from the village to a main road where minibuses are available. Health provisions include a local healer trained by the government and a local health clinic about one km from the village. Common health conditions include diarrhoea and vomiting, fevers, colds and coughs. Radios and televisions are common in households. A water and sanitation project is currently being implemented.

Kitchen and Stove

Kitchens are often small side rooms, with no windows and hardly any ventilation. Walls are black with soot. Another common kitchen is actually a temporary shelter set up against the wall of the home, made from gunny sacks or bamboo. This second type of kitchen is actually better in terms of ventilation and lighting. If a new, more modern home is built, it will often not have a kitchen, but the kitchen will remain in the old dwelling. Women of Bedugul most often cook for between four and eight people, spending around four hours in their kitchens each day, most commonly cooking rice and vegetable side dishes. They cook in a crouching position or sitting on a small wooden stool.

The kitchen is also a place for storage of food stuffs (often hung from above). A rack above the stove takes advantage of the smoke to dry fuel, fish paste, salt, red chillis, corn etc. Most stoves in use in Bedugul are made by older women. The small stoves usually have two holes, with the fuel opening in between the holes, but there are also one-hole and three-hole models. The stoves can be made of mud or of bricks, also locally available, layered with mud. Stoves like this can also be ordered for around Rp 1,500. They last for a long time, as repairs are easily made by the local women themselves

Improved ceramic two-pothole cookstoves have been introduced to some families through a community member that works for an NGO in Mataram. The women complain that it is more difficult to control heat to one or the other hole, the stove burns rice very quickly and ash builds up in the combustion chamber. But they like the fact that it can be taken to the fields or moved around.

A Case Family

Ibu Lia and her husband have two children. They live next door to Lia's mother. Outside of the home, Lia works as a farm labourer. For example, when it is dry crop harvest time, she may work six hours picking chilli peppers. During one day she can pick 20 kg, bringing home Rp 100 for each kg, or Rp 2,000 for one day's work (less than US $1.00). She is paid by the land owner, who will then sell the same chilli peppers for Rp 700 per kilogram. While she is working in the fields, her mother watches the children. The usual structure of one of Lia's days during harvest time is given below in Table 5.

Table 5: A typical day for Lia during harvest time

Time	Activity
05.00–06.00	Wake up, bathe, bathe and dress children
06.00–08.00	Cook breakfast
08.00–08.30	Take breakfast to those already working in the fields, eat
08:30–13.00	Harvest chilli peppers
13.00–13:30	Eat lunch brought to field by mother
13:30–16.00	Harvest chilli peppers
16.00–17.00	Return home, bathe, bathe the children, rest and visit
17.00–19.00	Cook dinner
19.00–20.00	Eat dinner
20.00–22.00	Wash dishes, wash clothes
22.00	Go to bed

Ibu Lia and her mother collect firewood from their local environment and fields two times a week. Fuel is stored under the eaves at the back of the mother's house. They do not have kerosene stoves and during the wet season Ibu Lia or her mother chop up biomass/ wood into smaller pieces to afford faster drying on the racks above the stove. If they buy fuelwood, for example during the rainy season, they spend about Rp 500 a day.

Kitchen and Stove

Lia uses a small side room with very little lighting and ventilation as a kitchen. The walls are covered with soot. Lia's mother's kitchen is on a raised dirt porch in front of the two bedroom home. The home has a thatched roof and brick walls with a dirt floor. The kitchen is blocked off on two sides by gunny sacks and bamboo. The roof over the porch of the house acts as the kitchen roof. In some ways this is a more ideal situation than that of Lia. At least in her mother's case, smoke easily leaves the cook's working space and the lighting is good.

The space in each kitchen is just enough for one of the women to cook. Preparation of food for cooking takes place outside on the porch, with water from a bucket. Waste water is thrown into the yard. Drying of dishes is done on a bamboo table placed out in the yard. Ibu Lia and her mother use a two-pothole mud stove made by her mother.

Actually, they have tried using the improved ceramic cookstove experimentally introduced. They complain that it is hard to control heat between the potholes, that the stove burns rice very quickly and ash builds up very quickly in the combustion chamber. However, they do admit that the improved ceramic stove produces less smoke and heats faster.

When asked about beliefs connected to the kitchen, Pak Kamil tells of earlier times when his grandmother's stove faced east. Although no longer a very common practice, *sirih* is still used by some to consecrate the stove upon its first use.

Forests for Life - A Reaction from WWF

On page 15 of the last issue of *Wood Energy News* (Vol. 11, No. 3), which focused on 'Wood Energy and Environment', RWEDP made some critical comments on *Forests For Life*, a WWF/IUCN forest policy book published in 1996. RWEDP's comments implied that (i) worldwide, woodfuel collection cannot be looked at as a major cause of deforestation, (ii) since 1990, substantial and relevant evidence has been collected on this matter in Asia, and (iii) information from Africa does not necessarily apply to Asia, which is home to some two billion woodfuel users, by far the largest number in the world.

RWEDP was grateful to receive a reaction from Nigel Dudley, on behalf of WWF, of which the following is an excerpt:

"Thanks for taking the trouble to comment in such depth. It was certainly not our intention to suggest that fuelwood collection was a major cause of deforestation – and indeed we stress with reference to the work of Leach and Mearns that its importance has often been exaggerated in the past. However, we believe that it is an important cause of forest degradation in some areas (and deforestation in selected places where a significant trade in timber fuel exists as the UNRISD work points out for parts of Central America). One of the underlying points of the book was that forest quality can be as important as quantity from an environmental perspective, and this may be particularly relevant to the Asian region. If you received a contrary impression from the text then I apologize.

"I would agree that logging is of greater importance overall. This is examined in more detail in a recent book from WWF – *Bad Harvest?* – which argues that on a global scale, the greatest threat to those forests which are richest in biodiversity now comes from logging."

Mr Dudley appends the following extract from the 1992 book *Forests in Trouble*, published by WWF:

"Woodfuel shortages have long been a controversial environmental issue and have been the cause of many aid programmes and funding. However, there have been serious mistakes made in both estimations of the scale of the problem and in proposals for solutions. Shortage of woodfuel was identified as a major global crisis by several development agencies and international organizations in the early 1980s, and considerable efforts were made to find ways to tackle these problems. However, some of the early pronouncements about woodfuel use are now acknowledged to have been overly pessimistic. Indeed there would be no forests left at all in the Himalayas if some of the predictions made fifteen years ago had been strictly accurate. There is now ample evidence (e.g. Leach and Mearns, 1988) that many of the early predictions of shortfall were exaggerated, or that local problems were used to suggest national or international disasters in the making.

"This does not mean that the 'woodfuel crisis' is purely a figment of the imagination. Shortage of firewood continues to cause practical problems for the many of the world's poorest people who are reliant mainly or solely on firewood. Overcollection of wood for burning or for conversion into charcoal is also causing a range of environmental problems. Whereas in the past dead wood was used for burning (if only because this is likely to produce more heat), increasingly living trees are felled or mutilated for firewood. World shortage of fuelwood is estimated (by the UN) at reaching a deficit of 960 million m^3/year by the end of the century. Far from wood being the fuel of the landless and poor, it has increasingly become a marketable commodity that is only available to more affluent people in the South. In some regions the poor are increasingly reliant on twigs, non-woody vegetation and dried dung.

"However, these very real problems are often more complex than simple resource scarcity. There is evidence that time spent gathering fuel varies greatly with labour availability, and the scarcity shown up by some studies may be more to do with scarcity of labour than real fuel scarcity (Leach and Mearns, 1988). It is important to stress regional variations here; problems may be acute in one region but far less serious a few miles away. The real shortages of fuelwood are compounded by many other social and political issues, and any solution have to be tailor-made for particular situations.

RWEDP thanks Mr Dudley and WWF for these useful clarifications.

WH

Readers' Contributions

Readers will have noticed that recent issues of *Wood Energy News* have focused on specific themes. So far, these have been: gender and wood energy; modern wood energy; wood energy planning; wood energy resources; wood energy data; and wood energy and environment. The next issue is to focus on the largest of our new member countries, China. We welcome suggestions, contributions and reactions from our readers, on this or any other subject related to wood energy.

Publications

Estimating Biomass and Biomass Change of Tropical Forests: A Primer

This primer, which is FAO Forestry Paper 134, is published this year by Forest Resources Assessment, FAO, Rome. The author, Sandra Brown, is in the Department of Natural Resources and Environmental Sciences, University of Illinois, USA.

The book is intended for use by planners and trainers in forest inventories, for estimating biomass density, condition and change in tropical forests. As forests act as both a source and a sink of carbon dioxide, which is exchanged with the biosphere, they play an important role in global climate change. Changes in area, condition and biomass could be due to the current use and management of the forest.

In order to assess the state and change in the forest with regard to biomass, it is necessary to observe the change in area and of biomass density over time. This is where the publishers hope the primer will be of use.

Estimating Biomass has seven descriptive sections and one reference section. In the introduction, the paper highlights three important issues that have been gaining wider attention in recent years: the global carbon cycle, biogeochemical cycles, and biodiversity, all of which can have a direct bearing on biomass density and forest conditions, in addition to the traditional timber value of forests. The author notes that, in the past, estimates of biomass density have been made for many of the world's forests based on ecological studies, as well as by the FAO for tropical forests. But she also cautions that such studies are either designed to characterize the local forest structure and so pose several problems for their global-scale analyses, or are based on very few national or sub-national inventories of the tropical countries. Therefore, a new effort to estimate biomass density directly from forest inventory data, for national and global assessments of the quality of forest resources, is needed.

Section 2, "Purpose and Scope of Primer on Estimating Biomass", presents the need for a long-term biomass estimation for forests of tropical countries, given the rapid rate of change occurring in those places in recent years, the forests' high biomass and carbon contents (which influence their role in the global carbon cycle), and their great potential for mitigating the problems of excessive CO_2 production through conservation and management. This section also explains what tree formations are to be included, and defines the term *biomass.*

In Section 3, the author gives methods for estimating biomass density from existing data found in volume tables and stand tables; and describes the methods for estimating biomass from individual trees, plantations and other forest components.

Section 4 deals with the primary data and field measurements for biomass estimation, and talks about much-needed improvements in forest inventories and field measurements for developing biomass regression equations. Section 5 deals exclusively with biomass density estimates for developing countries based on existing inventories. Cases of tropical developing countries from Africa, America and Asia are dealt with separately.

Section 6, "Biomass Estimates from GIS Modelling", presents both a general approach and examples. The last descriptive section, Section 7, entitled "Future Directions to Estimate Biomass Change", covers the application of field studies as well as a combined approach using remote sensing/field studies and GIS modelling. Of two appendices in the paper, the first provides a list of trees species from tropical America, Africa and Asia, and the second gives the original biomass data used to develop the biomass regressions equations. Five different figures show the relationship between various parameters or highlight biomass degradation in different areas.

As biomass, especially woodfuel, is likely to remain the most commonly used domestic energy source in the RWEDP region, *Estimating Biomass* should be of great use in rural energy planning, particularly for woodfuel, in RWEDP member countries.

TB

News and Notes

National Training Workshop on Woodfuel Trade in Myanmar

RWEDP assisted the Forest Department of Myanmar to organize this training workshop, which took place at its Forest Research Institute (FRI) in Yenzin from 27 to 30 November 1996. The workshop was attended by 42 participants and 68 observers, representing different agencies related to forestry development in the country: the Ministry of Forestry, the Forest Department, the Myanmar Science and Technical Research Institute, the Institute of Forestry, the Forestry Research Institute, and other forestry development projects. Only two NGOs were represented: the Forest Resources and Environmental Development Association (FREDA) and the San San Industrial Co-op Ltd. The workshop was inaugurated by the Director General of the Planning and Statistics Department of the Ministry of Forestry.

The main objectives of the training workshop were (a) to network the key

institutions and individuals who are the main actors in woodfuel production and trade; (b) to disseminate information regarding ongoing practices in woodfuel production, distribution, marketing and utilization, and to review them; (c) to enhance the knowledge and understanding of participants about the complexity, intricacy and linkages of the various elements of woodfuel flow systems, and to enable them to design appropriate policies, plans and programmes for woodfuel development; and (d) to identify and design the area-specific follow-up training programmes required for supporting its development.

Eight case studies were presented by different resource persons, which included a general position paper on wood energy in Myanmar; an area-specific case of woodfuel marketing from Pyinmana township; a report on cookstove dissemination; a position paper on woodfuel in mangrove areas; presentation of research findings on species and woodfuel production and on the role of non-forest areas in woodfuel production; an area-specific case from Yamethin District on woodfuel use in cottage industries; and the presentation of the 1993 report on woodfuel flow in the Dry Zone of Myanmar, also funded by RWEDP.

The training workshop assigned one full day specifically for field observation. The townships of Payawbwe, Yamethin and Pyinmana were visited to observe the prevailing practices of woodfuel production, supply and end-use in their neighborhoods. During the workshop sessions, participants were divided into three groups, one each for: analysis of the supply, demand and trade of woodfuel; identifying the policies and strategies for sustainable supply of woodfuel; and identifying technological improvements required for saving woodfuel during use, and for its substitution.

The training workshop concluded after a closing address by the Director General of the Forest Department.

National Training Courses on Integration of Woodfuel Production and Marketing

Between October and December of 1996, RWEDP collaborated with four of its member countries – Thailand in Southeast Asia and Bangladesh, India and Sri Lanka in South Asia – to organize national training courses on Integration of Woodfuel Production and Marketing in Forest, Agriculture and Tree Production Systems.

Thailand

The Royal Forest Department (RFD) organized the national training course in Phrae Province from 14–17 October. The course was attended by 27 middle-level professionals, mostly representing the Northern and Northeastern provincial forestry offices of Thailand. To take advantage of the commonality between Thai and Lao languages, RWEDP also sponsored one observer from the Science, Technology and Environment Organization (STENO) of Lao PDR to assist in preparations for that country's national training course in 1997.

The issues of woodfuel production and marketing were addressed through classroom sessions, case study presentations and field observations. Senior officials of the RFD, Department of Energy Development and Promotion (DEDP) and an NGO, as resource persons, made invaluable presentations. Specific areas covered by them included: an overview of the energy supply and demand situation in Thailand, and wood and biomass fuels' share in it; the issues and constraints of production and marketing of woodfuel from non-forest areas; important fuelwood-based and biomass based industrial/commercial activities in Thailand; the contribution made by the NGO in woodfuel production through its participatory tree planting programme; and an area-specific case study, of a ceramic industry, to present the economic feasibility of raising woodfuel plantations of fast growing tree species (e.g. eucalyptus) for meeting an industry's woodfuel demand. Additional issues addressed were the factors that could influence decisions in the farm household, and gender and wood energy. A visit was paid by the participants to a major producer of woodfuel, the Forest Industry Organization (FIO), in Lampang. A summary report on the training course has been compiled by the RFD.

Sri Lanka

RWEDP also organized a national training course on the same subject in Kandy, Sri Lanka, from 21-23 November 1996. It was inaugurated by the Conservator of Forests, and the FAO representative for Sri Lanka and Maldives attended as chief guest. All together, 17 participants and eight resource persons attended the training course, from the forest, energy, education and plantation sectors, representing the NGO, public and private sectors and the University of Peradeniya. Eight different papers were presented, covering the issues of woodfuel production, marketing and utilization in Sri Lanka. The training was successful in terms of networking the participants and resource persons from different organizations, many of whom are in a position to influence policies and programmes in their respective sectors.

During field visits, participants observed a number of woodfuel-based industrial and commercial activities, such as a fuelwood sales depot, a tea processing factory, a small vertical brick kiln, a lime kiln, a pottery, a bakery and a mixed tree species plantation established by the adoption of SALT (sloping agricultural land technology) in formerly degraded forest land. This is a model of sustainable land-use in state-owned degraded forest (or wasteland) which allows farmers to practise agroforestry on a long-term lease arrangement with the Forest Department. A summary report of the training course is expected to be made available in the near future.

India

The national training course in India was organized in collaboration with the National Botanical Research Institute (NBRI) in Lucknow, UP, a botanical research laboratory for North India under the Council of Scientific and Indus-

trial Research, Ministry of Science and Technology, from 2-5 December 1996.

The training was attended by 40 participants and seven resource persons. They represented both central and state - level organizations of the Government of India concerned with forestry and energy development, including institutions responsible for forest survey and forestry training. One Lucknow-based NGO, Hariyali, was also represented in the training, and NBRI Lucknow was represented by an additional nine observers. Also in attendance were senior officials from the Ministry of Non-conventional Energy Sources (MNES), and the FAO and UNDP representatives in New Delhi. The course was inaugurated by Dr P V Sane, Director of NBRI.

Presentations by the seven resource persons covered different aspects of woodfuel production and marketing in India. Another presentation was from the UNDP representative in New Delhi, who explained the current global thrust for sustainable forest management. He also discussed the mechanism for approaching the Global Environmental Facility (GEF) to seek assistance in development projects, primarily focusing on promotion of the use of renewable energy sources. The field trip segment of the course included a visit to the training centre of the Non-conventional Energy Development Agency at Chinhat, a fuelwood sales depot and a brick kiln, all near the city of Lucknow. A summary report of the training course is expected from the NBRI soon.

Bangladesh

The national training course in Bangladesh was organized jointly with the Bangladesh Forest Department (BFD) and the Rural Development Academy (RDA) of the Government of Bangladesh, and took place from 7-11 December 1996 in Bogra. The course was inaugurated by Dr S Rahman, Chief Conservator of Forests, and Dr M Solaiman, Director General of the RDA, was the chief guest.

The course was attended by 25 participants: from departments related to forestry, energy and rural community development; from forestry training institutes; and from a number of NGOs, among them BRAC (Bangladesh Rural Advancement Committee) and Proshika.

Seven lecturers and five resource persons discussed both general and specific aspects of woodfuel production and marketing. Their presentations covered forestry, agriculture, technology and research-related subjects, including general information about wood energy in Bangladesh; woodfuel utilization in rural industries; marketing of woodfuel; technologies for efficient use of woodfuel; the contribution of wood-based industrial activities in national economy/rural socio-economy; the role of non-forest areas in woodfuel production; the role of rural extension in woodfuel production and marketing; constraints in woodfuel production and marketing; the comparative advantages of woodfuel production over other systems of resource management; and programmes and strategies of the Forest Department for enhancing woodfuel production. A summary report of the training course is expected from the BFD soon.

Towards a Sustainable Local Wood Energy System - National Workshop on Household Energy

The FAO project on Participatory Natural Resources Management in the Tonle Sap Region (FAO-GCP/CMB/002/BEL), in cooperation with the RWEDP, organized a national workshop on household energy in Siem Reap, Cambodia, which took place on 12–14 November 1996. The meeting was attended by 48 persons from various governmental organizations, national and international institutions, NGOs and the two FAO projects.

The workshop was held in response to evidence that traditional sources of energy, and in particular fuelwood, are still and will remain an important source of energy in Cambodia; while in some areas, in particular around the capital, Phnom Penh, and the Tonle Sap lake, the imbalance between fuelwood supply and demand appears critical. At the same time, it was clear that very little data and information were available on this supply and demand, and very little development activity with regard to energy conservation had been undertaken.

The objectives of the workshop were:

1. To present the general wood energy demand situation and experiences gained in Cambodia;

2. To analyze wood energy use at household and small industrial levels, and in village activities (such as fish smoking and brick firing);

3. To analyze institutional and legal aspects of wood energy demand and supply; and

4. To identify the way forward.

Some of the issues were raised during the inaugural ceremony, presided over by H E Chun Sareth, Under-secretary of State, Ministry of Agriculture, Forestry and Fisheries. It was reiterated that even though Cambodia's forest resources can be considered plentiful, this does not mean that no problems exist. For instance, more agricultural land will be needed in order to feed the growing population. Good use should therefore be made of the existing resources and this will require the involvement of the local people.

During the three-day meeting, 15 presentations were made on various issues, including overviews of available data on energy, which must cover wood and other biomass energy. Participants were also familiarized with stove-related issues, including setting up a (national) stove programme. On the last day, there were extensive discussions. Critical issues in the field of data needs, legislative issues with regard to fuelwood, options for increased supplies, and conservation activities in the small-scale industrial and domestic sectors (stoves, stove programmes) were discussed at length. This resulted in the drafting of a concise set of conclusions and recommendations.

Possible follow-up action was identified in the form of setting up a coordinating body on wood and biomass energy consumption and supply issues (data collection, analysis etc.), and training at

various levels, e.g. on data collection, data analysis, energy conservation by means such as developing and introducing improved domestic stoves and improved kilns and furnaces for small-scale industries, and setting up programmes to introduce improved stoves. The proceedings of the workshop are being prepared and will be available soon.

National Workshop on Cookstove Development

The first of five national workshops on cookstove development to be organized jointly by RWEDP and the Asian Regional Cookstove Programme, ARECOP, took place in Mataram, Indonesia from 27 November to 5 December 1996.

The success of an improved stove programme depends largely on the capabilities and commitment of the stove promoters. However, information on the stove design, particularly the rationale behind certain parts of it, can be lost over time or in passing it on between the various actors in the programme, and with it some of the potential benefits are also lost.

The workshop included a variety of activities: lectures, role play, hands-on exercises, practical work (on stove construction), field surveys, etc. Twenty people from both the Indonesian government and NGOs participated. This mix of participants resulted in a productive interaction, generating a much better understanding between the governmental and non-governmental sectors.

Although the participants in the workshop considered the overall impact of the workshop as being very positive, the organizers feel that before the other workshops (expected to be held in the local language using local trainers), a training-for-trainers workshop would be very useful, if not imperative, in order to achieve the best possible outcome.

National Training Workshop on Rural Energy Planning and Development, Sri Lanka

RWEDP cooperated with the Energy Conservation Fund in organizing the National Training Workshop on Rural Energy Planning, with Special Emphasis on Wood Energy, which took place in Colombo, Sri Lanka, on 8-14 December 1996. Most of the participants were local provincial officials involved in province-level socio-economic planning or implementation of local projects. National energy, forestry and economic agencies were also represented, along with several NGOs.

This was the first training forum most of the participants had been to which discussed wood energy in depth. It was also the first aimed at local officials, and was thus welcomed. An important outcome was that the participants realized the importance of planning in policies and programmes for sustainable use of wood energy. Although there was lively discussion, the participants agreed that the workshop was only long enough to provide an introduction to the concepts of wood energy data and planning, so case studies were needed for them to learn more. Almost all volunteered to conduct case studies in their respective provinces, and studies are now to take place in three provinces.

Gender Training Workshop, Thailand

See page 13.

HEDON 7

HEDON, the Household Energy Development Organizations Network initiated by the World Health Organization, held its seventh meeting in July 1996 in Geneva. The meeting, HEDON 7, was on the topic 'Health Aspects of Household Energy and Indoor Air Pollution, and pooled the resources of 15 experts in the fields of energy, environment and health.

Two working groups were formed in the meeting to discuss methods and interventions for the proposed HEDON joint project on Health and Smoke. The first group, on methods, identified four shortfalls that could be the project's rationale to address in its methods and policy work: lack of commitment, lack of resources, lack of data and lack of methods. These were then transformed into objectives and tasks for the project. The second group discussed four levels of interventions in the field of household energy and health: technical, behavioural, health and political (or miscellaneous). Turning these into solutions is to be an output of research work done in other areas of the proposed joint work.

Details of the tasks assigned to the various agencies, and the people responsible, are given in the published meeting report.

Welcome to ENERGIA

The RWEDP offers a warm welcome to a new, and hopefully significant, player in sustainable energy: ENERGIA, the International Network on Women and Sustainable Energy.

ENERGIA is an international network on women and sustainable energy, founded in 1995 by a group of women involved in gender and energy work in developing countries. ENERGIA defines its objectives as to "engender" energy and to empower women, through the promotion of information exchange, training, research, advocacy and action aimed at strengthening the role of women in sustainable energy development. ENERGIA's approach (since it is a loose network rather than a formal institution) is to seek to identify needed activities and actions through its membership, and then to encourage, and if possible assist, members and their institutions to undertake decentralized initiatives. ENERGIA's new quarterly journal, *ENERGIA News*, is the principal vehicle for this approach.

ENERGIA published issue one of *ENERGIA News* in December last year. Four issues are planned for 1997, the this month. The editorial team invites contributions in the form of case studies and articles of around 1,500–2,000 words each, with relevant photos if possible.

For further information or to join ENERGIA (free of charge), contact the ENERGIA News Secretariat c/o TOOLConsult, Sarphatistraat 650, 1018 AV Amsterdam, Netherlands; tel. (+31) 20 626 4409; fax (+31) 20 4211202; Email toolconsult@tool.nl.

Events

Event, Description (Info)	Date, venue
Local Level Management of Trees and Forests for Sustainable Land Use Offered to senior personnel in charge of policy, design, planning, management and evaluation of rural forestry programmes or rural development programmes with forestry components. The present course is a revised version of IAC's older International Course on the Design of Community Forestry. (IAC)	7 Sept–12 Dec. 1997 International Agricultural Centre (IAC), Wageningen, Netherlands
Planning for Sustainable Rural Development Appeals to participants from a wide range of GOs and NGOs, and covers a broad range of issues in development, including: defining growth and development, planning levels and strategies, with particular emphasis on community participation; financial, economic, social, environmental and gender aspects in project appraisal; NGOs in development; women in development; and rural credit and train-the-trainer sessions to help the participants diffuse their knowledge to colleagues on their return to their home countries. (UNE)	6 Oct–21 Nov 1997 University of New England (UNE), Armidale, New South Wales, Australia
Environmental Management in Development Will equip planners, project managers and policy makers from GOs, NGOs and parastatal organizations to integrate environmental issues into development plans and policies. The course outline includes: ecosystems; agricultural development and ecologically sustainable development; environmental impact assessment; the project approach to environmental management—problem/solution and logical framework analysis; gender and social appraisal; evaluation and management of land and water resources; retention of biodiversity from a global/national view; and GIS. (UNE)	6 Oct–7 Nov 1997 UNE
Integrated Forestry Planning—Community Needs and Sustainable Management Core topics include project identification and design; issues in sustainable forest management and land restoration; computers in forestry planning and management; and community forestry, participatory development and extension techniques. The course should appeal to middle to senior-level forestry planners, foresters, other managers and rural development workers or NGO representatives involved in community forestry or land rehabilitation programmes. The course starts at the campus of the Australian National University in Canberra, and then moves up to subtropical Queensland for a series of study tours (ANU)	10 Nov–19 Dec 1997 Australian National University (ANU), Canberra
Energy and Environment for Sustainable Development The programme consists of a workshop on Planning for Energy and Environment: Issues and Methods at National and Regional Scale. Aimed at policy advisers, government energy or environment officers, staff of utilities and sectoral activities linked to energy, staff of programmes for environmental management and rural development, academics and staff of NGOs. (UT)	20 May–21 June 1997 University of Twente, Enschede, Netherlands

IAC: The Director, International Agricultural Centre, P O Box 88, 6700 AB Wageningen, Netherlands. Phone: (31) 317 490111; fax: (31) 317 418552; e-mail: iac@iac.agro.nl; telex: 45888-INTAS NL

UNE: University of New England in Armidale, Programme Director, Development Studies Program, University of New England, Armidale, NSW 2351, Australia. Phone: (61) 67 733248; fax: (61) 67 733799; e-mail: dsp@metz.une.edu.au

ANU: Australian National University, Canberra, Course Administrator, ANUTECH Pty Ltd, GPO Box 4, Canberra ACT 2601, Australia. Phone: (61) 6 249 4713 or 249 5881; fax: (61) 6 249 5875 or 257 1433; e-mail: anutech.courses@aplemail.anu.edu.au

UT: Course Administration, Technology and Development Group, University of Twente, P O Box 217, 7500 Enschede, Netherlands. Fax: (31) 53 489 3087

Health Hazards in the Woodfuel Cycle

Fuel Cycle	Activity	Possibble Health Effects
Production	Processing/preparing dung cakes	Faecal/oral/enteric infections
	Charcoal production	CO/smoke poisoning Burns/trauma Cataracts
Collection	Gathering fuel	Trauma Reduced infant/child care Bites from snakes etc. Allergic reactions Fungus infections
Transportation	Transportation of biomass fuel	Backache Severe fatigue Damaged reproductive organs over time (prolapsed uterus)
Processing	Cutting up fuel	Trauma Cuts Abrasions
Combustion	Smoke	Conjunctivitis Acute respiratory infection (ARI), including pneumonia *Cor pulmonale* Adverse reproductive outcomes Lung cancer Higher rate of infant morbidity/mortality Depressed immune response Chronic obstructive lung diseases (COLD): Chronic bronchitis Emphysema Asthma
	Toxic gases (CO)	Acute poisoning Low birthweight Higher rate of stillbirths
	Heat	Burns and scalds Cataracts
	Cooking position	Arthritis and related bone disease Back pain

Source: World Health Organization, adapted by W Hulscher, Christina Aristanti and Lydia Braakman