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In this edition . . .

We tackle one of the major problems facing humanity and, as always in *Boiling Point*, we try to provide positive ideas for improving the lives of people living in poverty. These include: ways to improve forestry resources; reducing the need for heating; increasing the efficiency of stoves and using residues to replace woodfuel. There are two excellent case studies which show how policy must be reflected in practice for initiatives to succeed. As the international community moves towards advocating fossil fuel for health improvements, another key issue addressed deals with the threats to the livelihoods of those employed in biomass provision. This edition concludes with two very human issues; the cost of using biomass in terms of health and the importance of disaggregating household energy information by gender when making decisions.

HEDON www.hedon.info
Have you visited the HEDON website recently? The website has lots of new initiatives – 'How to' picture guides which show you how to make various stoves, a fireless cooker, a kiln, a solar drier, etc. There are also new interactive pages on smoke monitoring where anyone can add and comment on the information – do join HEDON and share your ideas.

Contributions to *Boiling Point*

- **BP50: Scaling up and commercialisation of household energy initiatives** Small projects can have a huge impact on the lives of those who are involved in them. This edition of *Boiling Point* will look at how these impacts can be multiplied to benefit hundreds or thousands of households. There are important questions around how to ensure that the most vulnerable are not further marginalized in the commercialization process. We would like to hear from authors about successful scaling-up initiatives, the role of the private sector, public / private partnerships, government initiatives, effective marketing strategies, the role of education and information dissemination – we'd also like to hear from those brave enough to analyse case studies of work they'd done where scaling up failed.
- **BP51: Sharing information and communicating knowledge** This edition follows closely from BP50, with its theme of 'Scaling up'. How can people share what they 'know' about household energy? What are the routes, both formal and informal, which can be supported and strengthened in order to allow knowledge to be shared more freely? Are there ways for distributing information on household energy which you have found successful – locally? nationally? internationally? What factors inhibit people from sharing their knowledge? or from disseminating useful information? How can those barriers be overcome? These routes could involve local participatory approaches, educational programmes, local theatre, books and journals, media, electronic networks, exchange visits etc. If you have successful strategies, *Boiling Point* would love to share your knowledge and provide information so that others can benefit from your experience.

Articles should be no more than 1500 words in length. Illustrations, such as drawings, photographs, graphs and bar charts, are essential. Articles can be submitted as typeseripts, on disc, or by email.

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Cover photo: Woodfuel in Sudan has to be gathered from a great distance (photo: Nigel Bruce)

THEME EDITORIAL

Forests, fuel and food

by Liz Bates, ITDG, Schumacher Centre for Technology and Development, Bourton on Dunsmore, Rugby CV23 9QZ, UK. Tel: +44 (0) 1926 634 465 Email: lizb@itdg.org.uk

Introduction

The 'environment' has a number of meanings. The 'global environment' conjures up an atmosphere increasingly affected by globally polluting gases – a consequence of the growing demand for energy. The more localized environmental issues include provision of clean ambient air, sustainable forests, non-polluted water supplies, and adequate waste disposal.

For a poor woman living in a rural community, her 'environment' may well be a kitchen filled with smoke, inadequate access to fuel, water and sanitation, and insufficient money to improve her situation. However, she may also be the blameless victim of increased floods and drought from global warming, and fuel scarcity from non-sustainable wood felling.

How should we address the need for future cooking energy, in the light of increasingly scarce wood supplies in many countries, and the increasing dangers facing the planet from non-sustainable energy use? It may be stating the obvious – but an important starting point is that for people to have food to eat, *someone must cook*. Unfortunately, achieving this basic need, whilst improving both the global and local environments, is far from simple.

Options for household energy and their impact on forest resources

Biomass stoves

Biomass is the only available energy supply for millions of people, but in seeking to reduce pressures on forests, many stoves add to the burden of global pollution by creating more smoke than traditional three-stone fires. This is because the *overall* efficiency is made up of two parts: the *combustion* efficiency (how well the wood burns), which affects the amount of smoke produced; and the *pot* efficiency, which describes how well the heat is transferred to the cooking pot.

The *overall* efficiency of a stove can be much higher than a three-stone fire if the *pot* efficiency is very high. However, the *combustion* efficiency is often lower.

To be *greenhouse gas neutral*, the carbon dioxide absorbed by a wood when it is growing in the forest must match the amount of greenhouse gases produced when the wood is burnt. For this to occur, biomass fuels must be gathered from renewable sources and must have nearly 100% fuel efficiency (*World Energy Assessment*, Chapter 3, UN Publications, 2000). The majority of biomass stoves in current use have efficiencies of less than 30%.

Thus, a stove that is considered environmentally friendly by those seeking to protect the forests may be deemed very unfriendly by those concerned with greenhouse gases, and the smoke it produces may cause greater health problems to the cook than her original three-stone fire. Improved biomass stoves should be designed to use less fuel and emit less smoke.

Fossil fuels

For those with access to fossil fuels, such as LPG and kerosene, the effects on the environment, from all perspectives, can be very positive. (Coal is a special case and can be as polluting as wood.) LPG and kerosene, when used in urban centres, reduce the serious pressures on forests caused by charcoal production and non-sustainable fuel gathering.

Globally, less greenhouse gases are produced, especially with LPG, as the gas is more completely burnt. Although carbon dioxide is produced, this is not nearly so damaging to the environment as the *products of incomplete combustion*. For the cook, her environment will be cleaner, and her vulnerability decreased through improved health, less danger and fear in fuel collection, a cleaner kitchen and reduced drudgery. It can also ensure that during times of natural disaster – such as drought or flood – she still has access to fuel, and thus food.

However, forests not only provide fuel – they also provide employment. Moving from a biomass-based to a fossil fuel-based energy service may have a major impact on local employment. Fossil fuel stoves tend to be imported and the supply chain for fossil fuels will employ considerably fewer people than are needed to supply households with biomass fuel.

Other options

Solar cookers, insulated boxes, biogas, using lids on cooking pots, and insulating house walls in cold regions, are all very environmentally friendly. Where they are appropriate to people's lives, they can be highly beneficial. However, they are often introduced in a way that does not regard the cook as the 'customer' and this can lead to inappropriate introduction and low take-up of these interventions.

New technologies

Sustainably-grown biomass can be used to provide energy through gasification, methanol/ethanol production and gelfuel. *Boiling Point* will seek to report on any technologies that are affordable and appropriate. However, whilst the greatest polluters of the planet are in the industrialised world, it is surely incumbent on them to reduce their greenhouse emissions through research, development and change of behaviour, in order to mitigate the natural environmental disasters that afflict the most vulnerable communities.

Sustainable commercial firewood: the role of Forest Replacement Associations in Brazil and Nicaragua*

by Rogério Carneiro de Miranda (to whom correspondence should be sent)[1] , Stuart Conway[2], Afranio Cesar Migliari[3]

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*This article has been adapted from a paper presented to the XII World Forest Congress, FAO, Quebec City, Canada, September 2003 by the author

Theme

Introduction

A frequently asked question in the developing world is 'How can we finance reforestation for rural farmers, without international aid?' In the developing world, reforestation is usually needed to counteract deforestation and forest degradation that results from the need for fibre, timber and energy. The depletion of the natural forests is easier and cheaper than reforestation, and often, tropical forests superficially seem inexhaustible.

However, tropical forests are one of the fastest disappearing ecosystems worldwide, since they are usually associated with less developed countries. In these regions, the unspoken policy is 'privatize the profits from the country's forests, while socialising the external costs from the degradation of these same forests'. Local governments usually lack human and logistical resources to monitor deforestation.

Also, when the proposed solution is reforestation, the long-term return on investment is not attractive for local farmers, and, if accepted, the money is most likely to come from foreign aid.

An alternative solution to this problem is taking place in countries like Brazil and Nicaragua. The creation of regional Forest Replacement Associations among small-scale wood consumers and producers is proving to be an appropriate measure for developing countries and, by the mid-term, it is independent of foreign aid.

Methodology

Forest Replacement Associations (FRAs) are a 'win–win' solution for both industrial consumers and rural producers of wood products. This solution is based on four basic assumptions for the production of any agriculture commodity (Miranda, R.C., 1998):

- land availability
- labour availability
- capital availability
- market availability.

Small or medium-scale farmers usually have land available for reforestation. A small percentage of the land, from 5% to 20%, could be dedicated to a reforestation crop, which could mean anything from a quarter of a hectare to 10 hectares of land. The same farmers usually have labour available to invest in the project, mostly family labour that will not cost them a cash investment.

However, these farmers do not usually invest in reforestation due to the lack of capital or cash to buy the seeds or seedlings (the expected cost for the establishment of a hectare, for instance, may range from US$200 to $300, depending on species, soil preparation, fertilization, fences, etc.). Farmers also have to wait usually five to seven years to harvest for energy (fuelwood) and 12 to 25 years to harvest for timber, and recover the cash investment. Furthermore, farmers usually do not have a guaranteed market for their investment. Either there is no formal contract or contact with buyers, and the market might be at quite some distance, with high transportation costs.

On the other hand, small wood-consuming industries usually have neither the land available for reforestation to sustain their need for wood products nor the rural labour to plant and care for the plantation. However, as consumers, they are the market, and can guarantee a demand from any supplier.

Furthermore, because they are the ones that ultimately define the prices of the final product in which wood is used as raw material or energy, they can make a larger profit in the process – consumers do have the control over the profits.

In the forest replacement system, farmers and consumers of a given region (one or several clustered municipalities) form a partnership to create a Forest Replacement Association, which should be a legal entity. In Brazil there are models where some state governments and an FRA federation can assist with advice. In Nicaragua, PROLEÑA and the Ministry of Energy can advise as well.

Usually, consumers and producers together arrange to set up the tree nursery infrastructure, in which the consumer industry finances the seedling production, as well as the technical assistance to oversee the nursery operation and to assist farmers with training and assistance in reforestation techniques and maintenance.

Each farmer associated or enrolled in the reforestation programme has free access to seedlings, and also a guarantee from the industry that they will buy the wood produced, once a fair market price is agreed upon at the time of the harvesting. Farmers have total ownership of their land dedicated to the reforestation and its products, and furthermore have no obligation to

Table 1 The contribution of resources in a partnership for a forest replacement programme

	Land	Labour	Capital	Market
Small or medium size wood producing farmers	YES Own and have available 0.25 to 10 hectares of land for commercial/ industrial reforestation	YES Can contribute at least family labour for reforestation activities	NO Do not have available cash, much less for a long-term return on the investment	NO Do not control or have secure access to it
Small or medium size wood consuming industries	NO Does not own agriculture land	NO Does not have access to agricultural labour	YES Does control profits and is ultimately responsible for the forest sustainability of their business	YES Does control demand and can guarantee contracts

sell the wood to the industry, but can either keep it or sell to the highest bidder.

Table 1 summarises this scheme by presenting the contribution of resources in a partnership for a forest replacement programme.

Opportunities

The concept of FRAs was first developed in Brazil where, since 1975, the forest legislation requires that every industrial or commercial wood consumer should guarantee the sustainability of its wood products needs (Toledoe Guimaraes, 1993). If it is a small consumer with demand below 12 000 cubic metres of wood per year, it should establish its own reforestation project, or it could pay a fee to a forest replacement fund operated either by the government or as an alternative by private FRAs (Figure 1).

However the preferred contribution method today is to FRAs, since consumers in this way have a guarantee that their contribution will then create reforestation projects within their region, increasing in the near future a sustainable supply of industrial quality wood, with much lower transportation costs. An additional benefit of the FRA is that the contribution fee is significantly lower than the one paid to the government. This is due to the efficiency of the FRA administration.

For instance, in Sao Paulo State, for each cubic metre of wood consumed by the industry, they have to replant 8½ trees, for which they have to pay only about \$0.20 per tree to the FRA to do the work of reforesting, in contrast with \$0.50 they used to pay to the federal government. (FARESP, 2001).

In Nicaragua, based on a feasibility study done by Miranda 2000, a local NGO called PROLEÑA took the initiative to establish three FRAs with the three leading fuelwood consuming industries in that country. PROLEÑA also facilitated technical and financial co-operation from the Nicaraguan and the Brazilian governments through the National Energy Commission (CNE) and the Brazilian Cooperating Agency (ABC) respectively, as well as from Trees, Water and People (TWP), an US-based NGO that supports reforestation initiatives in Central and South America.

In this case, the small rural industries were brick manufacturers, lime manufacturers and fuelwood merchants for the capital city of Managua (Figure 2). It is estimated by PROLEÑA-ESMAP that Managua alone consumes about 100 000 tonnes of firewood per year.

In this initiative, each cluster of industry provided the land for the establishment of the nursery, the Nicaraguan government provided the infrastructure, while the Brazilian government, PROLEÑA and TWP provided the expertise for the FRA methodology and the nursery *tubete*

Figure 1 The tree nursery of a FRA in Sao Paulo state, Brazil

Figure 2 A typical fuelwood dealer truck transporting its cargo to the capital city of Managua, Nicaragua (Miranda, 2000)

Figure 3 Tree nursery of a FRA in Tipitapa, Nicaragua, with capacity to produce 95 000 seedlings

technology (including the hardware). A *tubete* is a recycled small rigid plastic container used for cultivation of seedlings in the nursery, which is raised above the soil and irrigated by a mist system.

Results

To date, each FRA in Nicaragua has the capacity to produce 95 000 trees annually, which has been in full operation since March 2002 (Figure 3). These FRAs are established in the Pacific region, where the deforestation process has been among the most severe in the country and the demand for rural industry and urban domestic fuelwood is still very substantial in terms of Nicaraguan energy needs (Miranda and Alves-Milho, 1999).

Small farmers of the region are expected to have additional security with their investment in reforestation, since the region suffers from time to time from agricultural crop losses from natural disasters such as drought caused by the El Niño meteorological phenomenon and floods such as hurricane Mitch of 1998.

When those disasters occur, many small farmers have no other income than from cutting and selling their natural forests woodlots as fuelwood for the local industries and urban domestic consumers.

In Nicaragua, where there is no incentive for reforestation, and the forestry authorities do not have the resources to enforce sustainable management or control fuelwood consuming industries, FRAs can fill this gap by leveraging private resources instead of public resources to accomplish the sustainable forest management goal.

Conclusions

For developing countries where small industries rely on wood as both timber and energy source, the government has no resources to enforce forest sustainability policies, and there are no public resources to provide reforestation incentives, FRA is a valuable model to address these problems.

Firstly, it guarantees a continuous supply of wood for those industries that need it to operate; secondly, it provides a sustainable supply of better quality wood and lower transportation costs with no deforestation consequences; and thirdly, it provides the necessary incentives for small farmers to incorporate forestry into their income generating activities. For farmers it can become a strategically resistant crop to mitigate hard times when agricultural crops are lost, and to alleviate pressure on the remaining natural forest stands.

In the medium term, FRA avoids using public, and in most cases donor aid funds in favour of private funds to mitigate an environmental impact created by private industries.

An amount of opposition can be expected, since there is often rejection from private businesses that are reluctant to assume the social and environmental costs of their profitable operations.

Continuous education of public opinion as well the consuming industries about the key role of FRA for sustainable development will slowly strengthen the FRA concepts in the eyes of forestry authorities, enabling them to implement and enforce FRA as a desirable modern forest policy.

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Theme

Super-insulated housing for Northern Asia

by Zhu Qing Yan (Linda)[1] and Kelly Lerner[2], Adventist Development and Relief Agency

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Introduction

With over 1.3 billion people and growing, China is actively seeking ways to reduce pollution, promote energy efficiency and use renewable resources. Aiming to improve people's lives while at the same time improving the environment, The Adventist Development and Relief Agency (ADRA) has been introducing a durable and super-insulated style of housing that uses straw bales as a building material (Figure 1). ADRA built the first prototype straw-bale house in Mongolia in 1995 and expanded the programme to China in 1998.

'Straw bales?' you say with surprise. 'Don't they rot or burn?' In fact, straw-bale construction has a proven track record over 100 years. The construction technique was born of necessity on the Nebraska plains of North Central USA, in the late 1800s. The loose sandy soil would not work for soil-block houses and there was little wood, so the new settlers started to build with bales. They found that the houses were exceptionally warm, quiet and strong.

Though straw-bale construction mostly died out just after the turn of the twentieth century, it was revived in the late twentieth century because of its energy efficiency and environmental friendliness. Now this technique is spreading all over the world. Straw buildings are being built in the US, Canada, France, England, New Zealand, Australia, and China, among others.

China has a long history of building with straw, often in combination with earth for walls and as thatch for roofs. But building with straw bales is a little different. Why are straw-bale houses so well suited for northern China?

- **Super Insulation.** Straw-bale walls (Figure 2) insulate six times as well as brick or concrete walls, saving 60–80% on heating energy depending on outdoor temperature. In northern China, millions of people are housed in substandard or dangerous houses often built of mud and rocks. Such houses usually are very poorly insulated and offer very little protection from cold winter temperatures that average below −25 degrees. This requires dwellers to burn large amount of coal for heat. Poor families can only afford to heat the small area where they sleep and leave the rest of the house unheated.
- **Reduction of carbon dioxide**, other greenhouse gases and air pollution. The energy-efficient straw-bale houses require families to burn less coal to heat their homes. Coal burning produces carbon dioxide and pollutes the air.
- Straw-bale construction utilizes a waste product (Figure 3). In most of northern China, straw is an agricultural waste. It is often burned in the fields, creating air pollution.
- Straw is a renewable, sustainable resource. Straw grows in one season, as an agricultural by-product, and requires no additional energy input.
- Building with straw preserves land resources. Replacing clay bricks with straw bales reduces the amount of soil required for brick making. China has a scarcity of land resource and brick making destroys the land. The Chinese government has made rules to ban brick use in the near future and is seeking substitute construction materials.

Though ADRA is building high-quality, energy-efficient straw-bale houses, their main project goal is tech-

Figure 1 Typical straw-bale house

Figure 2 Straw bale walls

Theme

Figure 3 Straw-bale construction utilizes a waste product

Figure 4 Building with brick and straw

nology transfer. Over the past five years, ADRA's consultants have worked closely with Chinese builders to adapt Western-style straw-bale construction to Chinese conditions. In the US, where the techniques first developed, straw-bale houses are usually load-bearing (where the straw-bale walls support the roof loads by themselves) or wooden post-and-beam with straw-bale infill. In China, the roof loads are too heavy for bales and wood is scarce and expensive. At training in 1999, builders from Tang Yuan County, Heilongjiang, helped develop a building system that makes the most of both bale insulation and brick structure (Figure 4). In ADRA's yearly training, builders from five provinces in northern China have improved and adapted this system for their own local areas. By the end of 2002, Chinese construction workers built 571 residential straw-bale houses and one school.

Like any new technology, the straw-bale construction met scepticism and difficulties when it was initially introduced. But after families lived in this new type of house over a freezing winter, they realized that they were much warmer and more comfortable compared with brick houses. ADRA has worked close with builders and farmers to ensure that the houses are aesthetically and functionally acceptable in rural communities. The interior and exterior of straw-bale houses are plastered and they are indistinguishable from brick houses around them (Figure 5).

This is one of the reasons why farmers embrace straw-bale houses and take pride in the ownership because it is a dream for almost all Chinese farmers to own a brick house that is a symbol of a prosperous life. Those families who did not participate in the project because of their fears showed deep regret. Farmers are happy to see that straw, which once was a nuisance to them, is now turned into a building material that can even become a commodity to generate income.

During our house-to-house visits, residents always told us their new houses were much warmer than brick houses. In 2002, ADRA's national partner in China, the Center for Environmental Sound Technology Transfer (CESTT), conducted a fuel efficiency monitoring programme in one of the pilot sites. The monitoring measured temperatures, and fuel use in both brick and straw-bale houses. The result showed that straw-bale houses are more energy-efficient than brick houses and reduce the consumption of coal and additional fuel materials (agricultural waste) by considerable amounts. The average consumption of coal is around 33% higher in brick houses. In terms of energy efficiency, straw-bale houses were on average around 68% more efficient than brick houses.

Figure 5 Plastered and painted house

ADRA has worked closely and successfully with local governments implementing this project. They are so happy with the project, many local governments have asked ADRA to drastically increase the scope and pace of the project. All financial and management responsibilities are shared. ADRA provides about a quarter of the building funds, local governments contribute a further quarter, and the new house resident supplies the balance. A typical 60 square metre house costs around US$3000 in northern China. If families decided to build a larger house, they pay for the extra.

During the coming summer, 23 straw-bale houses and one school will be constructed. ADRA is still seeking funds to help poor communities to build more straw-bale houses. ADRA's ultimate goal is to transfer this technology to China. Chinese workers will be able to design and build Chinese-style straw-bale houses without external technical assistance. So far, we have been able to implement a great part of the project successfully. Hundreds of workers have been trained to build these houses. It is rewarding to see the great interest stimulated by some local partners who are presently making attempts to build straw-bale houses on their own.

Insulative ceramics for improved cooking stoves

by Dean Still [1] Dr Margaret Pinnell, Damon Ogle and Brad van Appel

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Conversion factors

Many of the graphs in this article use imperial units – to convert to metric units, use the following:
1lb = 0.45kg
Celcius = (Fahrenheit −32) × 0.5555

Why it is important to use insulating clays

Multiple tests of the Lorena stove, beginning in 1983, showed that placing materials with high thermal mass near the fire can have a negative effect on the responsiveness, fuel efficiency and clean burning of a cooking stove. (High thermal mass materials are those – such as mud – that absorb a lot of heat.) Because of this, when stoves are built from sand and clay, their efficiency, when tested in the laboratory, is not much better than that of the three-stone fire.

What other materials can be used? More efficient stoves, such as the Rocket stove (see *BP47*, page 36), produce such high temperatures in the combustion chamber (where the fire burns) that even metals can be destroyed, including stainless steel. Don O'Neal (HELPS International) and Dr Larry Winiarski, Aprovecho Technical Director, have found that cast-iron combustion chambers, though longer lasting, conduct heat so well that it makes the fire hard to start. They eventually located an alternative material: an inexpensive Guatemalan ceramic floor tile, called a *baldosa* in Spanish.

The *baldosa* is about an inch thick so the combustion chamber only weighs 18.5 lbs (Figure 1). Like all Rocket combustion chambers, it is surrounded by insulation – either wood ash or pumice rock.

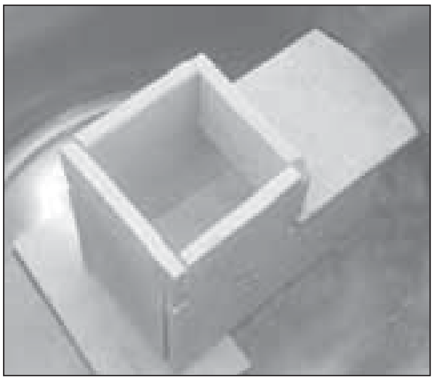

Figure 1 *Baldosa* being used to form Rocket stove combustion chamber

Recipes for making insulative ceramics

These recipes are intended to assist stove promoters to make insulative ceramics for use in improved wood-burning cook stoves. The clay insulation makes a good combustion chamber material for any type of stove and will improve efficiency. Each of these materials incorporates clay, which acts as a binder.

The clay forms a matrix around a filler which provides insulation. The filler can be a lightweight fireproof material (such as pumice, perlite or vermiculite), or an organic material (charcoal or sawdust). The organic material burns away leaving insulative air spaces in the clay matrix.

In all cases, the clay and filler are mixed with a predetermined amount of water and pressed into forms (moulds) to create bricks (Figure 2). The damp bricks are allowed to dry (which may take several weeks) and then fired at temperatures commonly obtained in pottery or brick kilns in Central America.

Our test samples were made using low-fired *raku* clay obtained from a local potters' supply store. In other countries, the best source of clay would be the kind used by local potters or brick makers. Almost everywhere, people have discovered clay mixes and firing techniques which create successful ceramics.

Figure 2 Stages in construction of a Rocket stove using low-density bricks

Insulative ceramics need to be lightweight (low density) to provide insulation and low thermal mass. At the same time they need to be physically durable to resist breakage and abrasion due to wood being poked into the back of the stove.

These two requirements oppose each other. Adding more filler to the mix will make the brick lighter and more insulative, but will also make it weaker. Adding clay will usually increase strength but makes the brick heavier. We feel that a good compromise is achieved in a brick having a density between 0.8 gm/cc and 0.4 gm/cc.

The recipes in Table 1 indicate the proportions, by weight, of various materials. We recommend these recipes as a starting point for making insulative ceramics. Variations in locally available clays and fillers will probably require adjusting these proportions to obtain the most desirable product.

Insulative ceramics used in stoves undergo repeated heating and cooling (thermal cycling), which may eventually produce tiny cracks that cause the material to crumble or break. All of these recipes seem to hold up well to thermal cycling. However, the only true test is to install them in a stove and use them for a long period under actual cooking conditions.

Sawdust/clay

In this formulation, fine sawdust was obtained by running coarse sawdust (from a construction site) through a #8 (2.36 mm) screen. Clay was added to the water and mixed by hand to form thick mud. Sawdust was then added,

Table 1 Insulative Ceramics

Type	Filler Grams	Clay (damp) Grams	Water Grams	Fired at Centrigrade	Density gr/cc
Sawdust	490	900	1300	1050	0.426
Charcoal	500	900	800	1050	0.671
Vermiculite	300	900	740	1050	0.732
Perlite mix	807	900	1833	1050	0.612
Pumice mix	1013	480	750	950	0.770

and the resulting material was pressed into rectangular moulds. Dried bricks were fired at 1050 °C.

Excellent insulative ceramics can be made using sawdust or other fine organic materials such as ground cocao husks or horse manure. The problem with this method comes in obtaining the large volumes of suitable material necessary for a commercial operation. Crop residues can be very difficult to break down into particles small enough to use in brick making.

This method would be a good approach in locations where there are sawmills or woodworking shops, which produce large amounts of waste sawdust.

Charcoal/clay

In this formulation, raw charcoal (not briquettes) was reduced to a fine powder using a hammer and grinder. The resulting powder was passed through a #8 screen.

Clay was hand mixed into water and the charcoal was added last. A rather runny slurry was poured into molds and allowed to dry. It was necessary to wait several days before the material dried enough that the mold could be removed. Dried bricks were fired at 1050 °C.

Charcoal can be found virtually everywhere and used where other filler materials are not available. Charcoal is much easier to reduce in size than other organic materials. Most of the charcoal will burn out of the matrix of the brick. Any charcoal which remains, is both lightweight and insulative.

Charcoal/clay bricks tend to shrink more than other materials during both the drying and firing processes. The final product seems to be lightweight and fairly durable, although full tests have not yet been run on this material.

Vermiculite/clay

In this formulation, commercial vermiculite (a soil additive) which is #8 (2.36 mm) and smaller in size is mixed directly with water and clay and pressed into moulds. Material is dried and fired at 1050 °C.

Vermiculite is a lightweight, cheap, fireproof material produced from natural mineral deposits in many parts of the world. It can be made into strong, lightweight insulative ceramics with very little effort. The flat, plate-like structure of vermiculite particles makes them both strong and very resistant to heat.

Vermiculite appears to be one of the best possible choices for making insulative ceramics.

Perlite mix/clay

For best results, perlite must be made into a graded mix before it can be combined with clay to form a brick. To prepare this mix, first separate the raw perlite into three component sizes: 3/8′ to #4 (9.5–4.75 mm), #4 to #8 (4.75–2.36 mm), and #8 (2.36 mm) and finer.

Recombine (by volume) two parts of the largest size, one part of the midsize, and seven parts of the smallest size to form the perlite mix. This mix can now be combined with clay and water and formed into a brick, which is dried and fired at 1050 °C.

Perlite is basically the mineral obsidian which has been heated up until it expands and becomes light. It is used as a soil additive and insulating material. Perlite mineral deposits occur in many countries, but the expanded product is only available in countries which have commercial ‘expanding’ plants. Where it is available, it is both inexpensive and plentiful.

Perlite/clay bricks are some of the lightest usable ceramic materials we have produced so far.

Pumice mix/clay

Pumice, like perlite, produces the best results when it is made into a graded mix. Care should be taken to obtain the lightest possible pumice to prepare the mix. Naturally occurring volcanic sand, which is often found with pumice, may be quite heavy and unsuitable for use in insulative ceramics. It may be necessary to crush larger pieces of pumice to obtain the necessary small sizes.

The mix is prepared by separating pumice into three sizes: ½′ to #4 (12.5–4.75 mm), #4 to #8 (4.75–2.36 mm), and #8 (2.36 mm) and smaller. In this case, the components are recombined (by volume) in the proportion of two parts of the largest size, one part of the midsize, and four parts of the smallest size. Clay is added to water and mixed to form thin mud. The pumice mix is then added and the material is pressed into moulds.

Considerable tamping or pressing may be necessary to work out the air and form a solid brick. The mould can be removed immediately and the brick allowed to dry for several days before firing at 950 °C.

Pumice is widely available in many parts of the world and is cheap and abundant. Close attention to quality control is required, and this could be a problem in many locations. It is very easy to turn a lightweight insulative brick into a heavy non-insulating one through inattention to detail. Pumice (and perlite as well) is sensitive to high heat (above 1100 °C). Over-firing will cause the pumice particles to shrink and turn red, resulting in an inferior product. Despite these concerns, pumice provides a great opportunity to

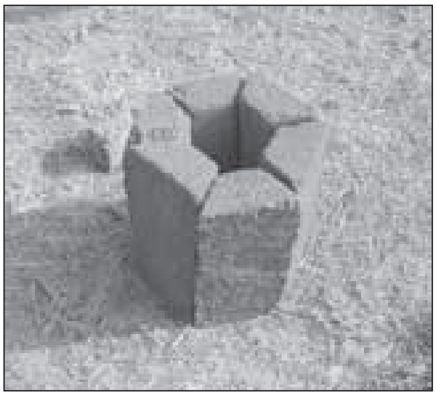

Figure 3 Pumice/clay combustion chamber

Theme

supply large numbers of very inexpensive insulative ceramics in many areas of the world (Figure 3).

Why it is important to use insulating clays

Appreciating that clay seemed a promising base material for Rocket combustion chambers, teams of researchers conducted more comprehensive testing to determine strength, durability, insulative quality, etc. This research resulted in several 'home-made' insulative clay recipes. In the Rocket stove combustion chamber, six insulative clay bricks (11½″ high by 2½″ thick) make up a hexagonal cylinder surrounding a 4″ diameter chimney. Sticks of wood enter the bottom of the chimney through a hole sawn in the bricks.

Making the Rocket combustion chamber from separate bricks has resulted in a reduced tendency to crack. The bricks have held up so far in durability tests and they help to make a hot, clean burning fire.

Tests have been done of same-sized brick combustion chambers made from adobe, home-made clay insulation, common brick, *baldosa*, and light-weight metal.

The following four graphs show the average results of three tests using each of the four materials. They reflect how heat passed into the four materials as 1½ lbs of wood was burnt.

Results

Shown in Figures 4–7.

Findings

The average temperatures ½ inch from the fire within the home-made clay insulation reached 906 ˚F. At the same place the *baldosa*/vermiculite combination rose up to 764 ˚F with the sensors ½ inch within the adobe. The more massive walls inside the heavier combustion chamber are much cooler. Cooler fires make more smoke.

In these tests, the graph shows that the better insulator allows a steep rise to higher temperatures. Also, the three lines on the graph for the better insulator are further apart, i.e., heat passes more slowly through the material so there are bigger differences in the temperatures recorded at a increasing distance from the heat source. The maximum difference between the furthest apart sensors in the home-made clay insulation was 839 ˚F. In the *baldosa*/vermiculite test the maximum difference was 439 ˚F. But in both the common brick and adobe combustion chambers the greatest difference was much lower (275 ˚F and 173 ˚F) – this tells us that heat is escaping more quickly through the walls, instead of going to the pot.

Fuel efficiency was affected by the weight of the combustion chamber, for 5 lbs of water being boiled. However, it can be seen that the differences in fuel efficiency created by the four earthen materials are not large and all four ceramic materials are satisfactory (Figure 8).

Each Rocket stove with any material in the combustion chamber did better in laboratory tests than the three-stone fire (the pot 'skirt' helps to raise efficiencies). A larger difference is seen in an additional test of a sheet metal combustion chamber which was appreciably faster than the ceramic types.

Noting the success of the very low mass sheet metal combustion chamber reinforces the design principle of lowering the mass of material around the fire.

The responsiveness of the stove and the speed at which water boiled was dramatically affected by the material used. The 5 lbs of water boiled at the following times:

- Adobe 16.5 minutes
- Common Brick 17.5 minutes
- Baldosa 19.2 minutes
- Home made clay insulation 12.7 minutes

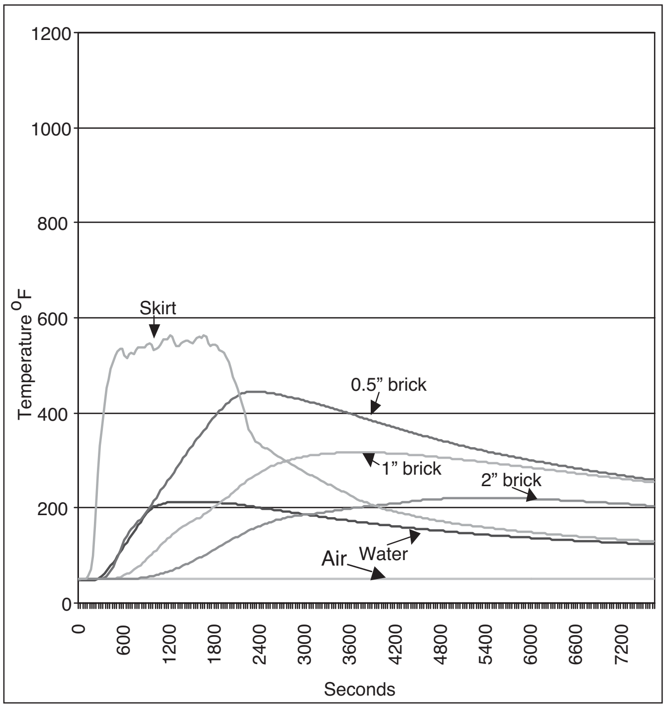

Figure 4 Average of three adobe brick tests

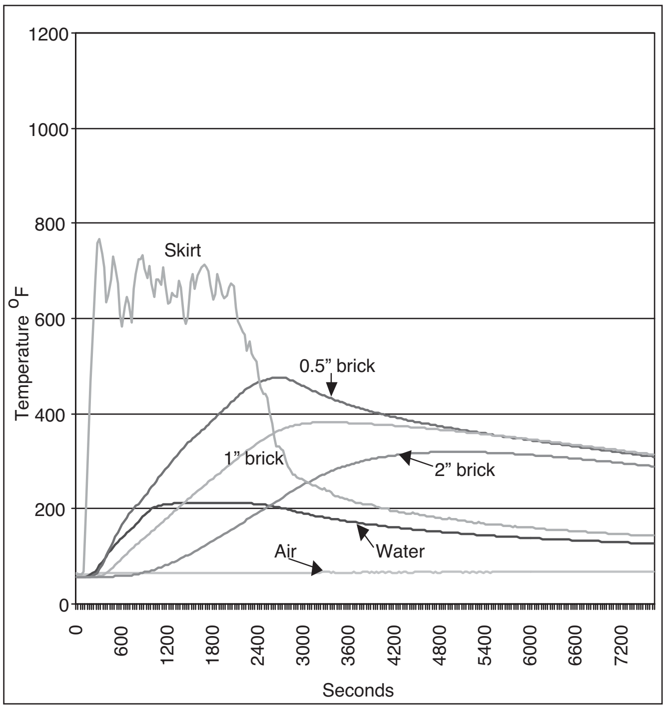

Figure 5 Average of three common brick tests

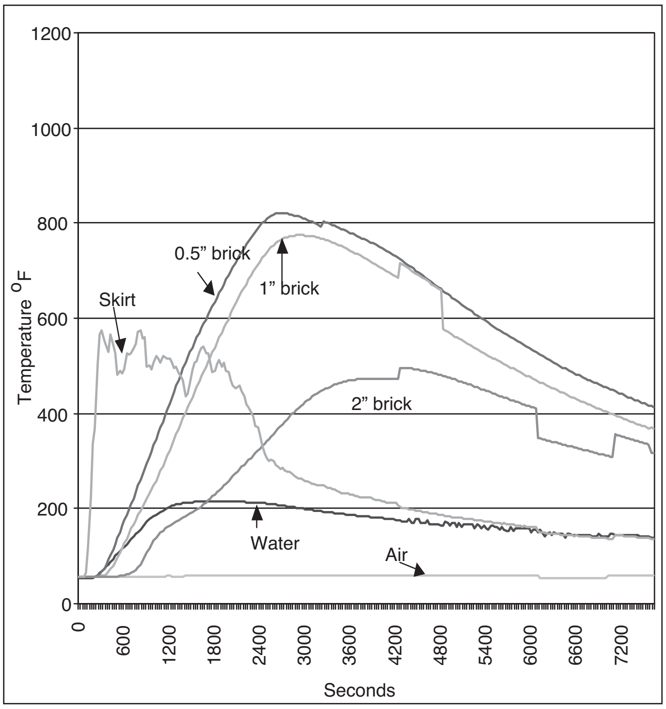

Figure 6 Average of three *baldosa* tests

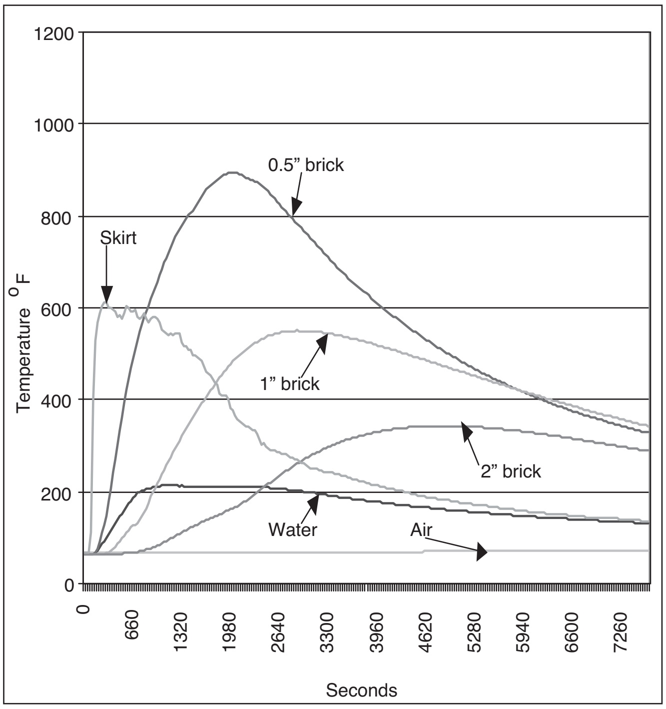

Figure 7 Average of three home-made clay insulation tests

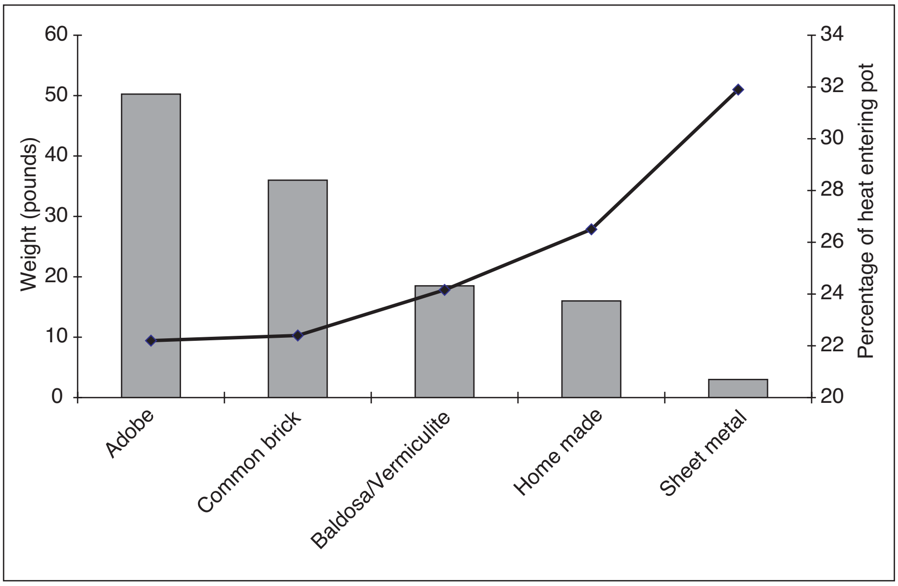

Figure 8 Percentage of heat entering the pot

Does material choice affect combustion temperatures?

Follow-up tests were performed on the clay insulation, adobe and low mass metal combustion chambers. The stoves were fired as hot as possible without creating excess smoke or charcoal. During a 45-minute period, temperatures were recorded using PICO software at 3″, 8″ and 11″ up from the bottom of the combustion chamber, at the inside face of the Rocket combustion chamber and at the top of the chimney for both the adobe and clay insulation combustion chambers. The results of this comparison showed that temperatures are higher in an insulated combustion chamber.

Distance	Adobe	Home-made clay
3″	1123 °F	1383 °F
8″	513 °F	1148 °F
11″	622 °F	1113 °F
Exit	1148 °F	1573 °F

It was not feasible to drill into the low mass stove to replicate the tests done on the two ceramic stoves. But exit temperatures found during a similar test reached 1592 ˚F.

Conclusions

Replacing heavy clay and sand materials next to the fire with lightweight ceramic insulation helps any type of stove to burn hotter and cleaner. More of the heat from the fire goes into the pot, not into the body of the stove. Local potters and brick makers can make the clay insulation by changing recipes. Making bricks that form combustion chambers helps to reduce cracking because the space between the bricks allows them room to expand and contract as they are heated and cooled.

If you want to see more about how to make insulative clay combustion chambers and have access to the web, visit http://www.ecoharmony.net/hedon/insulation.php

The author wishes to acknowledge the teams who created and tested the ceramic mixes. The teams comprised: Ken Goyer, Damon Ogle, Dean Still and Mike Hatfield in the Aprovecho laboratory and in Central America; and Dr Margaret Pinnell at University of Dayton and Dr Dale Andreatta at SEA Associates.

Implementing policy decisions to conserve forest reserves in Tanzania – a case study

by Bariki K. Kaale, TASONABI, PO Box 8550, Dar es Salaam, Tanzania. Email: bkkaale@yahoo.com

Background

Tanzania is a country famous for its natural and cultural heritage. It has an expansive variety of ecosystems containing some of the world's richest and most diverse plant and animal communities. With nearly 20% of its land area receiving protective or multi-use status, the government is committed to the people and environment of Tanzania. However, many challenges remain in the face of the rapid social and economic changes under way.

As Tanzania's traditionally subsistence-based population continues to grow, degradation to the environment is becoming an increasingly serious concern. The shrinking availability of forest products, arable land and clean water is diminishing the ability of people, both rural and urban, to maintain their livelihoods. In order to reduce poverty, it is imperative to develop and encourage sustainable living practices that balance the needs of communities with that of conservation.

The organization TASONABI has a mission to contribute and participate effectively in national efforts to eradicate poverty in Tanzania by enhancing the sustainable management and conservation of natural resources and biodiversity through concerted efforts with other stakeholders. The organization recognizes the intrinsic value and function of natural resources in maintaining the Earth's ecological systems and the essential role they must play in poverty eradication. Development endeavours can be accomplished without sacrificing the natural environment. Conservation is not only valuable in its own right, but is critical for improving the quality of life for all people.

Legislation

Between 1961 and 1997, Tanzania lost over 10 million hectare of forests. To prevent the loss of further forest cover, and to intensify the contribution of forestry to poverty eradication, concerted efforts have been made by the Ministry of Natural Resources and Tourism (FBD) with active participation of the local community and other stakeholders. In 1998, the New National Forest Policy was enacted by the parliament. The policy vests the responsibility of managing the forest resources sustainably under the forest sector (FBD) in collaboration with other stakeholders. FBD has produced a handbook, *Community-Based Forest Management Guidelines,* in English and Swahili. At national level, FBD has developed an effective policy framework and legal instruments for conserving forests.

To enhance effective implementation of the policy, in-depth studies were conducted leading to a Tanzania National Forestry Programme 2001–2010 (NFP). Workshops and seminars from district to national level were conducted to discuss findings of the studies and to obtain inputs from relevant stakeholders. The NFP that was finalized in 2001 contained a comprehensive chapter on 'Current Status and Trends in the Forest Sector' and solutions to identified weaknesses. Through a fast-track system, the Forest Act 2002 was enacted by parliament to facilitate efficient implementation of the New Forest Policy and the NFP.

However, proven current field experience has confirmed that serious degradation of forests and deforestation is still taking place in almost all regions of Tanzania, with negative impacts on environmental conservation and poverty reduction efforts. The alarming rate at which destruction of forest reserves is taking place in the Coast region (a few minutes drive from Dar es Salaam City) illustrates the unique challenges facing the forestry sector of Tanzania.

Case study: Kazimzumbwi National Forest Reserve

Kazimzumbwi is a protective Central Government Forest Reserve with an area of 4887 hectares, an elevation of 120–280 m and red to brown sandy-clay soils (Figure 1). The climate is influenced by tropical East African oceanic temperatures that are slightly modified by altitude. Annual average rainfall of 1236 mm has been recorded for Kisarawe town. A peak annual rainfall of 2385 mm and a minimum annual rainfall of 502 mm have been recorded between 1936 and 1970 at Kisarawe town. One permanent stream arises from the forest reserve and provides the water supply to local communities living close to the forest. Records show that in the past, when the forest was more extensive and connected to the Pugu Forest Reserve, streams arising from the forest area used to supply all the water needed in Dar es Salaam. Based on the recent surveys, some of the biodiversity resources of Kazimzumbwi Forest Reserve that are now at their advanced stage of vanishing include: plants 236 species; mammals 32 species; reptiles 28 species; amphibians 19 species; and butterflies 140 species.

Local opinion

The Wildlife Conservation Society of Tanzania (WCST), working in Kazimzumbwi and Pugu Forest Reserves, has intensified its efforts in raising public awareness of surrounding villagers about the need to conserve the forests. However, villagers indicated that ongoing initiatives will fail unless efforts are made to deal with corrupt forest workers and non-performing

Figure 1 Kazimzumbwi National Forest (photo: Nike Doggart, TFCG)

Theme

forest officers. Villagers wanted explanations of the criteria used by officials to pay forest workers who have failed to conserve forest reserves under their jurisdiction (Figure 2). However, village government officials and the Village Environmental Committee members have recently reported that illegal charcoal burning is conducted openly in the forest reserves (Figure 3). From initial felling of trees, to final stage of charcoal production, it takes on average one month working continuously in the field. Smoke from charcoal kilns can be seen by people far away from the reserve. With the obvious indicators, villagers want to know how paid government workers fail to stop illegal charcoal burning in the small forest of Kazimzumbwi?

Law enforcement

Photographs, video tape and GPS coordinates, taken during an informal visit to Kazimzumbwi Forest Reserve at the start of February 2003, were shown to forest officials at FBD and Kisarawe District and articles about the forest degradation appeared in the press. Senior officials from the Director of Forestry and Beekeeping and CARE-Misitu Yetu Project visited Kazimzumbwi in mid-February 2003. They visited a different site to the earlier visit, and reported the alarming rate of charcoal burning that was ongoing in the forest reserve. The Director of Forestry and Beekeeping released funds to intensify law enforcement in Kazimzumbwi Forest Reserve and other forest reserves in Coast region as a short-term solution to the reported problem.

Figure 2 Failure to conserve forest reserves (photo: Nike Doggart, TFCG)

Figure 3 Sack of charcoal produced in the Forest Reserve (photo: Nike Doggart, TFCG)

However, local government officials and Village Environmental Committee members have recently reported and claimed that their conservation efforts are frustrated by some corrupt forest guards who are participating in illegal charcoal and timber harvests in Kazimzumbwi Forest Reserve (Figures 4 and 5). Discussions held with Kisarawe district officials identify the urgent need for:

- structured work plans and greater supervision
- a more pro-active approach to identifying and prosecuting those making charcoal illegally
- clearer terms of reference on which authority is responsible for particular actions
- sufficient skilled manpower and working resources
- recruitment of competent and effective managers for national forest reserves.

Other factors contributing to illegal charcoal burning in the reserve include:

- poverty in the surrounding population with few income generation opportunities
- rapid population growth in Dar es Salaam City with high demand for charcoal for cooking with little affordable energy alternatives to the majority of households.

Goal and objectives of TASONABI

The main goal of TASONABI is to assist FBD and Kisarawe District Authorities to minimize further destruction in Kazimzumbwi Forest Reserve by the end of year 2004.

The main objective is to contribute to improved livelihoods of the local communities surrounding Kazimzumbwi Forest Reserve through improved environmental conservation and increased supply of forest products from village forest reserves and farmland tree growing. The destruction of Kazimzumbwi Forest Reserve is ongoing even as this edition goes to press.

Figures 4 and 5 Timber harvesting (photos: Nike Doggart, TFCG)

Key lessons learned so far on the ongoing win–win strategy for conserving Kazimzumbwi are:

- Many people have shown enthusiastic support for saving Kazimzumbwi Forest Reserve.
- FBD has shown keen interest in the ongoing efforts to conserve Kazimzumbwi Forest Reserve and other forest reserves in Tanzania.
- It is suggested that FBD and Kisarawe District Authority should facilitate NGOs and private sector organizations to take action and stop the illegal harvesting of wood from Kazimzumbwi.

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Fuelling development

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Introduction

Fuelwood is a serious issue in many developing nations. Internationally, traditional forest resources are being reduced faster than they are being replanted. Substantial energy can be obtained from burning ordinary agricultural and commercial residues. This paper discusses a wet, low-pressure briquetting process, which may be more appropriate where infrastructure is weak, supply of raw materials is inconsistent, and market populations are widely dispersed over inaccessible areas.

This process was initially developed in the mid 1980s by Dr Benjamin Bryant, at the University of Washington, US. The Legacy Foundation developed a field-based extension package for the technology, leading to briquette technology usage in South America, the Caribbean, West, East and Southern Africa and Asia (12 countries to date).

The production process is located within (or adjacent to) the user community, in areas of high environmental and population pressure, where there are few fuel alternatives, as cost determines what people will buy. The process requires modest technical skills and low start-up costs. The results in an optimum production unit are increased income and environmental protection.

Wet, low-pressure process

Fuel briquetting is not always the right solution. Easily-replicated affordable equipment and a localized market for the finished briquettes make the technology ideal for entrepreneurs in marginalized communities in rural or urban areas. The wet, low-pressure, manual briquette making requires good access to water (up to 300 litres per day), ample sunshine for drying and available human resources.

Resources

These include fallen, browned, nutrient-leached leaves, grasses, stems roots stalks, nuisance aquatic plants such as water hyacinth and agro-processing by-products such as rice husks, bagasse, sawdust, choir, scrap paper, and cardboard.

Production

Production comprises material gathering, preparation, pressing (Figure 1) and drying. The preparation process is the most critical: fibrous agricultural residues are chopped, the fibres are partially removed using either hammer mills, hand cranked devices or mortar and pestle. Once the materials are broken down sufficiently, these residues are blended in selected proportions with other residues or with commercial processing wastes to achieve the desired characteristics for the briquette.

This type of fuel briquette does not require binders such as starch, glues, resins or waxes as binding is achieved by mixing – effectively interlocking – the softened fibres of the agro-residues in a water slurry. These fibres also encapsulate more granular materials (sawdust, charcoal fines, rice husks), other more pithy residues and more resistant materials (stems stalks etc.), as water is driven out during compression using the briquette press and perforated pipe mould.

The required pressure in the wet briquetting process is easily provided by an average artisan, for continuous production of briquettes measuring 10 cm diameter × 7.5 cm height. At the basic level of the technology, the equipment comprises a relatively easily made wood hand-operated compound lever press. The press can be altered to fit local resources and skills and is usually made on site in a few days.

In Haiti for example, hydraulic jacks and concrete beams are used because of a shortage of wood. In other areas a single long lever is used because of the cost of metal bolts.

A production team of six trained and experienced entrepreneurs will typically produce between 750 and 1200 briquettes per working day, including material gathering and processing. Generally, it takes two to three months for a trained team to achieve this capacity.

Figure 1 Demonstrating briquetting machine

The briquettes are dried in the open air for several days before use. They can be stored indefinitely and used through the rainy season as long as they are kept reasonably dry.

Use of agro-residues

In rural areas, the raw residues required for these briquettes tend not to conflict with soil quality; the much preferred residues will be dry and brown and already leached of soil building nutrients. As a matter of convenience, these agro-residues tend to be collected not over the main fields but from depressions and up against natural windbreaks.

Following combustion, some of the residue is returned to the ground as ash. In all areas, commercial processing residues such as rice husks, peanut shells, maize-milling residues, sawdust, coir dust or waste papers are highly favoured as they do not require any chopping, pounding or decomposition. These processed residues can constitute up to 50% of an agro-residue based briquette and thus can reduce considerably the processing labour.

Heat output

Heat output varies with blend; a 45% charcoal fines and agro-residue

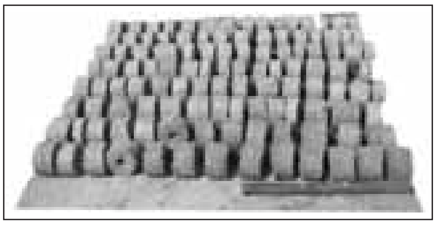

Figure 2 Briquettes made from residues

blend briquette, weighing 130 gm, will nearly equal the heat output of charcoal of the same weight in an open fire. Water hyacinth and certain other blends will produce only slow heat for extended periods, while others, particularly with oils in the original material, will burn with an intensity equalling a wood fire.

The briquette burns efficiently due to a hole in its centre which provides both a chimney and insulation around the combustion chamber. The advantage is relatively high efficiency with open/three-stone fires or standard uninsulated metal stoves where wood and charcoal burn at very low efficiencies. Conversely, stoves with higher efficiencies offer less of an advantage for the briquette than they do for wood or charcoal.

Cooking

Cooking with these briquettes is easy and efficient. As noted, with ample air supply and allowance for ash removal from beneath, fuel briquettes burn easily using either a traditional three-stone or metal stove.

Culturally, there appear to be no problems in making or using fuel briquettes made from agro-residues; food reportedly tastes the same as it does when cooked with wood. Other uses are also relevant: use of dried eucalyptus leaves creates special aromas which have long been popular for improved breathing; the leaves of the neem tree repel insects and pine or cedar fronds make a pleasant aroma. Burned briquettes leave only a wispy white ash by product, suggesting relatively good combustion.

Generating income

To the majority of producers and users, the prime advantage of these briquettes is the increase in daily income, so the economic viability must be evaluated before any training commences.

- **Materials** Most are residues and waste products, gathered in small quantities (one production team uses a maximum of 150 kg of all ingredients per day).
- **Equipment** The materials for the basic press costs commercially US$100–175. It can be made on site without electricity or welding and lasts eight years with basic maintenance.
- **Market** The market is usually within easy walking distance of the micro-entrepreneur. There is little required other than word of mouth advertising, though media advertising does help the producers. Distribution is either off the doorstep or delivered in sacks to local restaurants, hotels or other local institutions.
- **Labour** The cost of the briquette is therefore primarily dependent upon the cost of labour. With good training and a few months' experience, six persons can produce sufficient fuel for – on average – 75 families of six or seven persons each.

For the briquettes to be economically viable, the six daily wages divided by 75 families will give the cost of briquette fuel for one family for one day. This should be compared with how much the family spends on other fuels.

In rural areas, where firewood is 'free' for the gathering, hauling and chopping, the production of the equivalent in fuel briquettes has proved far less time-consuming, safer and less back-breaking. Project figures indicate that where people have to walk more than three hours a week for the family wood fuel supply, they are better off making briquettes, other factors being equal. In many cases the producers are former wood and charcoal makers, thus employment is not adversely affected.

The average fuelwood consumption is 1.2 kg per person per day, as quoted in FAO, the Swedish Beijer Institute, the World Bank, the French SEED organization and others. At this rate, one press team, in full production, reaching a market of 750 persons per day, is effectively reducing demand by over 300 tonnes of fuelwood per year, while giving employment to six persons.

Extension

The aim is to establish small income-producing groups which are combating deforestation through non-subsidized fuel briquette making and sales. Business and marketing training of the producer groups is part of the project. Awareness-raising and public promotion is the other part. For those projects with higher budgets, Legacy Foundation works with local partners to incorporate demonstrations, posters, graphics of many forms, in combination with newspaper, radio and video. We are experiencing a unique and growing network of colleagues who often can supply equipment locally, who are either trainers or project managers with direct training and production experience or who are conducting technical research in the 'briquette carrying capacities' of various land uses and forms, assessing heat values and thermal performance of various mixtures and developing a unique briquette gasifier stove.

To more effectively reach the growing demand for information about the technology, Legacy Foundation has recently compiled four manuals which address fuel briquette making, briquette press construction, extension training and group formation and advanced technology issues regarding alternative fuel technologies. These manuals are currently in print and are available on CD and as directly downloadable electronic versions. For detailed ordering information or information regarding extension training programmes please email info@legacyfound.org.

We feel that with such skills and exposure, the producer and trainer can enter a whole new world in which they gain respect, enhance their local identity, preserve their environment for their children and feed themselves in the process. In this way the briquettes do more than provide a cooking fuel: they fuel development.

Richard Stanley has worked with NGOs primarily in East Africa and South America for many years. With a background in renewable energy projects, he and his family are currently based in Kampala, Uganda.

Participatory approach for linking rural energy transitions and developmental needs in Uttar Pradesh, India

by Malini Ranganathan, Rakesh Prasad and P B Singh, Tata Energy Research Institute, New Delhi 110 003, India

Uttar Pradesh

Uttar Pradesh, the fourth largest state in India, is a culturally and geographically diverse region, with dense forests, meadows, perennial rivers, and fertile soil. The region plays an important role in the politics, education, culture, industry, agriculture and tourism of India. Uttar Pradesh is surrounded by Bihar in the East, Madhya Pradesh in the South, Rajasthan, Delhi, Himachal Pradesh and Haryana in the west and Uttaranchal in the north, and Nepal touches the northern border.

The main industries in the region are cement manufacture, vegetable oils, textiles, cotton yarn, sugar, jute, locks and scissors, carpet, brassware, glassware and bangles. Known for ages for its rich ancient traditions, Uttar Pradesh abounds in places of religious importance. The state is specially known for its cultural centres, so tourism is important to the economy.

The article describes field-level experiences in four villages in North India where rural energy interventions were carried out involving energy-efficient and renewable energy devices for cooking, lighting and water pumping. A valuable lesson learned is that transitions to improved fuels and devices in rural areas can be facilitated by meaningful participation of the community, with clearly defined roles for all members. Importantly, a participatory approach ensures that the energy transitions are also in line with the developmental needs of the community and, as such, aid in meeting them.

Introduction – why community participation?

For more than 700 million rural dwellers in India, biomass sources and kerosene continue to be mainstay fuels for meeting the domestic energy needs of cooking and lighting. The latest results from the National Sample Survey Organisation (2001) reveal that 76% of rural Indian households use firewood and wood chips as a primary source of energy for cooking and 51% use kerosene as a primary source for lighting[1].

The majority of initiatives for alleviating rural energy poverty in India have been carried out through national programmes instituted by the government. These are large-scale and target-driven in nature, often not building in sufficient channels for local participation in planning and decision making, nor ensuring adequate follow-up measures. The best known programmes include the National Program for Biogas Development, disseminating 3.3 million domestic biogas plants to date, and the National Program for Improved Cookstoves with a record of 33.8 million cookstoves to date[2].

Programmes that hinge on technology dissemination alone, however, cannot effectively bring about transitions to cleaner and more efficient fuels in rural areas. Experience has shown that a lack of user awareness rapidly erodes the efficacy of so-called improved devices. Further, the absence of community participation and feedback in planning, installing and maintaining the devices undermine the long-term sustainability of the technology transfer[3]. To this end, feedback from women – the largest beneficiaries of improved cooking technologies – is crucial in the planning and feasibility stages. Likewise, the involvement of local youth, in terms of raising awareness and providing labour inputs, ensures that all members of the community partake in and benefit from the intervention.

With regard to installation and maintenance, village-level energy management institutions empower the beneficiaries by reducing dependence on erratically available outside support. Apart from these important reasons, local participation is essential for assessing the developmental needs of the community. These needs may not be directly related to energy needs, but could benefit from improvements in household and village energy systems.

Nature of participatory approach

TERI, New Delhi, undertook village and household-level energy interventions from 1998 onwards in four villages in Jagdishpur Block of Sultanpur District, located in the northern Indian state of Uttar Pradesh[4]. The four villages – Mangrauli, Baghmeera, Harpalpur and Purebaz – were chosen because of their location in an area where TERI has had prior field experience, and also due to the villagers' enthusiasm and willingness to co-operate. Better quality energy was a felt need among the community members.

The project was executed in a phased manner by involving various community members with specified roles. The energy devices proposed for the intervention included improved kerosene lighting devices, solar lanterns, solar home lighting systems, improved cookstoves (Figure 1), and biogas plants at the household level (in all four villages); and solar water pumps at the village level (in two of the villages) (Figure 2). The highlights of the main phases of the intervention are given below[5]:

Figure 1 Using an improved cookstove (photo: Rakesh Prasad)

Theme

Figure 2 Biogas plant installation (photo: Rakesh Prasad)

Figure 3 Children reading by the light of a solar lantern (photo: Rakesh Prasad)

Theme

Detailed surveys and feasibility studies

Two major types of surveys were undertaken prior to installation of the devices:

1. assessing local development priorities
2. appraising household energy consumption profiles.

Input from the women household heads was crucial for the surveys. The major findings of both surveys are summarised below.

- Employment opportunities and basic infrastructure topped the list of priorities in these villages. Villagers sought additional employment and an improvement in the water and electricity supply. They were also concerned that the abundance of dung in the area was not being put to good use.
- Women complained of poor lighting for cooking meals, and the presence of smoke inside their houses.
- All villagers were using wood (4.11 kg/day/household on average), mainly collected by the female members of the house who spent 2-4 hours per day in this activity. Eighty per cent were also using dung cake for cooking (2.9 kg/day/household), which was burned in a traditional mud stove without chimney (the Improved Cookstove Program has not reached these villages).

Designing the interventions

Based on the energy and development-related needs analysis of the preliminary surveys, appropriate energy-efficient and renewable energy technologies were selected for transfer to the villages and households. It was decided that in order to meet their need for employment, all labour and masonry work required for setting up the biogas plants and solar water pumps would be sourced from the villages. Community members were willing to undertake labour in exchange for the energy infrastructure provided through the intervention. In this process, those trained for post-installation maintenance services also drew employment from the intervention.

Solar drinking water

Installation of solar drinking water pumps in the villages of Harpalpur and Purebaz was the method sought to meet the drinking water demand. This was decided on the basis of water demand in the village, calculated to be around 30 000 to 35 000 litres per day. Thus a submersible pump of 900 Wp was selected which could pump 50 000 litres per day and could work up to the total head of 30 m. Dissemination of solar home lighting systems and solar lanterns to certain households was conceived as a means to meet the need for lighting.

Biogas

As mentioned above, a non-energy development concern revealed through the surveys was the issue of fertilizer wastage: although ample manure was generated in the villages, it was felt that the dung was not being utilized to its full potential. Come the rainy season, the manure is washed away, thus depriving the fields of organic fertilizer. The solution to this problem was sought through household biogas plants which use cow dung to generate cooking fuel, but also produce digested slurry that can be used as fertilizer in the fields. Those with livestock and land are ideally suited for installation of household biogas plants.

Cookstoves

Finally, improved cookstoves were looked upon as an appropriate technology for this region, since they are believed to generate less smoke. Improved kerosene lanterns, being not as smoky as the conventional ones, and solar lanterns and home lighting systems that enable better light at night, were also selected for the intervention.

Awareness generation

Where the education and exposure level of the concerned beneficiaries is low, suspicion of the technology in question is likely to be a hindering factor. Hence an important strategy in raising awareness is the actual demonstration of the technologies; in essence a 'learning by seeing' experience. Seeing the devices operated by fellow villagers has the positive effect of convincing potential users that the technologies are reliable. In our intervention, it was found that even an impromptu demonstration of solar lanterns (Figure 3) at night in a religious ceremony worked extremely well in convincing others of the efficacy of lanterns.

Other methods used to raise awareness included promotional village-level campaigns. Such campaigns include village level meetings; house-to-house contact in demonstrating the technology efficiency; cultural programmes such as puppet shows depicting real-life situations; market fairs; painting competitions; and creative slogans coined in the local dialect. Young people were involved in the campaign through environmental educational programmes in the classrooms. They were deployed to write catchy slogans and draw wall paintings proclaiming the benefits of renewable and efficient energy devices. These were put up in public places like village roads, market places, and school buildings.

'Willingness to pay'

Along with the awareness generation initiatives, villagers were sounded out for their willingness to pay for the technologies and devices. It was discovered that the promotional campaigns had the desired effect of raising both the minimum amount the villagers were willing to spend on the devices, as well as the number of households who expressed an interest in purchasing them. Although the project provided the energy devices at a subsidized rate to the villagers (both through the government subsidy and through a corporate sponsorship), many households were willing to meet up to 40% of the total cost of certain technologies, such as improved kerosene lanterns. While the demand for solar lanterns was only 80 prior to the campaign, it shot up to 250 after the campaign. Finally, 201 lanterns were disseminated. Similarly, while only ten households were interested in biogas plants before the campaign, 29 biogas plants were finally implemented due to an increase in demand. The demand for the improved technologies continues to increase today.

Capacity building for village institutions and individuals

In each of the four villages selected for the intervention, a village-level 'energy management committee' was set up. These institutions consisted of local masons who were provided with on-the-job training for construction of biogas plants and cook stoves, and local technicians who were trained in the installation of solar photovoltaic systems (Figure 4). In Harpalpur and Purebaz, where solar water pumps were set up, a special committee consisting of five members was formed for ensuring proper maintenance of the pump and for holding regular meetings to discuss any problems. These committees were involved right through the intervention and were also active in motivating the youth groups and spreading awareness throughout the village. In addition, individual households received training for repair and maintenance of the improved kerosene and solar lanterns and improved cook stoves.

Conclusions

The technologies for dissemination in the villages of Jagdishpur Block were selected due to the felt need for better quality energy, as well as the potential ways in which the provision of improved energy could be linked to developmental needs. The use of participatory methods – from the feasibility stage, to the awareness generation stage to the installation stage – ensured that the energy–development linkage could be established. Further, it ensured that the intervention was designed and executed in an appropriate manner by delineating different roles for female, youth and male members of the community. Thus each group is given an important role in the participatory method, keeping in mind the socio-cultural sensitivities of the community. For example, while women were involved to a greater degree in the decision-making processes, and youth were given greater prominence in awareness generation and promotion, men were given charge of the installation, and operation and maintenance procedures. Thus, community participation appropriate to the local norms and practices aids in achieving the ultimate purpose of the intervention, namely the transfer of energy technologies that are more efficient and advantageous for the health of the end-users.

Figure 4 Solar water pump installation in Harpalpur village (photo: Rakesh Prasad)

The authors belong to the Tata Energy Research Institute (TERI), New Delhi. Rakesh Prasad (Research Associate) was one of the Principal Investigators of the project described above. Malini Ranganathan (Research Associate) and P.B. Singh (Research Assistant) are in the Renewable Energy Technology Applications and Rural Energy groups respectively at TERI. The article is based on field experiences and the TERI project 'Implementation of energy efficient technologies in selected villages of Jagdispur, District Sultanpur, U.P' (report no. 98RE62). *The authors gratefully acknowledge the support of BPCL India Ltd.* *For any further questions, the corresponding authors, Rakesh Prasad and Malini Ranganathan, may be contacted at rakeshp@teri.res.in and malinir@teri.res.in.*

Notes

1. National Sample Survey Organisation (2001) *Energy Used by Indian Households – Fifty Fifth Round,* July 1999-2000. New Delhi: Ministry of Statistics and Program Implementation.
2. Ministry of Non-Conventional Energy Sources (2002). For the latest statistics on their rural energy programmes and technology dissemination, see their website **www.mnes.nic.in**
3. For further reading on the relevance of participatory methods in rural energy planning, see Malhotra, P., Dutta, S., Ramana, V. (1998) *Participatory Rural Energy Planning – A Handbook*. New Delhi: Tata Energy Research Institute.
4. Bharat Petroleum Corporation Limited, a public sector oil company sponsored the project and provided a subsidy on the devices. This, along with the existing government subsidies and individual user contributions, met the total cost of the devices.
5. The methodology described here has been adapted from the TERI project report 'Implementation of energy efficient technologies in selected villages of Jagdispur, District Sultanpur, U.P.' (report no. 98RE62), Tata Energy Research Institute, 2000.

Theme

Decentralised household energy planning for selected villages in Shivalik belt of Haryana, India

by Chetan Kumar, Tata Energy Research Institute, D S Block, Habitat Centre, Lodi Road, Delhi-110003, India

Theme

Background

This article is based on a household survey conducted in selected villages located near the forest area of Haryana Shivalik, India. The state of Haryana, which is located in the north-western part of India, has a meagre forest cover of 3.8% of its geographical area. About 40% of these forests are located in Shivalik belt, which lies in the foothills of the Himalayan range, and has been identified as one of the most degraded rainfed agro-ecosystem of the country (Mittal et al. 2000).

Since the early 1800s, the Shivalik Hill Forests have been used as grazing areas by neighbouring village communities. Agriculture being labour intensive, people kept large herds of cattle and grazed them in the forest. The open access nature of the forests led to severe erosion, which also affected agricultural production. Decreasing agricultural production led to increased pressure on the forest area.

The destruction of the fragile ecosystem of Shivaliks began as a result of fire, reckless felling to provide timber to the Royal Navy, and settlement by the people from the plains who brought large herds of cattle to the hills for grazing and cleared large areas for agriculture. This led to dense forests being replaced by bare hill slopes with scattered thorny bushes. Serious soil erosion became quite common and the once perennial streams became seasonal torrents washing tonnes of sand and boulders down from the hills. The sudden and violent character of floods was a clear indication of the complete denudation of the catchment areas. Degradation of forest resources in the region has been a matter of serious concern for more than half a decade.

Rural people in the area largely depend upon fuelwood, crop residues, and cattle dung for meeting their basic energy needs for cooking and heating. Meeting their energy requirements in a sustainable manner continues to be a major challenge for them. Almost 75% of the total rural energy consumption is in the domestic sector. The average daily fuel consumption per household/family in the area is around 6.5 kg. The villages near the forest meet about 60% of their fuel requirements from government forests, about 30% from cattle dung and 10% from agricultural land (HFD, 2000). For meeting their cooking energy requirements, villagers depend predominantly on biomass fuels often burnt in inefficient traditional cook stoves. The inefficient burning of the biomass in traditional stoves creates high levels of indoor air pollution, which cause eye-related and respiratory diseases among women and children in the rural areas. To alleviate these problems, promotion is required for both efficient recycling of cattle dung, and the use of energy-efficient devices, such as improved efficient stoves, to conserve fuel wood and reduce domestic air pollution.

Figure 1 Cattle dung cake commonly used by the villagers for cooking

Survey objective

The objective of the survey was to carry out a feasibility assessment to popularize and pilot an energy plan of energy-efficient technologies. The main focus was on the domestic sector in selected villages near the forest areas of Pinjore and Yamuna Nagar Forest Division in Haryana.

Project method

Four representative villages were selected in the two forests divisions in Haryana, located at a distance of 6–20 km from the district headquarters. All study villages are electrified and connected by a metalled road, and have primary and middle level schools with in village boundary. The nearest markets of the villages are located within 10 km from the village boundaries.

Energy use pattern

The energy use pattern in the selected villages is mainly based on biomass. Most of the households use biomass fuels like fuelwood (including shrubs, twigs and branches) and dung cake for cooking. The survey revealed that the fuelwood is used in all the households and dung cake is used in about 80% of the study households for cooking in all the villages. Fuelwood, mainly from shrubs, is collected from village land and forest areas. Besides this, some of the households use kerosene stoves and liquefied petroleum gas (LPG) for cooking.

In all the study villages, no households use crop residues as a fuel, as these are used as either fodder or as organic manure in the cultivated fields. Although all the villages are electrified, some of them use kerosene for lighting, especially the local lamps (*dibris*).

Figure 2 summarizes the energy use pattern and consumption for different fuels in the selected villages. Cooking was found to be the main energy-based end-use in all the villages. The traditional two-hole mud stove (*chulha*) without a chimney was the main cooking device. The survey showed that households use kerosene for lighting and wood for cooking.

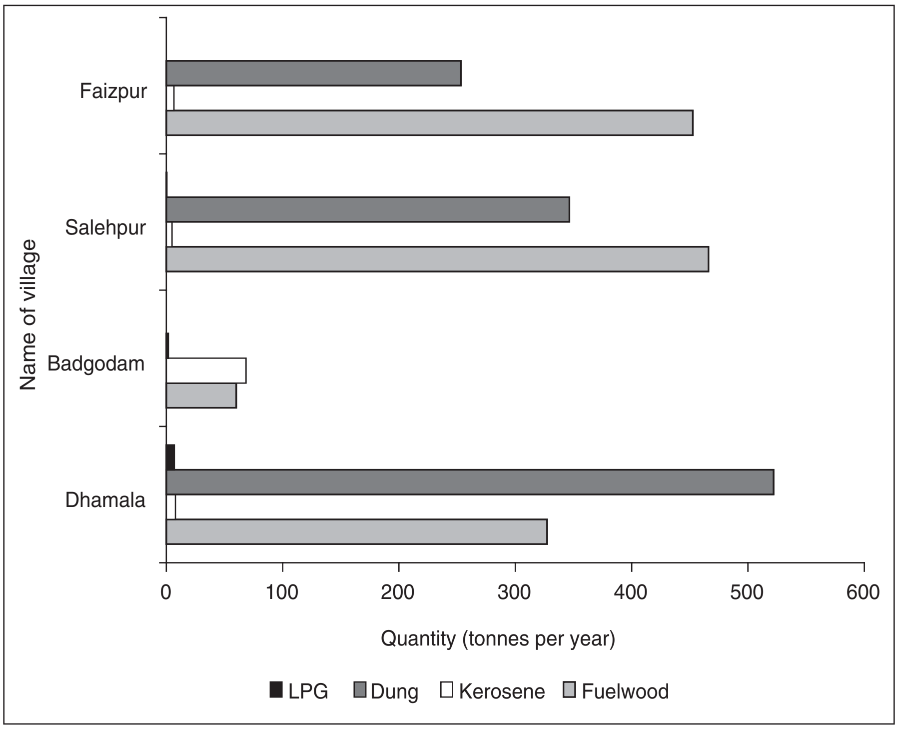

Figure 2 Fuel consumption pattern in selected villages in Haryana Shivalik
Source: TERI, 2000

Intervention plan

The proposed intervention plans for all the villages are based on discussions and feasibility assessment of different rural energy technologies within the villages. The emphasis of the intervention plan is largely focused on the domestic sector. Within the domestic sector, as all villages are electrified, the interventions are focused on cooking and lighting. All the villages face the problem of fuelwood collection; hence the focus was to identify alternative technologies which can meet the cooking, water heating and lighting requirements.

The intervention plan is based on the observations made, and on the response of the villages, during household and village surveys. Technologies were identified according to the preferences of the communities shown in figure 3.

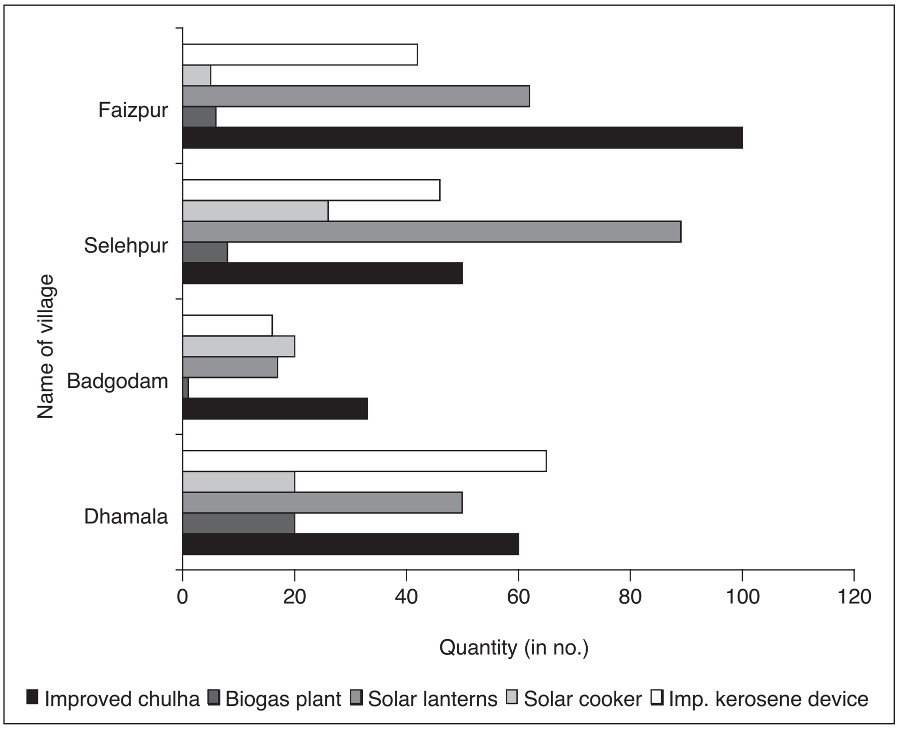

Figure 3 Technology preference of selected village
Source: TERI, 2000

It can be seen that technologies for conserving fuelwood, using improved stoves (*chulhas*), solar lanterns for lighting, and improved kerosene devices are important components of the energy intervention plan.

A summary, by village, of planned interventions is as follows:

Dhamala village

The proposed energy plan for Dhamala village is based on a scarcity of fuelwood in the village. All the village occupants travel considerable distances to meet their fuel requirements. Due to the scarcity of wood, a few households are shifting to kerosene and LPG for cooking. The improved cook stove is one technology which can be disseminated at household level, especially in low-income households which are largely dependent on fuelwood. There is potential for biogas in households that own more than three head of cattle. Of the 39 households which expressed a preference for biogas plants, it was feasible for just 20 to have it installed (Table 1). Households in the higher economic group were found to be aware of solar

Table 1 Energy intervention plan, Dhamala village

Intervention area	Potential (Number)	Energy saving (in tonnes fuelwood/year)
Cooking	Improved cook stove (60)	2.4
	Biogas (20)	32
	Solar cooker (20)	3
Water heating	Solar water heater (1)	10
Lighting	Solar lanterns (50)	3.0
	DLS (5)	0.6

Source: TERI, 2000

Table 2 Energy intervention plan, Badgodam village

Intervention area	Potential (Number)	Energy saving (in tonnes fuelwood/year)
Cooking	Improved cook stove (33)	13
	Biogas (1)	1.6
	Solar cooker (20)	3
Lighting	Solar lanterns (17)	1.0

Source: TERI, 2000

cookers, solar lanterns and domestic lighting systems (DLS); these technologies could also be promoted.

Besides these household level interventions, a community solar water heater can be installed in the village.

Badgodam village

The energy plan for Badgodam includes biogas plants, improved cook stoves and management systems for an energy plantation to strengthen the supply of biomass (fuelwood). Table 2 gives the proposed set of interventions in the village.

Thirty-three improved stoves (*chulhas*) can be disseminated in households which are largely dependent on village forests (Table 2). Biogas potential is very low due to insufficient cattle. Two households gave their preference for biogas plants out of which only one can be installed. Fifty per cent of households were found to be aware of solar lanterns and wanted to adopt theses devices.

Salehpur village

The intervention plan for Salehpur is given in table 3. The proposed plan is based on the feasibility of different technologies and demand of renewable energy devices in the village. The fuelwood demand can be suitably addressed by following interventions.

Faizpur village

The improved cook stove is one technology that can be disseminated in households which have low purchasing capacity, but large dependence on fuelwood. Six households of the total surveyed showed a preference for biogas plants. Most of the men were aware of improved cooking systems and solar lanterns and domestic lighting systems (DLS). Table 4 gives the energy intervention plan for the village.

Table 3 Intervention plan for Salehpur village

Intervention area	Potential (Number)	Energy saving (in tonnes fuelwood/year)
Cooking	Improved cook stove (50)	20
	Biogas (8)	13
	Solar cooker (26)	3.9
Water heating	Solar water heater (1)	10
Lighting	Solar lanterns (89)	5.3

Source: TERI, 2000

Table 4 Energy intervention plan, Faizpur village

Intervention area	Potential (Number)	Energy saving (in tonnes fuelwood/year)
Cooking	Improved cookstove (100)	40
	Biogas (6)	9.6
	Solar cooker (5)	0.7
Water heating	Solar water heater (1)	10
Lighting	Solar lanterns (62)	3.7

Source: TERI, 2000

Figure 4 Cook stoves presently used in the study villages

Conclusion

The proposed intervention plan is based on micro-level implementation focusing mainly on the domestic sector.The plan promotes conservation of biomass fuels, with consequent reduction of environmental pressures on adjoining forest areas. Added to this is the impact of improved technologies on the health of women. For implementing the energy plan, a management system will be devised with the active role of local village organizations and its capacity building role will be enhanced. Finally, it is highly desirable that both forestry and energy sector activities in the area be integrated to enhance their impact.

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Theme

Livelihoods in the urban biomass sector – realities and threats*

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Whether it be wood, charcoal or simply branches, leaves and twigs, traditional biomass fuel remains the most important source of household energy for more than two billion people in today's world.

Associated with the mass consumption of these biomass resources are concerns about environment and health, and much research has been carried out to identify and measure impacts such as deforestation from unsustainable wood and charcoal production, and smoke-related illnesses that can occur when biomass fuel is used in poorly ventilated kitchens.

In the last few decades attempts have been made to reduce biomass consumption through a range of interventions that create the conditions for 'fuel substitution' to occur.

If measures are effective in reducing biomass consumption, what might this mean for the livelihoods of the many people who serve the biomass trade?

This question formed the basis of a recently completed DFID KaR project, carried out by Energy for Sustainable Development Ltd (ESD) and a team of experts from Ethiopia, Kenya and Uganda. All three countries have experienced various fuel substitution measures in recent years, such as:

- **Addis Ababa**: Subsidies on electricity and the introduction of electric Mitad stoves (used for baking the Ethiopian staple bread injera) led to a massive increase in ownership of these stoves – from 13% in 1985 to over 70% by 1995.
- **Nairobi**: Liberalisation of the petroleum sector in 1994 brought favourable conditions for the supply and marketing of LPG, though the price currently limits its use to upper and middle income classes. Kerosene has been subsidized, and more than 94% of Kenya's population currently use kerosene.
- **Kampala:** Electricity was subsidized during the 1960s to reach the poorest, but tariffs have been rising since 1993, especially since privatization of the Uganda Electricity Board in 1999. Interventions to promote LPG and kerosene have so far not been widely implemented.

What is 'fuel substitution'?

The term 'fuel substitution' encompasses a number of measures, including:

- **more efficient use of biomass** (i.e. by means of efficient end-use appliances and technologies such as improved stoves)
- **use of modern fuels or energy sources** (e.g. kerosene, LPG, electricity, solar PV, etc)

In both cases, this could mean either:

- **fuel switching** – termination of the use of one type of fuel and uptake of another source of energy in its place
- **Inter-fuel substitution**: introduction of new energy sources that do not replace, but supplement, existing fuel types.

One of the first objectives of this research was to characterize the biomass sector in these three cities. If fuel substitution measures have the potential to threaten livelihoods, who would be affected and on what scale?

Through a series of tallies held at major entry points to each city, and at key vending locations, the team identified a diverse range of actors engaged in transportation and sales of both wood and charcoal, and, in the case of Addis Ababa, branches, leaves and twigs. The full range of actors and some key social characteristics are summarised in Table 1.

This broad spectrum of activities corresponds to an equally wide range of livelihood circumstances for fuel suppliers. The circumstances for each group were examined in terms of access to a number of different assets, as identified in the Sustainable Livelihoods approach.

In all three countries, some common trends were identified:

- The difference in income levels of motorized versus non-motorized transporters and wholesale versus retail vendors is significant.
- The correlation between gender and type of activity means that it

Case Study 1 – A 'Branches, leaves and twigs' (BLT) vendor in Addis

Mrs B, a 30-year-old widow with two children, has seen the price of BLT increase, having an impact on her ability to secure sales, and she states that her daily income has decreased almost by half in the last four years. Her only reason for remaining in the business is the lack of an alternative. One of the main problems expressed by Mrs B is the lack of a secure vending place. The main space she now occupies is on a roadside, although she vends in and around a designated market place. As a result, she is exposed to occasional harassment.

Her accommodation, an informally sub-let single room in a family house, was affordable to begin with, but has been gradually increasing at the same time that her income has been decreasing. With two children to care for, and no other income to rely on, her situation illustrates extreme vulnerability in this sector.

Table 1 Social characterisation of biomass fuel suppliers

Fuel transporters	Vendors
Mode: Lorries, trucks **Countries:** All In all three countries, it is only **men** that transport fuel by motorized means. As local plantations are depleted, and fuel supplies become more distant from city centres, this mode of transport has been increasing.	**Type:** Wholesale, depots **Countries:** All In Ethiopia and Kenya, it is **mainly men** and very few women that own and work in wood or charcoal depots. In Uganda, women as well as men are engaged in wholesale of charcoal, but this is considered a ‘dirty’ business.
Mode: Human carriers **Countries:** Ethiopia, Kenya In Ethiopia, 70% of the human carrier sample were **women**. In Kenya, only a small proportion of fuel transportation is undertaken manually. When this does occur, it is usually by **women**.	**Type:** Shops/Kiosks **Countries:** Ethiopia, Uganda Fuel is usually sold in these outlets alongside other goods. These are usually owned by **men** in Ethiopia, whilst in Uganda, charcoal vending activities are dominated by **women**.
Mode: Donkeys **Countries:** Ethiopia Donkeys are the second most common mode of non-motorized transportation in Addis Ababa. While only 25% of female carriers have access to donkeys, 82% of **men** are able to use donkeys for transporting fuel.	**Type:** Market stalls (Figure 1) **Countries:** All In Ethiopia, it is mainly **women** who operate in markets, whilst in Kenya it is mainly **men** that are involved in all types of fuel vending. In Uganda, markets are decreasing in importance, as neighbourhood-based sales increase.
Mode: Bicycles **Countries:** Kenya, Uganda In Kampala, bicycle transportation is usually by self-producers bringing charcoal into the city. Bicycles are also used to transport fuel from depots to customers. These are predominantly **male** activities.	**Type:** Neighbourhood vendors **Countries:** All These vendors sell very small quantities of fuel to regular customers, and keep a limited stock. As with all charcoal vending activities in Uganda, this category is dominated by **women**. The same is true in Ethiopia.
Mode: Wheelbarrows and carts **Countries:** Kenya, Uganda Wheelbarrows and carts are mainly used to transport fuel across town, linking vendors with domestic or commercial consumers. Like bicycles, it is mainly **men** that transport fuel in this way.	**Type:** Roadside vendors **Countries:** All In Uganda, it is mainly women selling firewood. Roadside vendors are a relatively recent phenomenon. In Ethiopia, these are also mainly **women** who have self-collected the fuel they sell.

is only men that are able to earn a decent wage from the fuel supply business.

- Physical assets were identified as the most important asset for all suppliers. Examples include vehicles, donkeys, a secure vending location and storage space.
- Women are concentrated in activities in which access to these assets is extremely limited, for example manual transportation of fuel, market sales and roadside vending.
- While women have strong social assets in terms of networking with other women, and membership of community associations, it is men who are most able to use their social assets to enhance their livelihoods. Greater access to social assets enables men to obtain credit, avoid harassment with authorities or access shared resources such as donkeys or other vehicles.

Figure 1 A fuel market in Addis Ababa

Those with fewest assets are the most vulnerable position within this sector. However, in order to really judge what this means for the population of fuel suppliers as a whole, it is necessary to consider the proportions of fuel suppliers engaged in each type of activity.

Results of the tallies carried out at the beginning of the research are shown in Table 2. They indicate that the most secure and well-paid activities, i.e. motorized transportation and wholesale vending, are in short supply, with a high proportion of suppliers employed in non-motorized transportation and the retail sector. If broken down further, these statistics show a clear concentration of women in the lowest-paid, most arduous and least secure jobs.

In this study, clear evidence of livelihood loss as a direct result of fuel substitution measures has been very difficult to pinpoint. Two possible reasons for this are:

- Fuel substitution policies are yet to be effective in reducing overall quantities of biomass fuel consumed in urban areas. This may be due to increasing urban populations or the fact that greater efficiency does not reduce fuel use but means that the same amount of fuel is being used, but for additional purposes, such as boiling water.
- Individuals do not relate changes in their livelihood circumstances

Table 2 Breakdown of fuel supplier tally by activity

		Transporters		Vendors	
City	Sample size	Motorized	Non-motorized	Wholesalers	Retailers
Addis Ababa	9537	8%	50%	7%	35%
Kampala	7487	20%	10%	10%	59%
Nairobi TBC	24%	34%	42%		

Table 3 Recommendations for action

Assets	Indicators	Livelihood improvements	Recommendations
Financial	● Ability to save. ● Access to credit. ● Increased income.	● Savings can support households in times of low fuel supply and demand. ● Credit may allow purchase of labour-saving aids, e.g. vehicles and can improve sustainabilityof businesses.	● Formalization of traditional fuel supply business is likely to improve the conditions for credit and other business activities. However, we should also recognize that the informality of the sector has its own benefits, such as ease of entry, a certain degree of freedom and autonomy, invisibility and escape from government control.
Physical	● Storage space. ● Designated selling areas. ● Adequate and sheltered premises.	● Less frequent journeys, security. ● Reduced scope for harassment. ● Reduced risk of damage to supplies from rain, etc.	● The extent to which formalization of this sector should occur is, therefore, an issue for further investigation, and this should include an analysis of the likely impacts on the most vulnerable fuel suppliers.*
Social	● Business networks. ● Community groups. ● Supplier organizations.	● Collective bargaining power to influence prices and quality of wood and charcoal, especially for women. ● Improved security (collection, transportation in groups); better access to shared resources (e.g. vehicles), especially for women.	● Recognise the valuable contribution of fuel suppliers, and especially women, in supplying an important and affordable source of fuel for institutional, commercial and domestic consumers.
Human	● Education. ● Training.	● Improvement of opportunities to pursue alternatives in times of low supply and demand, or in case of displacement as a result of fuel substitution.	● Ensure that, where significant losses of employment are likely, sustainable and gender-neutral re-employment or training programmes are pursued.
Natural	● Sustainable production.	● Security of supply; ● reduced scope for harassment; ● improvements to status of sector; ● reduction in necessity for motorized transportation.	● Develop existing and new policies and strategies for the rational and efficient production, transportation and marketing of biomass fuels and household energy efficiency (e.g., improved stoves).

*DFID KaR 'Livelihood Substitution' Contract No. R8175 is currently researching ways to integrate the interests and needs of the poor into infrastructure and services development, which includes sector formalization.

with interventions at a macro level – especially since they are often unaware of the policies that have been introduced.

Nevertheless, individual case studies indicate that the lack of alternative livelihood options for the vast majority of fuel suppliers makes them extremely vulnerable to changes in the market for traditional fuel. Fuel substitution measures that do not consider this group are likely to have serious impacts on them.

Perhaps more importantly, however, this research has shown that, right now, the greatest threat to livelihoods of fuel suppliers relates to the environment in which these actors operate. The conditions of the fuel sector itself have a direct impact on those who are trying to make a living in this business.

- **Biomass regulatory measures**, such as charcoal bans in Kenya and Ethiopia have created conditions in which corruption and institutional harassment flourish, thus increasing the vulnerability of suppliers, and particularly harming those who cannot afford to pay bribes and are more visible to the authorities, e.g. roadside vendors.
- **Lack of sustainable forestry policies** mean that, as local sources of fuel are depleted, it becomes increasingly necessary to use motorized transport to bring supplies to the capital. As a male-dominated activity, this pushes women out of the sector.
- **Social conventions** mean that attitudes towards the traditional fuel sector are generally negative, partly due to its illegal nature, and also as a result of the nature of the work itself, since charcoal is a naturally dirty commodity. The results indicate that women tend to have lower negotiating power, are excluded from the motorized transport sector, and are very rarely present in the wholesale supply of fuel.

Social and institutional factors take time to change. However, by improving people's access to assets, their vulnerability can be reduced, placing them in a better position to positively influence the structures and processes surrounding them.

In this regard, the team has identified a number of measures that can improve both the existing circumstances of suppliers and better equip them to deal with any future impacts that may result from successful fuel substitution policies (Table 3).

Toll on Human Resources due to lack of Energy, Water, Sanitation and their Health Impacts in Rural North India

by Jyoti K. Parikh[1], Vijay Laxmi, Shyam Karmakar and Pramod Dabrase, Indira Gandhi Institute of Development Research (IGIDR), Mumbai, INDIA

1. Author to whom correspondence should be addressed

Introduction

A comprehensive survey was conducted covering 10 265 rural households from 118 villages in three states of Rural North India (RNI) comprising:

- Uttar Pradesh (includes Uttaranchal) – flood plain of the Ganges
- Rajasthan – dry desert
- Himachal Pradesh – mountainous region

The survey, which aimed to address issues of energy, water, sanitation and health, included a health survey of 58 768 individuals. However, health results are presented here only for direct responses reported for adults (above age 15 years). The three states were selected to reflect the socio-economic groups and differing terrain within the region. The sample was random and representative of the villages and households of Rural Northern India.

The data were analysed and the results scaled up to gain some macro-level policy insights for Rural North India. The three sampled states cover much of this region, as shown in Table 1.

Table 1 Percentage of Rural North India represented by sample households

	%
Land area	68.50
Estimated inhabited villages	86.78
Total population (2001 census: urban + rural)	77.17
Rural population (2001 census)	82.48
Rural households (2001 estimated)	82.71
Net Domestic Product at current prices (1998-99)	62.75

Box 1 Choosing households

Stage 1: Districts from each state were selected.
Stage 2: The number of households selected in each district was based on the distribution of all rural households in these districts.
Stage 3: The villages were grouped according to size of population: fewer than 1000; 1000–3000 and 3000–5000. Villages with populations of more than 5000 were excluded from the sample because they resemble semi urban areas.
Stage 4: Households within villages were selected using systematic random sampling.

Survey design

The survey was conducted at individual, household and village level.

Individual level

- Physiological characteristics: age, sex, height, and weight and behavioural characteristics such as smoking habits and literacy.
- Occupation, time activity pattern, cooking involvement, years of cooking and other behaviour.

Household level data was collected to get a comprehensive picture of socio-economic conditions, energy use pattern, water and sanitation related facilities:

- housing characteristics, number of rooms, type of house and type of kitchen, location of kitchen, number of doors and windows in the kitchen
- cooking behaviour, environmental priorities of women, number of meals cooked using different fuels, hours of cooking, cooking involvement of different age groups and type of involvement (Figure 1)
- willingness to pay to improve water and sanitation facilities
- energy-use pattern included information on consumption of biofuels and commercial fuels for cooking, place of procurement of cooking fuel, time, distance and effort involved in procurement, progress along the energy ladder etc.
- people's willingness to reduce the impact of indoor air pollution including information on people's choice for type of intervention, reason for not using clean fuels, willingness to pay for additional clean fuel and additional demand for kerosene in the area
- water availability, source of collection, efforts required to fetch water, problems faced in collection, quality, storage and filtering practices, etc.
- data on availability of sanitation and sewerage facilities and willingness to contribute to improve water, sanitation and sewerage facilities was also collected through the survey.

Village level surveys

- Validation of data acquired at household and individual level (Figure 3).
- Overall picture of the village.

Figure 1 Polluted kitchen environment due to cooking

Box 2 Energy in Rural North India

Biofuel

- 96.6% households use biofuel for cooking
- 56 million tonnes biofuels are gathered annually (Figure 2)
- 35 million households spend 8000 million hours annually in gathering biofuel
- Forests contribute 39% of the fuelwood needed
- 33 % of rural households are willing to contribute to the cost of reducing smoke in their kitchen

Kerosene

- 4.9% of households use kerosene for cooking
- 34% of the households that use kerosene as a cooking fuel buy it on the open market
- 97% of households procure it from fair price shops
- 1.8 million households use 1.74 million tonnes of kerosene per annum for cooking and lighting
- 49% of households are willing to pay more than the market price to purchase kerosene for cooking

LPG

- 4.95% households use LPG for cooking

Biogas

- 0.2% of households use biogas for cooking

Electrification

- 63% of households are electrified

Figure 2 35 million households spend 8000 million hours annually in gathering biofuel

Health

- A questionnaire produced by the Medical Research Council (MRC) in the UK in 1986 for respiratory symptoms was followed, which included questions in six symptom categories.
- Measurement of PEF (peak expiratory flow), an indicator lung function and the extent to which it is impaired, was also conducted.
- Symptoms of diseases such as worms in stool, diarrhoea and jaundice were recorded.

Figure 3 Woman wearing air sampler to measure pollution levels

Box 3 Water and sanitation in Rural North India

Water

- 62% of households do not have a water supply in their home
- 22.78 million households spend 32 billion hours per annum collecting water from outside the home

Sanitation

- 10% of households have a toilet facility inside the house
- 1% of households use community toilets
- Only 5.6 % of households have a sewerage facility

Proportion of households willing to pay for:

- Clean drinking water – 9 %
- Community based drinking water supply – 25 %
- 'In-home' toilets – 29 %
- Community toilets – 22 %
- Sewerage facilities – 27 %

Toll on human resources

Smoke-related diseases

Analysis of the prevalence of respiratory diseases shows that 24 million adults (17% of the total rural adults) show respiratory symptoms. Out of these, 15 million adults (13% of the total rural adults) have serious respiratory symptoms. These respiratory symptoms, confirmed by medical practitioners, are shown in Figure 4 and indicate that:

- 6 million adults (4.3% of the total rural adults) suffer from bronchitis
- 4 million (2.9%) suffer from pulmonary tuberculosis
- 3 million adults (2.1%) from chest infections
- 2 million (1.45%) from bronchial asthma.

Bronchitis and pulmonary tuberculosis are strongly associated with indoor pollution, and the latter two may possibly act as triggering factors.

Water-related diseases

Prevalence of water related diseases is recorded in 13 million adults. These diseases occur mainly due to unhygienic conditions and the non-availability of clean drinking water.

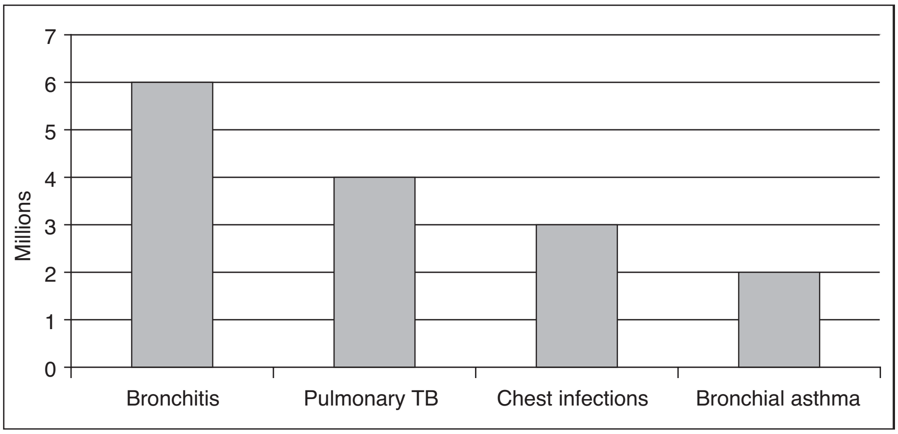

Figure 4 Prevalence of respiratory diseases

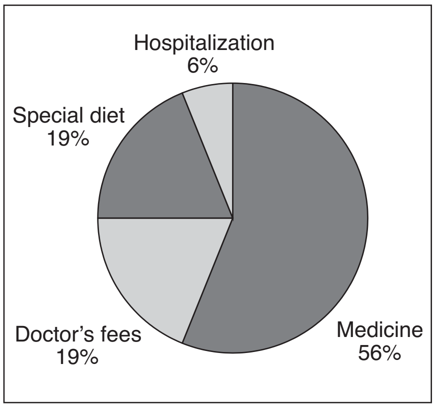

Figure 5 Respiratory disease costs

Water related diseases, measured in the previous one month showed that of the 13 million adults (9.4% of total adults):

- 5.5 million adults (3.9%) pass worms in stool
- 7.8 million adults (5.7%) suffer from diarrhoea; lasting more than 2 days
- 1.7 million adults (1.2%) suffer from jaundice in past 2 years

The cost of respiratory and water-related diseases

Despite considerable government subsidies to health centres, the rural adult population spend considerable sums of money on healthcare, as shown in Table 2 and Figures 5, 6 and 7.

Economic burden due to energy, water, sanitation and health problems per year

The economic burden comprises the time spent in both water and fuel collection, the direct expenditure on health by adults, and the economic value of working days lost due to the health impacts of poor energy, water and sanitation provision – as shown in Table 2.

Table 2 Economic burden due to energy, water, sanitation and health problems (per year)

	Energy (a)	Water (b)	Total (a+b)
Days spent/lost (million)			
● Days+ spent in collection	822	3212	4034
● Days lost due to diseases	260	521	781
TOTAL	1082	3733	4815
Monetary value* of working days spent/lost (Rs billion)			
● Fuelwood gathering and water collection	49	193	242
● Due to diseases	16	31	47
Direct expenditure on health (Rs billion)	21	13	34
Total economic loss (due to improper energy and water facilities and due to health impacts of their procurement and use)	86	237	323

1 Days spent in fuelwood gathering and water collection are given in column (a) and (b) respectively
2 Respiratory and eye-related diseases are shown under energy column (a) and water and sanitation related diseases under water column (b)
+ Taking 10 hours as a standard working hours per day
* Includes imputed cost per working day taken at Rs 60 per day (approx. wage rate)

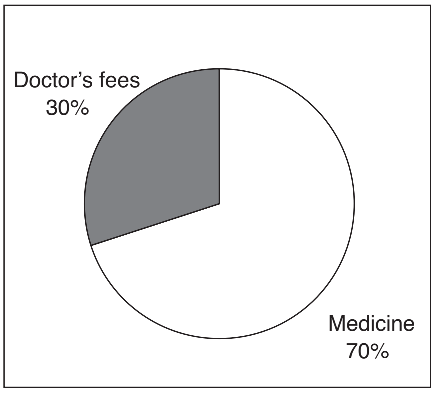

Figure 6 Costs associated with eye disease

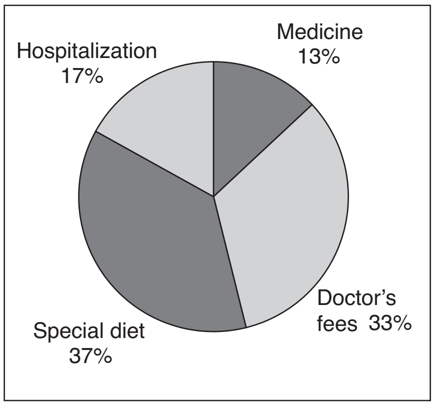

Figure 7 Costs associated with water-related disease

Conclusions

From the above table, it can be seen that a loss of 781 million working days (two to three work days per adult) per year due to respiratory and water-related diseases leads to a loss of Rs 47 billion per annum, if calculated using normal wages. The real cost, however, due to improper energy and water facilities, and health impacts of their procurement and use, amounts to a loss of more than Rs 320 billion per annum.

Gender dimensions in household energy

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In much of the literature, it has been argued and proved that women are the primary managers of household energy. Women collect and use firewood resources effectively and efficiently, and process grain with traditional technologies using their own energy. Women as the primary users of household energy, have expertise in local biomass resources, including their properties as fuels and in adopting fuel-saving techniques. Women can differentiate between those woodfuels that burn fast with high heat, those that burn slowly with low heat, and those that smoke (Kelkar, 1995; Cecelski, 1995). In fact, women have become excellent managers of energy resources in order to survive, because they are the ones most affected by energy crises (Batliwala and Reddy, 1996:3).

Gender dimensions become particularly important when energy is a part of the household system. Knowing how men and women participate in the household energy system and how they benefit is important and needs to be analysed.

Gender roles in management of household energy resources

Women are highly involved in managing household energy resources, Table 1 presents the gender roles in firewood management in one of the villages in Kavre district, Nepal.

Table 1 Gender roles in firewood management

	Who cuts down trees? (%)	Who collects firewood? (%)	Who stores it? (%)
Women	35	65	71
Men	44	5	3
Both	21	30	26
Total	**100**	**100**	**100**

Source: Field survey, 2002

As indicated in Table 1, more than 60 per cent of women were involved in collecting and storing firewood. The highest percentages of men were involved in cutting trees, as women were considered not to be strong enough for this task. In some cases, both men and women were involved in cutting, collecting and storing the firewood as well. Especially, in *Tamang* households, men also shared women's work in managing energy resources, unlike with *Brahmin* households.

Figure 1 shows the average time taken by women for collecting a bundle of firewood in one of the villages in the Kavre district of Nepal.

The 48 per cent of respondents (women) who mentioned that it took two hours for them to collect the firewood gathered it from their own fields or community forest. Those who collected firewood either from private or public forest other than their own took longer than those collecting from their own fields or community forest.

Access to biomass resources

It is important to know how women manage the biomass resources, since biomass still occupies a major share in the household energy system. During my field visits, I found that women collect firewood from around their fields to fulfil their minimum fuel requirements. Often women used agricultural residues and fodder sticks for cooking. Since the local community had access to the community forest (community forest is the forest owned and managed by the community and accessed solely by that community), women could collect the fallen dry firewood from this forest regularly. They would collect high quality firewood once or twice a year when the community forest needed to be cleared.

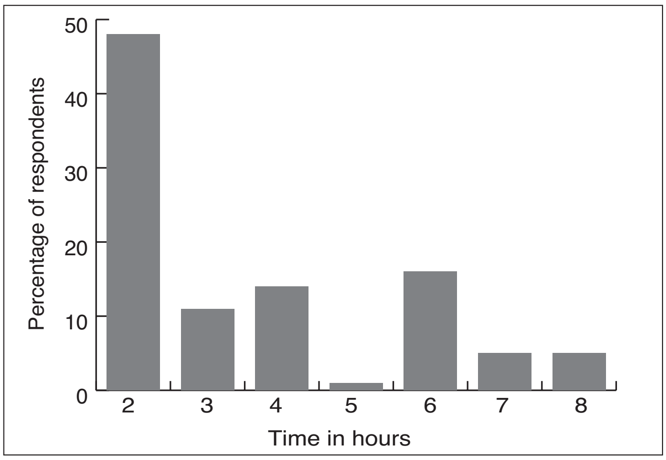

Figure 1 Average time for collecting fuelwood
Source: Field survey, 2002

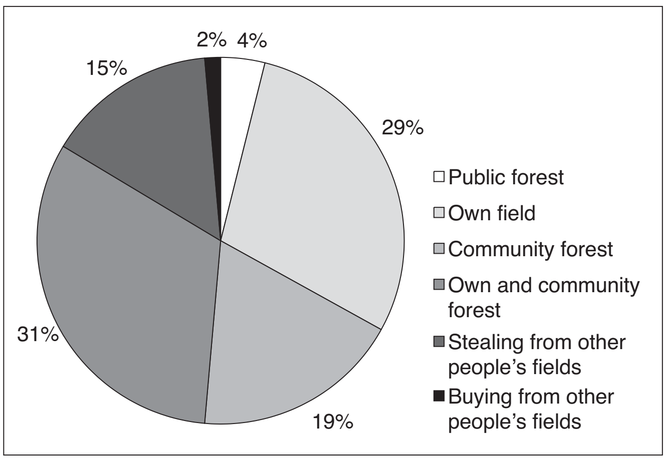

Figure 2 Access to firewood
Source: Field survey, 2002

In areas where there is no access to community forests, women would go to the government-owned public forest – with access to all – or to privately-owned forest far away from the village once or twice a month to collect high quality firewood. Thus, I observed that the deforestation was not directly related to the consumption of firewood at local level. There could have been some other reasons for deforestation like commercial logging or selling the firewood in market place.

Figure 2 shows the different access of firewood to the women in one of the village in Kavre district.

As shown in the diagram, the highest percentage of women have access to firewood in their own fields and forests, and in the community forest. The second highest percentage of women get firewood from their own fields and forest. I found that the fodder grasses collected from around the fields were used to fulfil their firewood requirements as well. The tops of the grasses were used for livestock feeding and the residue sticks were used as firewood for cooking. It was interesting to note that around 16 per cent of the women steal firewood from private forests; this was because they had neither their own forests nor access to public forests. Women were sometimes at risk while stealing firewood from other people's forests. A few women bought firewood from other people's forests.

Gender implications of alternative energy technologies

Have alternative technologies made women's lives easier and better? Answering this question is a tricky one. Both men and women have access to alternative energy technologies (AETs). My fieldwork experience in Nepal has provided me with a greater insight into how women feel about AETs, and their adoption of technology. There is no doubt that women wish to have access to technologies like biogas, improved stoves and micro-hydro electricity. Men and especially women have benefited from technologies such as these in many ways. Table 2 shows a gender analysis matrix (GAM) conducted with a few men and women's groups which summarizes the implications of micro-hydro plants (MHP) for men and women.

Looking at Table 2, it can be observed that MHP has positive implications for everyone, especially for reducing women's labour and time spent in processing activities. It also indicates that women's work has increased both in the morning and at night, through access to electric light. However, some women have found that they have more time for rest and leisure with access to micro-hydro for milling. With micro-hydro, women no longer need to fill up the kerosene lanterns and lights in each room, thus their time and work was reduced. Women have gained access to some income generating and social activities, such as incense making and adult literacy, with the lights available at night.

Similarly, there was a positive change in women's and men's attitude towards women's mobility and participation through the awareness raising implemented by the Rural Energy Development Program (REDP). This also helped in the eradication of a gambling habit of men, with positive implications for women and their culture.

Similarly, MHP has some benefits for men and the overall household. For instance, men felt more comfortable holding social gatherings with electric light. There was some possibility for men to become involved in income-generating activities. In addition, women's saved labour and time could be used for other household activities (such as more time for child care) or involvement in some income-generating and social activities as well. Overall, the analysis indicates more positive implications of MHP for women than for men.

Findings

During the focus group discussions with the users' group for biogas plant and improved cooking stoves (ICS), the women's group reported that the biogas stoves and ICS were very convenient means of cooking.

Women felt that these technologies reduced smoke diseases such as eye irritation and headaches, and reduced the work involved in cleaning and collecting firewood. Biogas stoves were especially easy for cooking light meal and snacks. It was reported that even men would get involved in preparing tea and light snacks with biogas stoves, which was not the case with traditional stoves. However, the biogas stoves were only used as a complementary stove to the traditional stoves and could not fulfil the variety of cooking needs of local women. For instance, they needed to use traditional stoves for cooking big meal during rituals and festivals. In addition, the biogas stoves frequently break down due to inadequate gas production. This caused them more troubles in cooking and sometimes it destroyed the taste of food. The women's group further reported that burning firewood in the traditional way was essential during the winter to warm their houses, and the firewood smoke made them less susceptible to insects.

Similarly, despite the convenience of micro-hydro milling, women sometimes liked to use the traditional way of processing such as *dhiki* (a traditional way of hulling grain) and *janto* (a traditional way of grinding grain), and the water mill for hulling and grinding grain, since grain and flour would be tastier than that from the power or the diesel mill. In addition, women preferred to use *dhiki* and *janto* for hulling and grinding small quantities of grain, which would be more costly to bring to the mill. Hence, the local women were using the traditional and alternative technologies as complementary to each other.

Women felt distanced with AETs since they were not much involved in the planning and management of such technologies. For instance, male members of a family mainly made the decisions on the location and installation of biogas plants, while women often had to operate the plants carrying water and dung, and mixing them together. In addition, women were not aware of the full potential of biogas plants, such as utilizing the biogas slurry for making good compost. In the same way, more men were involved in construction of the ICS, and women were not given a chance to address any technical problems concerning their use. Sometimes women destroyed the stoves because they did not find them convenient. The main

Table 2 Gender analysis matrix: micro-hydro user's group

	Labour	Time	Resources	Culture
Women	*Positive* Reduced workload for processing (rice hulling and grinding grains) Reduced work as no longer needed to light using kerosene in every room *Negative* Increased work with the lighting in the morning and in the evening	*Positive* Saved time for rice hulling and grinding grains Saved time for filling the kerosene and lighting Increased time for rest and leisure	*Positive* Access to income generatingand social activities (incense making,and adult literacy, poultry keeping)	*Positive* Positive change in women's and men's attitude for women's mobility Eradication of gambling and drinking habits of men
Men	*Positive* No change in men's work	*Positive* More time for chatting and gatherings with electric light	*Positive* Possibility for income generation through saw mill and poultry Access to information through radio and television	*Positive* Increased gatherings and entertainment *Negative* Young men hanging around radios and televisions
Household	*Positive* Women's labour saved for other activities	*Positive* Women's time saved for other activities	*Positive* Possibility to increase income Possibility for irrigation *Negative* Decreased opportunities for young labour	*Positive* Positive attitude of men and women

Source: Field survey, 2002

problem they identified was that the smoke bounced back into the kitchen instead of passing out through the chimney. There were no training programmes for women on any repair and maintenance activities, and women had to rely on technicians (men) or other male members of the family for any small repairs.

Figure 3 Focus group discussion with ICS and biogas users' group
Source: Field survey, 2002

Conclusion

Women have key roles in managing household energy systems, and are more affected by rural energy alternatives than men. Different alternative energy technologies have provided for men, and especially for women, in terms of saving their labour and time in energy-related activities. However, AETs have not been a substitute for the traditional technologies for a number of reasons. For instance, women still preferred to use those indigenous technologies such as *dhiki* / *janto*, and traditional stoves as an integral part of their livelihood, to fulfil their various energy needs. Adoption of AETs by women was not very positive due to their limited involvement in planning and management of such technologies. There was a shift in control of energy services after having access to technologies, since women were not able to repair AETs.

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Kelkar, G. (1995) 'Gender Analysis Tools', Wood Energy News, Vol. 10 (2).

Cecelski, W.E. (1995) 'From Rio to Beijing: Engendering the Energy Debate', Energy Policy, Vol. 23, pp.561–575, UK.

Book reviews

Air Pollution and Health in Rapidly Developing Countries
Gordon McGranahan and Frank Murray (eds)

This really interesting book covers each aspect of air pollution in surprising detail for a volume of such modest size. Excellently formatted, each chapter sets the problem of environmental pollution in context, provides key data and well documented evidence, with full references, for the information contained in it. The book gives a good overview of the topic for those not directly involved in the pollution debate, whilst providing those with specialist knowledge on particular aspects with a broad overview of other aspects of environmental pollution.

Starting with a brief introduction to set the work in context, chapters deal with pollution assessment, the health impacts of each pollutant, a review of evidence, ambient air, analysis for policy, air quality management, indoor air pollution and vehicular pollution, and concludes with three case studies from Hong Kong, Santiago, Chile and Greater Johannesburg.

SEI and Earthscan, London, Sterling VA pp.224 £19.95 ($32.50)
ISBN: 1 85383 895 X (paperback) and 1 85383 966 3 (hardback) 2003

Stakeholder Incentives in Participatory Forest Management: A manual for economic analysis
Michael Richards, Jonathan Davies and Gil Yaron

This manual addresses the need for a greater understanding of the costs and benefits to local communities of participatory forest management. The book is designed to be used at project level, integrating economic analysis with other criteria for decision making. The book introduces economic analysis in a style accessible for social development advisers, social foresters, donor advisers, project managers as well as economists. The second part of the book goes through the methodology for economic stakeholder analysis, quantification and valuation of costs, comparison of decision-making alternatives, participatory analysis and monitoring, and includes many examples. The book is completed with a glossary of terms, index, sources and economic tables, making it clear and user-friendly.

DFID, FRP and ODI £19.95 ISBN 1 85339 559 5 ITDG Publishing, UK, 2003

Other news

The Global Village Energy Partnership

The Global Village Energy Partnership (GVEP) is 'a partnership of partnerships' that seeks to reduce poverty and enhance economic and social development through the accelerated provision of modern energy services to those unserved or under served.

The Energy Sector Management Assistance Programme (ESMAP) was established, with strong support from UK Government Department for International Development (DFID), to assist developing countries respond to the oil price shocks of the 1970s. The concept of GVEP first emerged from the ESMAP co-sponsored Eighth Village Power Conference in 2000.

Between then and the launch of the Partnership in 2002, more than 2500 people were consulted through online consultation, focus groups, group meetings and one-on-one discussions.

This series of consultations was used to decide the breadth and focus of the Partnership. The result is that GVEP is 'technology neutral' – applications for enhancing lighting, cooking, heating and cooling should be of equal importance; and that the Partnership should offer five services:

- action plans
- capacity building
- finance facilitation
- knowledge management
- results monitoring and evaluation.

It offers these services to partners in an effort to scale up modern energy service delivery.

GVEP was launched on 31 August, 2002 at the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa. Approximately 450 people over the course of WSSD were contacted through a wide variety of GVEP-related events, including the launch, such as UNDP's Energy Day at the Community Kraal and the Energy for Sustainable Development Day hosted by the Electrical Supply Commission of South Africa (ESCOM), the International Energy Agency (IEA) and UNEP.

As of May July 2003, over 220 organizations have committed to the GVEP Statement of Principles, pledging to work together to increase access to, and affordability of, modern energy services. The Partnership base currently comprises: 103 NGOs, 74 firms from the private sector, 36 governments and 8 multilateral agencies. Fifty one countries are represented.

To date, the GVEP Technical Secretariat has co-sponsored activities worldwide and findings from these activities can be found on the GVEP website.

Contact details: GVEP secretariat; c/o ESMAP, 1818 H Street NW, Washington DC 20433, US. Tel 202 458-2849 Website: www.gvep.org European contact Dick Jones: Tel; +44 (0) 20 8686 8455. Email: Dick Jones [R-Jones@DFID.GOV.UK]

Ashden Award for Sustainable Energy 2004

The Ashden Trust is inviting submissions for the Ashden Awards for Sustainable Energy 2004. We hope to offer five first prizes of up to £30 000 each to outstanding sustainable energy projects (three for developing countries and two for the UK). The awards are for community-based renewable energy and full details of criteria and application instructions can be found on the website www.ashdenawards.org. Overseas applicants will be asked to send a two-page concept note by 14 November 2003 (forms are available on the website). Because of the level of funding available, the judges are likely to favour smaller organizations for whom the award would make a real difference. Selected candidates will then be invited to submit a full application. Applicants must use the forms provided, both for the concept note and for the fully completed application.

Criteria

- To be environmentally sustainable. This refers to the local and global environment. Projects should minimize local environmental impact and should lead to reductions in greenhouse gas emissions.
- To have a significant and measurable impact on the quality of life of a community (for example in terms of income generation, education or health).
- To have an ability and willingness to involve the community (and particularly users) throughout the project's development, and to provide local training where necessary.
- To be exemplary, with the potential for replication and/or expansion.
- To represent innovative approaches to technology application.
- To provide an energy service, rather than technology alone, and to be clearly demand – rather than technology-led.
- To show evidence of the necessary skills (technical and project management) and a willingness to work in partnership with others where appropriate (e.g. NGOs, banks, credit providers, training providers).
- To have a proven track record and continuing commitment to renewable energy.
- To lead towards financial sustainability.

Absolute start-ups will not be considered. The judges are seeking successful innovative projects, however small, that are proposing a new phase of development or an interesting adaptation, replication or expansion. Projects that have found ways of overcoming obstacles will be of interest (for example finance or credit facilities, tackling policy barriers, building technical capacity). Indigenous applicants will generally be favoured. Commercial organizations are not excluded provided they fully comply with the charitable objects of the award).

For further information
email: info@ashdenawards.org

The Origo and CleanCook stoves

In 1999, *Boiling Point* 43 reported the production and use of methanol as a clean fuel. Two new stoves have been developed for burning such fuel – the Origo and CleanCook stoves, manufactured by Dometic AB of Sweden. Both methanol and ethanol are ideal fuels for these stoves. Methanol can be manufactured from natural gas which is now flared in most of the oil producing regions of Africa (and available in other African countries as dry gas, unassociated with oil). Ethanol is of course manufactured from certain agricultural products and residues and is currently produced in some eight or nine African countries.

A pilot study project is planned with the CleanCook stove in Ethiopia using ethanol manufactured from the waste molasses at the Finchaa Sugar Factory as the primary alcohol for the stove fuel. Because alcohols are so safe in their burn characteristics and so clean when they burn, they are ideal liquid household fuels. They are also the ideal fuel to use in confined spaces, such as emergency housing, including tents. They handle as a liquid, but burn clean as a gas. The CleanCook stove holds the alcohol in an absorbent fibre in a rechargeable fuel canister that does not allow the fuel to spill. The alcohol fuels contain a strong bitter tasting agent, as well as a colorant and an odorizer, to prevent their being drunk. When properly treated, the alcohol is less likely to be drunk than kerosene, by child or adult.

The CleanCook stove is very stable, it holds large cook pots and will not tip easily. If tipped, the fuel will not spill. Studies are ongoing in South Africa and in Nigeria assisted by Winrock International's Clean Energy Group.

Dometic is working with an Ethiopian manufacturer, Iacona Engineering of Addis Ababa, to test these stoves in varying settings in Ethiopia. We would like a potential co-operating agency to look at the feasibility of these stoves for use in refugee relief efforts and test them. Dometic would provide both stoves and fuel for testing.

Contact: Harry Stokes, MSc Forestry, The Stokes Consulting Group, For Dometic AB, 22 Mummasburg Street, Gettysburg, PA 17325 USA, Tel: (717)334-5594, Tel/Fax: (717)334-7313, Cell: (717)495-4274, Email: hstokes@blazenet.net

World Wind Energy Conference and Renewable Energy Exhibition, 23–26 November 2003, Cape Town International Convention Centre, South Africa

The World Wind Energy Conference has confirmed over 120 speakers and 40 poster presentations from 33 different countries. The conference programme is structured around: global markets; policy issues; technology development; wind assessment and prediction; specialized applications; financing; private sector; and capacity building.

WWEC 2003 consists of a conference, exhibition and a number of social functions. There will be a trade exhibition on renewable energy supplies, products and services.

Websites: www.sbs.co.za/wwec2003; www.sbs.co.za/wwec2003/Programme.xls

NEPAD new website

The African Forum on Science and Technology for Development (AFSTD) has been established by the New Partnership for Africa's Development (NEPAD) to promote the application of science and technology for economic growth and poverty reduction.

Their new website (www.nepadst.org) features information about the forum and its initiatives, details of related events, and access to the forum's publications.

Website: www.nepadst.org

Cities Energy Strategies Conference

19–21 November 2003, Cape Town, South Africa

South Africa's first ever conference on energizing South African cities is to take place at the Cape Town International Convention Centre to help equip cities to formulate and implement a city energy strategy within the context of their development strategy.

Hosted by Sustainable Energy Africa, South African Cities Network and the City of Cape Town in association with SALGA, and ICLEI and endorsed by UNEP, the conference aims to inspire mayors, city managers, councillors and senior officials from all relevant city departments to thing strategically and sustainably about energy, and to equip cities to implement these strategies.

Breakaway sessions will include debates around water services, public lighting, transport, green procurement, housing, energy education, fleet management and public buildings. The conference will conclude with a discussion towards forming an African Energy Cities Network.

Contact: Leila Mahomed at leila@sustainable.org.za

Micro level coping strategies by rural women for managing biomass resources

[Report No.1994RE53, Sponsored by: The John D and Catherine T MacArthur Foundation, Chicago, USA]

Though women are responsible for managing the fuel (primarily biomass-wood, animal dung and crop residues) and fodder needs of the household, they have little control/access to the sources.

With an increase in the pressure on these sources (increase in population, overexploitation of forests for commercial and other purposes, increase in agriculture and settlement land, etc.), women are finding it extremely difficult to cope and the impacts, therefore, are much more severe for them (drudgery and associated health impacts).

The objective of the project was to study coping strategies adopted by rural women in managing biomass resources in relation to their complexity and variability across different ecosystems. The research design was based on village level case studies.

The common factor across all the case studies was that the coping strategies adopted could provide only a limited reprieve from the problems associated with the resources under stress.

Thus emerges the need to find solutions based on the principle of sustainability; the project recommended technology development, capacity building, and an integrated approach towards rural development to help meet this requirement.

Field-testing of improved kerosene lighting devices

[Report No. 1998RE61, Prepared for Research and Development Centre, Indian Oil Corporation (IOC), Faridabad]

A large number of electrified and non-electrified rural households in India use kerosene for lighting. Most households cannot afford the initial cost of connection or the recurring costs of a supply that is erratic and often at low voltage. These three factors together have meant that 66% of rural households still use kerosene as the primary source of light.

Commonly used kerosene lighting devices include the wick lamp or diya, hurricane lantern and kerosene petromax. These devices consume large amounts of kerosene and produce light of a poor quality (a little more than half of the BIS specification) adversely impacting the quality of life.

Users' perceptions were measured for:

- light intensity
- kerosene consumption
- safety
- smoke emission
- aesthetic appeal
- handling ease
- durability.

The study also examined the local market supply network for kerosene lighting devices with a view to suggesting methods for market-based promotion. Desirable features were listed as, 1) high light intensity (even if that meant greater maintenance), 2) low smoke emission, 3) durability, 4) a thick metal sheet at the base of fuel tank to prevent leakage, and 5) local availability of device parts and repair facilities.

Recommendations included: developing a wider product range; developing a competitive and user-oriented marketing strategy; identifying quality conscious manufacturers; co-ordination between the R&D Centre, IOC, the Petroleum Conservation Research Agency (PCRA) and the Bureau of Indian Standards (BIS) for greater information dissemination in the rural areas and can include improved kerosene lighting devices in their portfolio of promotional campaigns; continuous research and development for making these devices more user-friendly.

These interesting articles can be found on the TERI website:
www.teriin.org/reports/rep31/rep31.htm and www.teriin.org/reports/rep29/rep29.htm

WoodGas stoves keep emissions low

If you generate gas from wood, and use the correct amount of air to mix and burn it, the stove will be very efficient and have very low emissions.

The first forced draft 'toplit updraft gasifier' commercial stove is now available; details can be found on www.WoodGasllc.com. The stove is 15 cm high × 12 cm in diameter. It burns about 10 g/m (~3 kW thermal) of twigs, chips, cobs (10–20 minutes) and especially wood pellets (40 minutes). It typically also makes 20% charcoal which can also be burned in the stove. The stove uses a single AA battery which lasts three hours on high and six hours on low.

Although this first stove is targeted at the camping market in the US, the Biomass Energy Foundation is hoping that this stove will lead to developing better biomass and WoodGas cookstoves around the world to fill a desperate need.

Contact: Dr Thomas Reed, Biomass Energy Foundation.
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ITDG energy news

Intermediate Technology Consultants

Ethiopia Energy Access Program

Work started in February on this World Bank funded project, which has been established to implement an Energy Access Program (EAP). A key development objective of EAP is to accelerate, in a commercially viable manner, the use of electricity for economic growth and improved quality of life in underserved areas. ITC have been contracted to carry out feasibility studies and assessments.

Development of rural electrification strategies and policy framework, Papua New Guinea

Work starts in October on this project to develop policies and programmes which encourage innovative approaches to rural electricity services provision. ITC will develop a rural electrification policy framework and strategy that will become the basis for a national programme to bring electricity to the rural poor in a sustainable and economical fashion, and will also identify, define, develop and document design approaches for sustainably supplying electricity for critical and essential education and health service needs in rural Papua New Guinea.

The impacts of Clean Development Mechanism, Kenya, Tanzania and Ghana

ITC and the University of Surrey have now finished work on this study on Clean Development Mechanism and its contribution to environmental protection and poverty alleviation, which arose from the Kyoto conference on climate change. The project contributed to the design of the CDM to ensure that energy projects are encouraged, and also to provide some capacity building for host countries to implement small-scale projects under the CDM.

Generic training material for rural electrification projects

ITC have produced generic training packages and guidelines on rural electrification projects for community leaders, district officials and national policy makers as part of multi-sector community-driven development projects. These guidelines will be soon available on the ITC website: www.itcltd.com.

For more information on any of the above projects please contact: Dr Rona Wilkinson, ITC, Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby, CV23 9QZ, UK. Telephone: +44 (0)1926 634 403 Fax: +44 (0)1926 634 405 Email: ronaw@itdg.org.uk, Web www.Itcltd.com

ITDG international projects

Sparknet

As outlined in *BP48*, Sparknet is an interdisciplinary, interactive knowledge network on energy for low-income households in Southern and Eastern Africa. Country information is accessible for Uganda, Kenya, Mozambique, Tanzania, Zambia, Mozambique and South Africa. The data found on the website is relevant for low-income income communities, and is not easily found from standard country economic data.

Not only can you find data about each country, but also, by using the 'report builder' function, comparative data on energy sources and household energy use can be easily accessed across the countries involved in the project. For those seeking policy-level information on the efficacy of particular approaches to improved energy services, comparisons between adjacent countries within Southern and Eastern Africa will prove valuable tools.

Another aspect of the network is the briefing papers by leading specialists in health/energy, gender/energy, and forestry/energy, which discuss the latest issues. These papers look at both the international context and the key issues, and comment is welcomed from those who specialize in these aspects of household energy.

The website is developing rapidly as information becomes available through the project, and Sparknet would value your comments on its usefulness and how you feel that future development could best meet your needs. Additional data and discussion on content for particular items are especially welcome. This website is there for you to use, and your knowledge is valuable to the further development of the network.

Two on-line discussions will be held during next year, and if you wish to participate, visit the website and click on 'keep informed'.

Contact: *Email directly to Sparknet through the website – designed and maintained by eco Ltd, or contact Liz Bates, ITDG, Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby, CV23 9QZ, UK. Telephone: +44 (0)1926 634 465 Fax: +44 (0)1926 634 401.*

Urban waste management for small-scale energy production

This DFID-funded project, completed in March 2003, looks at the waste streams in Cuba, Kenya, Nepal, Senegal and Sri Lanka and their potential for energy production. Emphasis has been given to ensuring that any proposed changes in waste management practice do not have a negative impact on the employment of those already engaged in recycling waste.

A more detailed study, conducted into particular technologies – in Cuba, solid fuel blocks; in Kenya, charcoal and sawdust briquetting – is described in the project findings.

A limited number of booklets are currently available, and CDs will be available from ITDG in the near future. For either of these please contact:

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Smoke, health and household energy

This project is taking place in Kenya, Sudan and Nepal. Funded by DFID, the project seeks to identify effective and sustainable ways to reduce the level of indoor air pollution caused by biomass cooking in poor households. The project recognizes that for interventions to be effective, they must be acceptable to the cooks involved. Thus, there is a high level of participation between the project teams and the community members, especially the women cooks. High levels of pollutants have been recorded in each country during the baseline measurements. Very different solutions to alleviating smoke have been selected by the participants in each country.

The project would like to hear from other groups working in this field, to seek ways of pooling knowledge and identifying methods for standardizing and comparing monitoring methodologies.

Contact: *Liz Bates. Details as above.*