ITDG TECHNICAL INFORMATION SERVICE

With over 30 years experience of development and appropriate technology, ITDG can provide timely, quality information that responds to the information needs of individuals and organizations.

This service is provided free of charge to organizations and individuals working in development. The TIS always aims to supply information of direct relevance to the your circumstances, but to do this we require you to send us specific details at the time of writing.

In addition to energy, we also offer technical advice on a range of technologies including agro-processing, building materials, food production, transport and manufacturing.

To improve the speed and efficiency of our services, the ITDG TIS can now be accessed via the ITDG website (**http://www.itdg.org.uk) and via e-mail** (**infoserv@itdg.org.uk**).

Please send your enquiries to:
Technical Information Service
ITDG
Schumacher Centre for Technology and Development
Bourton on Dunsmore
Rugby CV23 9QZ
United Kingdom

Tel: +44 (0) 1926 634400
Fax: +44 (0) 1926 634401

Enquiries can also be submitted directly to our partner offices in Bangladesh, Kenya, Nepal, Peru, Sri Lanka, Sudan and Zimbabwe.

Editorial Production Team

Elizabeth Bates	–	Editor
Leonard Tedd	–	Theme editor
Smail Khennas	–	Senior energy specialist; French résumé author
Anne Wright	–	Administrator

Back issues of Boiling Point

47 – Household energy and enterprise
46 – Household energy and the vulnerable
45 – Low cost electrification for household energy
44 – Linking household energy with other development objectives
43 – Fuel options for household energy
42 – Household energy and the environment
41 – Household energy; the urban dimension
40 – Household energy and health
39 – Using biomass residues for energy
38 – Household energy in high cold regions
37 – Household energy in emergency situations
36 – Solar energy in the home
35 – How much can NGOs achieve?
34 – Smoke removal
33 – Household energy developments in Asia
32 – Energy for the household

In this edition . . .

Leonard Tedd, the latest arrival to the ITDG energy team, kindly agreed to be theme editor for this edition. With an academic background in small wind systems, and currently working on wind turbines and a street food project, his thoughtful editorial looks at the need to ensure that those involved in formulating the major international policy objectives are aware of the real needs of those living in poverty.

Sadly, this edition goes out for the first time since Edition 22 without input from our friends and colleagues in GTZ. Since 1990, we have worked on *Boiling Point* as a collaborative exercise and the journal has benefited from the knowledge and support of our GTZ colleagues, as well as the generous funding which helped pay for each edition. Despite the closing of the HEP office in Eschborn, we hope that a mechanism can be found to renew our relationship in the future.

Recently, I was asked about payment for articles – the policy we have adopted is this: we do not pay for articles, but neither do we charge for the journal – this is a journal written by those working in household energy to be read by others working in the same field. It is very costly to produce a print run of about 2000 copies, and each time we struggle to find funding to get it published. In the future, we may need to ask our Northern readers to pay for copies, especially if they belong to institutions which can afford to do so.

However, many of our authors recognise that *Boiling Point* is an important dissemination route, and I would urge those working in the field to remember that their work can be made much more effective if other people benefit from their findings – so remember to put a dissemination line in your funding proposals, and use that funding to pay for time to write an article for the journal.

Contributions to *Boiling Point*

- **BP49: Desertification, forestry and household energy** Desertification is related to household energy in two ways: Critically, the abuse of forest resources for non-energy purposes can impact on essential fuelwood supplies for basic energy needs. Where forest resources are already vulnerable, use of woodfuel, especially where it involves tree-felling, can exacerbate this situation and lead to desertification. Pro-poor policy decisions can have a major impact, and this issue will look at both policy initiatives and field-level mitigation to address the effects of desertification.
- **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.

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.

All correspondence should be address to : *Boiling Point* editor, ITDG, Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby CV23 9QZ, UK or by email to Boiling.Point@itdg.org.uk

Boiling Point is the journal of ITDG's energy programme. Typesetting by The Studio Publishing Services, Exeter, printing by Russell Press Ltd, Basford, Nottingham.

Cover photo: Decentralized electricity providing light for studying (photo: Zul/ITDG Sri Lanka)

ITDG energy news

ITDG – East Africa

As ITDG bids farewell to Stephen Gitonga, we wish him every success in his new role with the GEF/SGP in New York. Stephen Gitonga joined ITDG-EA in November 1994 and has been one of the most committed, hard working and trusted members of staff – we will all miss him as both a colleague and a friend.

Community micro-hydro and pico-hydro

The first micro-hydro scheme run by ITDG in Kenya is nearing completion and has taken significant steps towards sustainability. Capacities for local turbine manufacture have been built, including the electronic component fabrication. The project is being developed in partnership with the Renewable Energy Department (Ministry of Energy) which is reviewing the standards and regulations for distribution and transmission for micro power systems. This is a key issue which may have a significant impact on the costs of micro-hydro power schemes.

The pico-hydro power project is seeking to establish a sustainable infrastructure for the development of micro-hydro power for rural communities. It is researching the potential for pico-hydro (up to 5kW per unit) to be a sustainable and affordable technology for community electrification projects in rural Sub-Saharan Africa. The project is a collaborative activity between Nottingham Trent University and ITDG-EA Energy Programme.

Low cost hurricane lamp

This project is focused on manufacturing a low-cost kerosene hurricane lamp aimed at rural communities in Kenya. The lamp has to fulfil the following specification:

- A design and construction allowing an expected retail price below that of the current lantern and easy to fabricate by micro-enterprises.
- Manufacturing a lantern with similar or higher efficiency than the products currently commercialized.

Contact: Energy team, ITDG Kenya, PO Box 39493, Nairobi, Kenya. Tel: 00 254 2 710083 E-mail: itkenya@itdg.or.ke

ITDG-UK

SPARKNET: Sustainable-energy Policy And Research Knowledge network:

SPARKNET is an interdisciplinary interactive Knowledge Network in Southern and East Africa involved in energy for low-income households in rural areas. The focus of SPARKNET is on increasing knowledge resources for local, national, regional and EU policy making and research through the creation of knowledge and the acceleration of the application of that knowledge to economic and social development.

SPARKNET is striving to reduce boundaries between sectors and stakeholders and make a valuable contribution to sustainable development. SPARKNET is bringing together policy makers, research centres, universities, manufacturers and NGOs (and through them communities and end-users) around the issues of household energy, and thus contributing to the development of effective policy. It is thus knowledge-oriented, meets basic needs (i.e. poverty) and aims at identifying sustainable development strategies (optimizing the use of resources) for countries to formulate their own priorities.

SPARKNET is helping to maximize the impact of Community policies and Community research (through the increased availability of reliable data), stimulating dialogue and innovation, and enhancing the impact of national/donor funding by identifying priority areas for research, exchanging experiences and disseminating best practices.

Website: www.sparknet.info

Contact: Smail Khennas: ITDG, Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby CV23 9QZ, UK. Telephone: ++44 (0)1926 634400 Fax:++44 (0) 1926 634401. Email: smailk@itdg.org.uk and grant@ecoharmony.com

SRI LANKA

Village hydro project

Within its first six years, from 1991, the project implemented 27 micro-hydro schemes in the Southern and Sabaragamuwa provinces. Thereafter, in 1998, the project was extended to the plantation sector. ITDG is now acting as a facilitator rather than implementor. Over the last year, 17 micro-hydro projects were completed, 7 are in progress and several new sites were identified. One water-wheel electricity generation project was completed and another one is in progress. A community grid-connected scheme is an interesting and complex issue as it involves several partners and a long-term commercial relationship.

Manufacturers have won contracts with substantial amounts of work: wiring and maintenance; grid-connected schemes; manufacturing workshops, etc. The impact on livelihoods derived from micro-activities is significant. Two manufacturers purchased a lorry and a van from their income. Six manufacturers worked in 12 micro-hydro schemes and earned a total income of Rs.8.5 million. Another 40 to 50 people employed by the manufacturers benefited from these orders.

Although the plantation sector remains a key component of Sri Lanka's national economy, it often lacks basic social and economic infrastructure. The micro-hydro scheme set up in two estates is aimed at improving the livelihood of this population. The projects will be monitored to assess their impact.

Thanks to access to electricity, people now have access to a wide range of information through radio and TV. This is attested by the number of TV and radio sets purchased after some villages were electrified. For example 116 TVs and radios were purchased by the beneficiaries.

The level of the financial contribution by the owners is a good indicator of the sustainability of the micro-hydro programme. A trend to finance micro-hydro schemes by prospective beneficiaries has developed over the years. The State has also started contributing to the financing of micro-hydro schemes, although at a modest level. These developments indicate that there is a real process towards scaling-up and sustainability of the micro-hydro business in Sri Lanka.

Contact: Energy team, ITDG Sri Lanka, 5 Lionel Edirisinghe Mawatha, Kirulapone, Colombo 5, Sri Lanka. Tel: 00 94 1 829412; Fax: 00 94 1 856188; E-mail: itdg@itdg.slt.lk

THEME EDITORIAL

Household energy and poverty reduction

by Leonard Tedd, ITDG, Schumacher Centre for Technology and Development, Bourton on Dunsmore, Rugby CV23 9QZ
Tel: +44 (0)1926 634400 Email: leonardt@itdg.org.uk

Energy advocacy

We live in a world where the big questions about how the world accesses the energy services it requires are left unanswered. The greenhouse gas emissions and fossil fuel dependence of the North is arguably the most 'non-sustainable' activity currently taking place by humanity, as it continues to change the ratios of gases in the planet's atmosphere. At the same time there is increased recognition of the role of improved energy services in the context of development. The major argument is that *basic* energy services should attract the focus of the world's decision makers.

Millennium Development Goals

Addressing basic energy needs for cooking and heating is a key element in reducing 'extreme poverty and hunger' by half by 2015. Energy that enables productive end uses can be the means by which fewer people live under the crude dividing line of one dollar per day. As for the other targets, improved energy services can make both direct and indirect contributions. It is hoped that there will be universal primary education by 2015. The link between energy and education might not be immediately obvious to some, but if a daughter's time is freed from firewood collection or other 'survival activities' then there is a higher chance that she will be able to attend school. Also, the impact on decentralized electricity services to provide improved lighting for schools and households is a clear example of energy and development that is easily communicated (see front cover). The fourth development goal is to reduce child mortality by two thirds by 2015. Indoor air pollution, which is a major risk factor in acute respiratory infections, is an area where improved household energy can have a direct impact on health. The article by Liz Bates details participatory methods for addressing this need.

Sustaining life and livelihoods

ITDG is increasingly learning from a diverse project base, and seeking to influence policy thinking on the role of energy and sustainable development. One focus is to ensure that organizations do not follow the pattern of designing a technology then looking for a need. One aspect is ensuring that policy makers and campaigners do not confuse renewable electricity production (small amounts of watts from solar photovoltaic panels) and the technology which is needed for people to meet their basic cooking and heating energy needs. For two billion people this will continue to be met using traditional biomass. ITDG's activities within 'Sustaining Life and Livelihoods' includes working with Greenpeace (an international environmental pressure group) on a campaign which is calling for governments to commit the resources for providing modern energy services to people in developing countries.

The World Summit on Sustainable Development

At the end of August world leaders, NGO delegates, businesses – a total of tens of thousands of participants – converged on South Africa, ten years after the Earth Summit in Rio de Janeiro. On 14th May 2002, Kofi Annan, Secretary General of the UN, named energy as one of the five key areas where action from the summit can make a difference:

> *'Energy is essential for development. Yet two billion people currently go without, condemning them to remain in the poverty trap. We need to make clean energy supplies accessible and affordable. We need to increase the use of renewable energy sources and improve energy efficiency.'*
>
> *Kofi Annan*

So in Johannesburg the role of energy and poverty reduction received unprecedented attention which, it is hoped, will lead to action.

Debate

For the recognition of these issues, and for change to take place, it is necessary that governments and international institutions understand the reality and the impacts that 'issues' such as energy have on peoples' lives. The only way for this to happen is for small NGO's and community organizations to communicate what is important about their work to people who can change current trends. This is the ambition of having such a summit.

Discussion can take place through networks where different well-informed groups contribute from a variety of perspectives. One example, concerning household energy, is with fuel substitution. Someone whose key concern is the magnitude of the indoor air pollution problem would see a move to pressure-kerosene or LPG as being progressive because these are cleaner fuels than traditional biomass. An environmentalist would draw a very different conclusion in comparing imported fossil fuel to biomass which, if sustainably managed, is a renewable source.

One initiative for linking work on the ground to the policy level dialogue is SPARKNET, an interactive network focusing on energy for low-income households in Southern and East

Africa. This covers the main themes of health, gender, forestry and policy. More information can be found on the website: **www.sparknet.info**. Online discussions are expected to take place during this project.

Boiling Point

This edition of *Boiling Point* discusses how to optimise household energy's role in poverty reduction, and how positive activities might be further promoted. As shown in the quotation from the UN Secretary General, the need for the sustainable use of energy in developing countries is recognized. The key question is how to integrate this into countries' poverty reduction strategies and into development programmes.

In this edition there are details of new technology possibilities, such as the plant oil stove developed by Hohenheim University, which offers carbon neutral energy compared with kerosene pressure stoves which it could replace (Figure 1). There has been some introduction to the sustainable livelihoods framework in *Boiling Point* (Andrew Barnett *BP46*), and it is interesting to note the increasing use of this analysis by projects for project design, as a framework for social research and for monitoring. Examples are given in Alison Bannister's article using this livelihoods framework for investigating the links between energy and poverty. Rona Wilkinson presents the findings of an impact study of energy infrastructure projects on poverty using sustainable livelihoods analysis. This level of social/cultural awareness is critical because of the danger of assuming the benefits of a technology-based intervention. Didier Bazile also presents an impact assessment on poverty, based on monitoring work in Madagascar. Auke Koopmans' article details experience gained in strengthening community based organizations and NGOs in household energy and reducing indoor air pollution.

The managing director of Grameen Shakti, Bangladesh, Dipal C. Barua, has described the solar home system programme in Bangladesh (Figure 2). As there are over 8000 units installed, there is a context for the possible large scale dissemination of this improved energy service in that country. Also on solar technology, Erica de Lange and Marlett Wentzel have written about solar stoves in South Africa. Their monitoring has focused specifically on the reduction in fuel use and the impact on poverty. There is an introduction into rice-husk stoves in Estela Assureira's article on the usefulness of rice-husks in Peru.

One of the largest stoves programmes, based in India, was started in the mid 1980s. To date more than 32 million improved stoves have been installed, with a 50% subsidy. Though the 'scaling-up' has been on a large scale there have been some problems, with 40% of the stoves not being used and the subsidy causing various distortions. These are detailed together with the lessons learnt in Bhaskar Sinha's article.

In conclusion there is scope for widespread understanding of the complexity of working to improve the access of the one third of humanity who rely on traditional energy. But it is vital that dialogues such as the World Summit on Sustainable Development take place with the issues properly known. For this, links must be created between smoke-filled kitchen spaces and air-conditioned UN meeting rooms.

Leonard Tedd is the Energy Researcher in the International Programmes Unit of ITDG. Active work includes Energy and Street Food Vendors, and Small Wind Energy Systems.

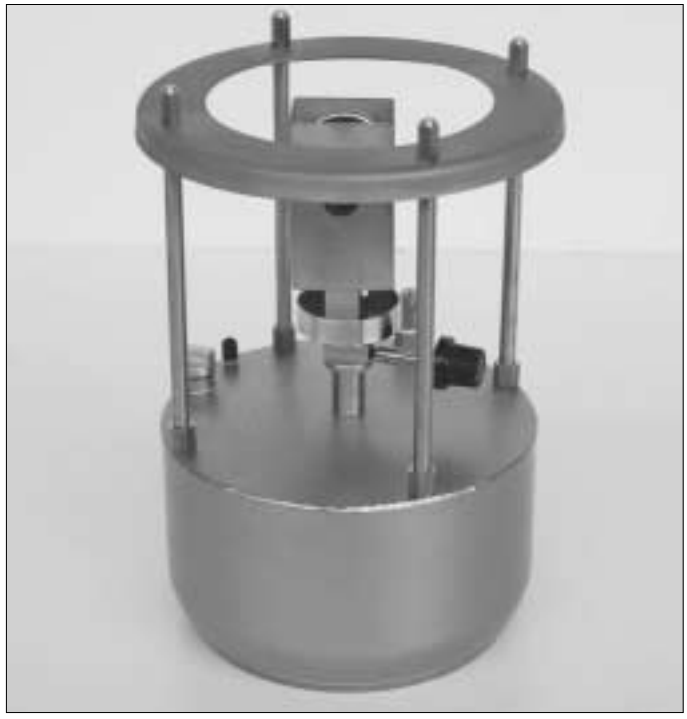

Figure 1 Plant oil stove developed by Hohenheim University

Figure 2 Solar energy system used for illuminating a small business

Getting to know the change agents

by Grant Ballard-Tremeer, eco Ltd, 64C Fairholme Rd, London, W14 9JY Web: www.ecoharmony.com Fax: +44(0)870 137 2360 and +44 (0)70 9236 7695 Email: grant@ecoharmony.com

Apprendre à connaître les agents de développement
Les agents de développement peuvent être définis comme les personnes disposées à entreprendre des actions visant à des changements positifs au sein de la société. Au sein du secteur de l'énergie domestique, les acteurs de terrain doivent être au courant des changements dans la communauté en montrant comment des investissements visant à améliorer l'approvisionnement en énergie vont conduire à des revenus durables. Le dialogue et les réseaux d'acteurs doivent être les moyens privilégiés de communication de la connaissance.

What are 'change agents'?

Energy improvements in households are important levers for improving the position of women within the family, providing opportunities for home businesses, and improving health, particularly for young children. These improvements can make a real contribution to poverty alleviation and improved livelihoods. As people belonging to organizations working in the field of household energy, we know how important energy improvements are, but how do we convince others of these benefits and bring about the changes in society that are needed?

Changes come about, for better or worse – in society, in the world, in a country, a region, or an organization – through the activities of people. Positive changes come about through the actions of people who have the courage to take the lead when it comes to changing things for the better. These people are the 'change agents', and if household energy organizations want to make a difference, it will be through being change agents, and through influencing other change agents.

Change agents are positive people: they do not see problems – they only see challenges. Change agents also have the ability to motivate others to accept change. They are contributing members of society and of their workplace.

Keeping household energy on the agenda

Organizations and individuals working in household energy have, however, been largely unable to keep pace with changes in the development community, and we have consequently struggled to interest practitioners from other non-energy sectors, decision-makers and change agents. Many organizations are barely at the beginning of the learning curve of how to energize and empower people to make positive and thoughtful changes in their lives, their workplaces and their communities. We seem to have difficulty explaining clearly and consistently how investments in improving household energy will lead to more sustainable and poverty-free livelihoods. We face barriers in incorporating our knowledge and perspectives into local, regional or global decision making.

Need for communication of knowledge

The need for communication of research and knowledge is increasingly recognized and stressed by funders, and an increasing number of projects have, at the very least, a dissemination phase. With an increasing quantity of information being made available, decision makers are finding it more and more difficult to absorb it. Organizations consequently have to 'shout louder', as it were, (and target and tailor messages) to get themselves heard. One government research funder even admitted '. . . we are paying you and others to generate all this research and information. But we don't have the time to even read the executive summaries of your outputs.' (Saywell & Cotton 1999:21).

Real engagement with change agents, however, needs more than just communication of targeted messages. Just as there has been a growing consensus in development, that communities need to participate in developing solutions in order to understand them and to want to implement them, decision makers and change agents at all levels need to be engaged in the process of knowledge generation (Figure 1). Effective engagement strategies can lead directly from knowledge to action; they are important tools for moving ideas and practices from innovators to broad-based implementation.

Is generating good research enough?

Within some circles there is a belief that the *generation* of good research and the *development* of solutions are sufficient to cause people to take action. Information and knowledge, however, tend to stay where they are generated, unless action is taken to disseminate. Many organizations have now reached the point where they understand that they have to make an effort to be heard, so they try to *disseminate* their knowledge as widely as possible through reports and journal articles.

A smaller number of organizations have internal processes for creating these *communications strategies* that

Figure 1 'Women's Voices' in Kenya, planning a script for a video about poverty (photo: Zul, ITDG: Kenya K5-A1.12 2002)

target specific audiences with tailored messages delivered through a variety of communications media. These organizations build in pathways for communications from the beginning of projects and initiatives to ensure that clear messages are developed and delivered.

Engaging change agents in dialogue

Very few organizations working in poverty reduction through household energy improvements have to date worked to *engage decision makers and change agents* in real conversations and collaborative research and action. Engagement strategies serve to bridge the gap between knowledge and action by systematically fostering relationships with policy-makers and change agents. These relationships serve as the foundation for joint learning and innovation. The 'engagement' process allows organizations to take into account the many processes used by policy makers (Sutton 1999).

Engagement is a process of relationship building

Relationship building with change agents in the household energy field is much like any other relationship building: it starts with getting to know each other and moves on to learning to trust each other. In their book *Strategic Intentions*, Creech and Willard (2001) point out that a successful strategy:

- has goals and a clear focus
- acknowledges that people are the most important resource for sustainable development
- uses tangible projects as a way of focusing conversations and attracting interesting people to learn from each other
- provides graduated steps for the participation of stakeholders – from information provision, through the nurturing of relationships, to joint action and learning. Household energy organizations should work to build action orientated relationships, that grow over time (see Figure 2).

Using networks

Building action-orientated relationships involves the engagement of change agents in conversations. This may come about through regular meetings with a change agent in local government, for example, leading to collaborative work and actions. The way in which one needs to communicate depends strongly on the type of relationship, and the most effective ways of building relationships with stakeholders. On an international level, modern internet communication, through email and the internet can be used effectively in the initial stages of engagement. SPARKNET (**www.sparknet.info**), a knowledge network being developed jointly by ITDG and *eco Ltd* and funded by the European Union, is working to engage decision makers in Europe and Southern and East Africa in household energy and poverty in precisely this way. The SPARKNET members, from seven Southern and East African organizations are actively involved in *joint action* within the project and in other joint activities being developed. Relationships are being *nurtured* (the second level in the engagement pyramid) with associates in each country, bringing over 50 change agents into the SPARKNET process. *Information provision* will take place through the web page and email system, and incentives are given for key stakeholders to get more involved in the work of the network. Through a network of carefully selected member organizations and associates, SPARKNET aims to build relationships with change agents and local and international levels. More information is available on the SPARKNET web page and will be made available in *Boiling Point* as the project develops.

Useful resources

The work of the International Institute for Sustainable Development (IISD) is highly recommended for those wanting to find out more (www.iisd.org). Their address is 161 Portage Avenue East, 6th Floor, Winnipeg, Manitoba, Canada, R3B 0Y4, Tel: +1 (204) 958-7700, and Fax: +1 (204) 958–7710. Creech and Willard (2001) *The Strategic Intentions: Managing knowledge networks for sustainable development* is available online at http://www.iisd.org/networks/research.asp.

The Water, Engineering and Development Centre (WEDC) at Loughborough University in the UK has done extensive research (mostly focused on water issues) for the UK government. Online visit http://lboro.ac.uk/departments/cv/wedc/publications/stw.htm and select 'Knowledge Transfer'. Their address is WEDC, Loughborough University, Leicestershire LE11 3TU United Kingdom, Tel: + 44 (0) 1509 222885, Fax: + 44 (0) 1509 211079.

eco Ltd, the consultancy to which the author belongs, is able to provide support to your organization in developing and implementing an engagement strategy for the organization or particular projects.

Project reports, news and events may be publicized without cost on the HEDON Household Energy Network web page: **www.ecoharmony.net/hedon**, and in *Boiling Point*.

Saywell & Cotton 1999: 21, online at http://lboro.ac.uk/departments/cv/wedc/publications/stw.htm

Dr Grant Ballard-Tremeer, director of eco Ltd, focuses on project and market development in Southern countries and in Central and Eastern Europe, and in tailor-made communications and information technology solutions to organizations.

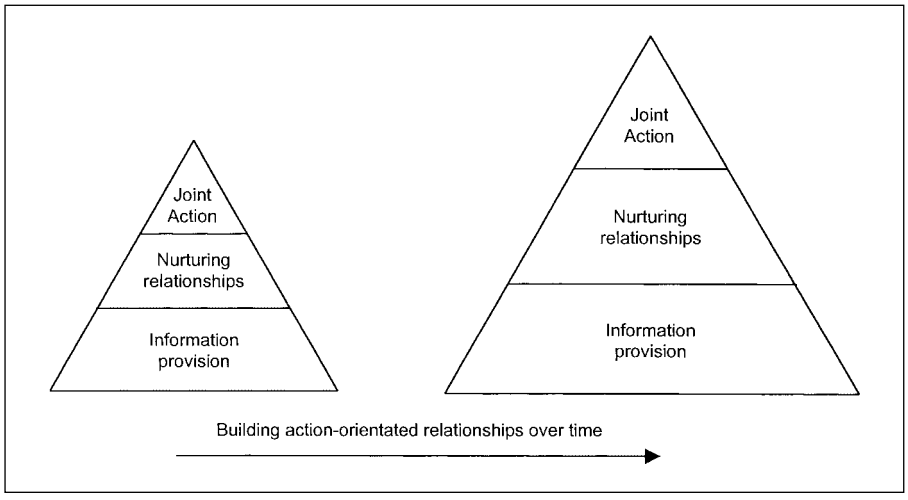

Figure 2 The Engagement Pyramid (source: Creech and Willard, 2001)

Strengthening NGOs and CBOs working with traditional household energy issues

by Auke Koopmans P.O. Box 167, San Pa Koi PO, Chiangmai 50000, Thailand Email: koopmans@loxinfo.co.th

Renforcement des ONG et Organisations communautaires impliquées dans les énergies traditionnelles

Quelque 2 milliards de la population du globe n'a pas accès à l'électricité et dépend la biomasse pour les besoins de cuisson et de chauffage. Les changements sont relativement lents ce qui tend à affecter la santé de ces populations. Des interventions telles que les foyers améliorés, la ventilation et les cheminées sont généralement en mesure d'atténuer les émissions de fumée. ARECOP et RWEDP ont abordé ce problème grâce à une information approfondie et des interventions de terrain de manière à ce que les praticiens locaux soient en mesure d'évaluer, selon le contexte, les modèles de foyers proposés ainsi que d'autres solutions. Les résultats semblent prometteurs.

Introduction

Worldwide some two billion people have no access to electricity, and the same, or maybe even a larger number of people, rely on traditional fuels such as firewood, charcoal, agro-residues, and dung for cooking and heating.

Hundreds of millions of women and children, particularly in rural areas, will keep spending several hours a day collecting and transporting firewood for food preparation, in many cases using poorly operating stoves in kitchens that often have very little means of ventilation. As a result air pollution levels in kitchens, which often also serve as a social gathering place for the family, are high. Acute respiratory infections (ARI), eye infections, low birth weight, etc. as well as more chronic diseases like chronic obstructive lung diseases (COLD), are diseases which appear to be much more common in women and children who spend long times in these polluted surroundings. In addition there is also increased evidence that smoke exposure may increase the risk of developing tuberculosis and other diseases.

Methods for reducing indoor air pollution

There are many ways in which indoor air pollution levels can be reduced or eliminated. One solution, which springs immediately to mind, besides the introduction of fuels which are less polluting, is improving ventilation in the kitchen. However, in practice, this may not always be possible due to concerns of security (theft), the type of building materials used to construct the kitchen or the materials and skills available with which chimneys or chimney hoods can be made. There are other solutions, like ensuring that firewood is dry, or extinguishing cooking fires as soon as possible, etc. Another solution is the introduction of improved stoves for cooking and/or heating.

Learning the lessons in stove dissemination

However, the past has also taught us that introducing improved stoves is not as easy as it sounds. Why is this so? First of all, it should be very clear from the outset of the programme why these stoves are to be disseminated. Is the stove really an improved one, not only in the opinion of those who are committed to stove programmes, but particularly for the user. There are an enormous variety of factors that determine cooking practices. The improved stove must match with all or at least with most of these factors, as it is not likely that people will easily change their prevailing cooking habits. In most cases the users are women, and we can only find out about their needs and constraints by consulting with them on the basis of mutual trust and respect.

Balancing positive and negative effects

At the same time, experience has shown that improvements in one area may make things worse in another area. Introducing chimneys will reduce indoor air pollution levels but in many cases will result in increased firewood use. A popular method to reduce fuel consumption of traditional cookstoves is simply to reduce the airflow by enclosing the fire. This increases the heat transfer efficiency to the pot, but at the same time may lower the combustion efficiency and increase emission levels, resulting in adverse impacts on health and environment.

Over time, initiatives to introduce improved stoves have shifted from more centralized undertakings by government organizations, INGO's, etc. to a much more 'bottom-up approach' – something which CBOs and NGOs, with their roots in the communities, are much better geared to address.

Addressing the skills shortage

Practice has also shown that, at least in Asia, one of the primary obstacles faced by CBOs and NGOs who want to be active in the promotion of improved stoves is the concentration of technical and programmatic skills among a few experts in improved cookstove research and design.

In recognition of this, the Asia Regional Cookstove Program (ARECOP) and the Regional Wood Energy Development Programme (RWEDP) addressed the issue by developing comprehensive training materials and implementing national training activities, particularly for staff from NGOs and CBOs. The goal of the training activity is to increase the acceptability of improved stoves within these countries by transferring the necessary skills so that the staff will be able to:

- evaluate stove design based on combustion and heat transfer concepts, knowledge of raw materials and technical stove parts
- determine appropriate modifications/improved stove

designs based on the needs, wants and conditions of the target group, in addition to technical knowledge
- become familiar with construction techniques for a selection of different stove designs
- determine an appropriate dissemination strategy based on existing technology dissemination channels
- incorporate gender analysis into stove design selection and introduction
- monitor the progress of a stove programme and trouble shoot where necessary.

The participative and intensive training programme – normally spanning a 2 week period – does this by using local case studies, guiding participants through a step-by-step process to come up with either an appropriate existing stove model or by modifying improved stove designs. A project workplan for their organization, etc. is formulated, based on new skills and knowledge gained during the training period, as shown in Figure 1.

The diagram in figure 1 reflects the training cycle. The oval shape shows that the process of stove introduction is an iterative process, with changes taking place over time when people re-assess what resources are available in terms of materials, skills, etc. As the training takes a long time, the practical work (mud stove and brick stove construction) are interspersed with other activities to make the course more interactive. Mud and brick were chosen as stove construction materials for their ease of use, as the trainees often have little practical stove construction experience. This does not imply that these are the preferred materials.

Evaluating the training programme

In order to evaluate the training materials, and to get answers to specific questions like 'Would trainers be able to take the training materials and run the training course on their own without external expert support?', a trial training programme was organized in Indonesia. Although, overall, the trial was successful, with participants integrating technical and social factors into the two stove designs provided by the participants, two things became clear:

1. A longer and more thorough training should be held for the potential trainers. This would have a longer lead time before the actual training and emphasize participative training methods – if possible integrated with planned national training activities.
2. Where possible, training programmes should be held in the local language, with trainers preferably responsible for the translation of the module into the national language.

Subsequently a Training of Trainers workshop was organized for key persons from NGOs and CBOs. These individuals would potentially be able to act as trainers in those countries where national workshops would be organized. By acting in this way, it was expected that those local trainers would:

- be clear on where and how the module fulfilled each of the objective of the training/workshop
- understand why the particular stove selection process is used, and understand how the training progresses towards the identification of an appropriate stove design and workplan
- be familiar with the technical and social components of the training module
- understand adult learning styles, and the reason behind using participative training methods
- have the opportunity to practice the participative training methods employed, and receive feedback for improvement
- Become a more unified training team, clear on their individual roles and responsibilities.

Impact of training schemes

During the last few years several national training activities have been held in Asian countries. In several countries, stove activities have received a boost as the number of skilled 'stove-practitioners' (particularly at local level), has been enlarged. Training materials are available in local languages, and there has been a renewed interest in stoves and a better understanding of what can be expected from improved stove programmes. It has also become more clear that linking improved stove programmes with other programmes like those related to health, sanitation, promoting the small scale industrial sector, etc. may offer better success rates than 'stand-alone' stove programmes.

Auke Koopmans was Chief Technical Advisor of the (recently terminated) Regional Wood Energy Development Programme (RWEDP). He has a long-standing interest in all aspects of biomass energy, with a particular interest in household energy issues.

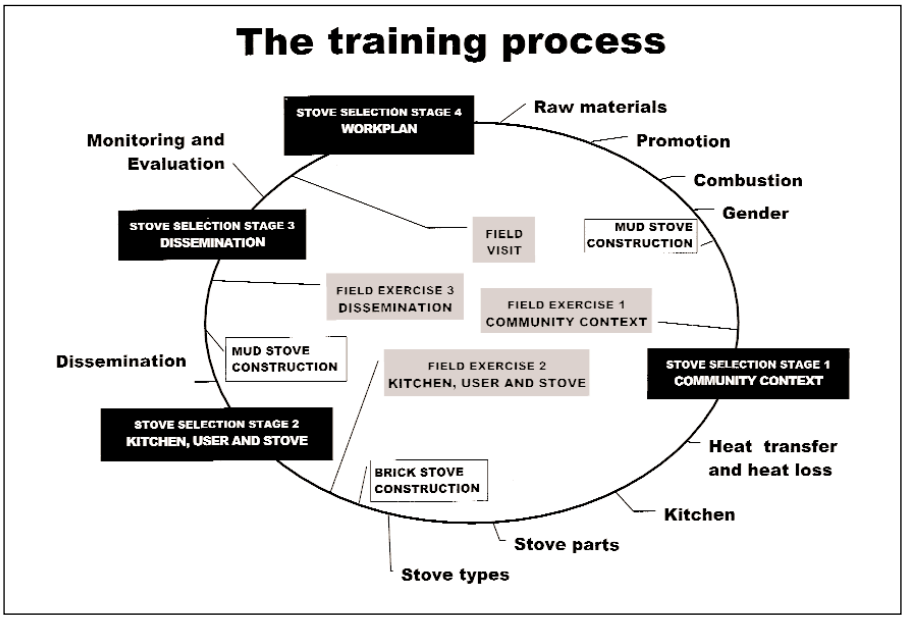

Figure 1 The training process

The Sustainable Urban Livelihoods Framework – a tool for looking at the links between energy and poverty

by Alison Bannister, Future Energy Solutions, AEA Technology plc, B154, Harwell, Didcot, Oxfordshire OX11 0QJ, UK

Méthodologie pour des revenus urbains durables: un outil d'analyse de la relation énergie-pauvreté

L'impact d'une augmentation de 96% des prix de l'électricité et de 64% des combustibles pétroliers au Ghana est abordé à partir de ce cadre d'analyse. Cet article traite de l'impact de cette augmentation des prix sur le capital des ménages et leurs stratégies pour faire face à cette situation. Cet article montre que les populations pauvres ne sont plus en mesure d'acheter des biens de consommation électriques, et d'épargner. Par ailleurs les visites familiales sont considérablement réduites. Les modes alimentaires ont par ailleurs changé et les dépenses de santé ont été réduites. Les entreprises ont également été durement touchées. Ce cadre d'analyse s'est avéré un instrument adéquat pour l'analyse des changements en cours.

Introduction

This article describes an evaluation of the importance of energy in relation to interventions, shocks and stresses in a poor community in Ghana. The focus of this article is the research findings from Moshie Zongo, one of the two urban communities studied in Ghana, located in a densely-populated inner city neighbourhood with few social and infrastructural amenities. The research was undertaken six to eight months after massive price rises for electricity and fuel had been implemented. The research was managed locally by the Energy Foundation, with social study experts from the Kwame Nkrumah University of Science & Technology, Kumasi. The Ghanian experience described in this article is part of a larger project called 'Energy, Poverty and Sustainable Urban Livelihoods' located in Indonesia, China and Ghana. The specific change examined in each country is summarised in Table 1.

This project uses a *Sustainable Urban Livelihoods Framework* (see *BP* 46, page 30), to examine the links between energy and poverty. Drawing on the project's findings, ways will be developed for measuring the importance of energy in the lives of poor urban people. The project is managed by Future Energy Solutions in partnership with the Development Planning Unit (DPU) of University College London, working closely with development, poverty and energy experts in Indonesia, China and Ghana.

The community of Moshie Zongo

Moshie Zongo was originally settled by migrants from Burkina Faso and ethnic groups from the north of Ghana in the 1950s. It is in a low-lying part of the city, bordered by three rivers. During the rainy season the community is often cut off from the rest of the city due to flooding. The majority of the population (Figure 1) are employed in the informal sector, the women selling small items in front of their homes, hairdressing, dress making and producing palm kernel oil, and the men making pots, or corn milling. Those in the formal sector tend to be unskilled labourers, drivers or security men. The community is very poorly served with sanitation facilities and its piped water supply is irregular and prone to contamination, since the pipeline passes through a heavily contaminated stream. In common with other poor urban areas of Ghana, many families, ranging from 10 people to as many as 23 in Moshie Zongo, live in 'compound houses'. Often there is only one electricity meter and therefore bills have to be shared using an agreed formula. This can have a significant impact on how people use electricity and the way they plan their spending.

Research method

The research team used the version of the Sustainable Livelihoods Framework developed by the DPU to analyse changes in the community after the energy price rises. They collected information through a combination of:

- semi-structured interviews based around the Sustainable Livelihoods Framework
- focus group meetings

Table 1 Specific event in each country analysed during the study

Country	Project
Indonesia	Energy efficiency/ clean transport programme in Jakarta and how this impacted on the lives of taxi drivers
China	Factory boiler replacement programme and how this affected the lives of the vulnerable households around the factory
Ghana	Effects of a 96% increase in the price of electricity and a 64% increase in the price of fuel on access to energy and the subsequent implications this had for household assets and strategies

Figure 1 Residents of Moshie Zongo *(photo: Alison Bannister)*

Figure 2 The road into Moshie Zongo *(photo: Alison Bannister)*

- transect walks with some of the residents. (Transect walks are walks involving the research team and the residents where housing types, infrastructure and amenities, religious and cultural features, economic activities, skills, occupations and land use are observed.)

The DPU approach to Sustainable Livelihoods starts by finding out about the short term and long term objectives of poor men and poor women, identified using a participatory approach. It goes on to establish the assets or *wealth* available to them. These assets include:

- *Human* assets, such as health, education, skills
- *Physical* assets, including property, equipment and infrastructure
- *Natural* assets of water, air, soil, vegetation, etc.
- *Financial* assets, such as access to credit, loans, savings, remittances
- *Social* assets, including support mechanisms within families and communities, religious groups, community groups, etc.

Access to these assets is affected by the social or cultural situation, the economic position, the political and administrative context and the environmental conditions in which people are living. How these assets are accessed and used are also determined by policies, institutions and processes. Some of these can influenced by poor people, in which case they can take control – but others cannot.

The livelihood strategies which people adopt will result in their lives becoming more secure or more vulnerable. The more secure a household, the better it can cope with the many *shocks*, *stresses* and *trends* that affect its members lives. Strategies in an urban environment might include income-generating activities such as selling goods, fishing, making pots, selling firewood and urban agriculture. They may also include spending less when times are hard – for instance, cutting back on food, transport, education and health.

Preliminary field results

A summary of some of the key findings from the Ghanaian field work at the Moshie Zongo site is described below. The Sustainable Livelihoods Framework provides the structure for the analysis. The impact of price rises on household assets and strategies was particularly significant. This summary is based on a draft report produced by Dr Rudith King of the Kwame Nkrumah University of Science and Technology, Kumasi and Dr Alfred Ofosu Ahenkorah of the Energy Foundation, Accra.

Physical assets

Increases in energy prices resulted in increased disputes within the community about how to share out the electricity bills fairly.

> *'. . . even last week, people had to fight in this house over electricity bills'*

As a result there was a reduction in the use of physical assets. Some households decided to abandon using labour saving devices or entertainment devices such as TVs, radios and cassette players that required electricity, not only because of price increases but also to avoid the problems that came with splitting the bill.

Figure 3 highlights the large number of TV aerials in the community. However, most households either do not have a TV or cannot afford the cost of electricity to use it and therefore do not use such items.

One third of the people in the project have stopped buying electrical appliances, and refrigerators and freezers are turned off at night. Ben, a 32 year old fitting mechanic had an electric cooking stove, but has stopped using it and only uses charcoal for his meals now.

Financial assets

The high illiteracy rate in such deprived communities often increases the vulnerability of people to fraudsters and dishonest people. In one such incident a compound house, with about 24 tenants sharing a common electricity meter, gave their money for the electricity bill to one of the tenants to pay to the utility. He kept the money himself. The electricity company disconnected the supply but this man, having squandered the money, reconnected them illegally. The electricity company found this out and the families in the compound are now being taken to court and face a bill of 3 million cedis ($430). This is a sizeable debt given that 50% of the population of Moshie Zongo earn less than $1 per day.

Not only are families going into debt, but those that could previously save are finding this difficult, as all their spare cash is being 'soaked up' by energy price increases.

> *'Prior to the increase in energy prices I could save 30,000 cedis ($4) a month – now we save nothing'*

Figure 3 TV arials in Moshie Zongo
(photo: Alison Bannister)

This reduction in the community's spending power is seriously affecting those earning a living in the community through trading and providing services.

Social assets

Social assets relate to the networks of trust, cooperation and support which exist within communities. The social capital of households is determined in part by the networks to which they belong and in part by their contribution to, support of and cooperation with other members of that network. Such capital can be used at times of stress. But to do this households need to have built stocks by supporting others in their times of need. Social events, such as weddings, bring social networks together. Those who are part of the network while partaking in a social event also contribute, through gifts, to the establishment of the new household of the bride and groom. An action which the bride and groom will be expected to reciprocate at appropriate times in the future.

In Moshie Zongo links between extended urban and rural families have been severely affected by the increasing cost of transport, due, in part, to the petrol price rises. Mothers can no longer afford to visit or take gifts to their children and other relatives.

'My daughter lives with my parents in the North. I can't afford to visit her now'

'I relied on my family sending food to us but transportation costs are so high now it has become impossible'

The reduction in spending money because of having to pay more for energy has further reduced the ability of households to participate in social events, and this has a long term impact on their chances of receiving support in times of need. Also, other people in the community can see which households have not been able to pay for electricity.

'When electricity is cut off people are very aware of it – it is very visible. There is a shame from not being able to pay your bills'

Human assets

The increase in energy prices has changed the way in which the families interviewed spend their money. Although the money people earn has not gone up substantially for the households in Moshie Zongo, the amount actually spent on energy has increased in many cases. This is not just for electricity and petroleum – but also for firewood (90%); kerosene (67%) and charcoal (82%). Although it is difficult to prove on the basis of our small, qualitative sample, we believe that this must reduce the available funds for other items such as food, education and health, causing further hardship. To complicate matters further, the cost of food, education and health are also going up in price due to the general economic situation in Ghana. The following facts are known:

Food

Food consumption patterns are changing which might lead to problems with nutrition in the longer term. Consumption of milk, bread, meat, eggs, fish, fruit, rice are all falling, and *Tuo Zaafi* (a meal prepared from maize flour) consumption is increasing.

Absorbing or passing on the cost?

Selling charcoal

Figure 4 Woman selling charcoal
(*photo: Alison Bannister*)

The cost of charcoal has gone up and this charcoal seller has to pay for transport costs from the production site into the city. Transport costs have increased due to the increased price of fuel. She cannot pass the full cost on to her customers as they are reducing the amount they buy in any case. Her profits are now so low that she has to take on other jobs in order to afford to live.

Kenny's experience running a bar

Kenny, a drinking bar operator in Moshie Zongo, Kumasi, says that energy is the second biggest item of expenditure after food for him. He is paying out three times the amount he paid last year on energy, and his profits from operating the bar have been reduced as he cannot pass on the increase to his customers. He is thinking of trying to find an extra job to bring in enough money to meet his needs.

Table 2 Findings

Lesson 1

The Sustainable Livelihoods approach can be used for identifying factors which are critical for success, and problems which should be avoided in policies, programmes and projects

Using the Sustainable Livelihoods Framework as an analytical tool in three countries we quickly saw common patterns, particularly in how coping strategies and assets changed in response to shocks, stresses and interventions.

For instance, responses to price rises followed a similar sequence – people switched energy types to cheaper options (e.g. from charcoal to wood), then reduced consumption (e.g. through cooking less or sharing the cooking with neighbours), and once energy consumption was at the lowest level they were prepared to accept, households started cutting other items of expenditure.

Lesson 2

The Sustainable Livelihoods Framework demonstrates the role of policies, institutions, and processes (PIPs) in determining the effectiveness of policies, programmes and projects

The electricity tariffs set by the Public Utilities Regulatory Commission of Ghana and used by Electricity Company of Ghana incorporates a 'Lifeline Tariff' which allows every metered premises to enjoy a certain amount of electricity per month at a reduced rate. In 2001, the Lifeline tariff covered the first 50 units of electricity consumed in every given month. Those who have low levels of consumption pay the lowest tariffs and as consumption increases, rates per unit consumed increase. Poorer families in Ghana, particularly those living in compound houses, tend to share meters – as many as 24 families could be drawing electricity from a meter at any time. Therefore consumption per meter soon reached the expensive tariffs resulting in the 'poor' in the society paying more per unit of electricity than middle and high income families who live in separate apartments with individual electricity meters.

Although policy makers were aware that this might happen, the effect of the policy at the micro level on households coping strategies and assets (and thus the consequences for the long term security of the household livelihoods) were clearly highlighted by using the Sustainable Livelihoods approach.

This was an awareness raising aspect of the approach and is closely linked to lesson 3.

Lesson 3

Using the Sustainable Livelihoods Framework leads to improved dialogue between social and technical stakeholders at government, consultant, academic and community level

The Sustainable Livelihoods Framework provided a way of sharing understanding for the energy, poverty and development experts working on this project. Poverty and development experts became increasingly aware of the importance that poor households placed on access to energy. And in turn, energy experts were quickly able to see the potential and actual implications of a change in energy policy or the introduction of an energy project on poor household's assets and coping strategies.

The number of meals eaten is also falling – fewer people are taking lunch now (50% as compared to 86% prior to the energy price rises).

Health

A survey of people's use of healthcare facilities revealed a change from using the hospital to using the local drug-store in the post-energy price rise period. (Hospital attendance of 60% fell to 32% and attendance at drug-stores increased from 23% to 50%).

Education

Expenditure on education has increased but people are maintaining this with difficulty:

> *'I have stopped buying dresses for myself so I can have money to buy school uniforms and shoes for my children'*

> *'I now pay my children's school fees in instalments'.*

The reduction in expenditure on education, health and food will have a negative impact on human assets.

Natural assets

Natural assets in Moshie Zongo are poor: the river is polluted; there has been no waste removal for eight years; and sanitation is inadequate. However, there has been no immediate impact on the local environment due to the price increases.

Conclusions

The use of the Sustainable Livelihoods Framework for understanding the relationship between the effects of an energy intervention or shock on households has proved to be a valuable analytical tool for a number of reasons as shown in Table 2.

Many of the above effects will be recognisable to readers. The use of a Sustainable Livelihoods analysis has enabled the identification of common patterns of response across of a variety of households and countries. Using the Sustainable Livelihoods tool, it is possible to explain these important issues to policy makers.

Overall, these three lessons draw out the very real potential for the Sustainable Livelihoods approach to be used in a variety of situations. The next stage of the project is to draw together our research findings in Ghana with those from Indonesia and China.

However, we would welcome the thoughts and comments of the readers of *Boiling Point* on the issues raised above in order to maximize the potential of our work.

This project is funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

Alison Bannister is a qualified accountant who moved into environmental and energy management 'to make a difference' and then into social development when she came to realise that it was really people that made the difference to the success or failure of an endeavour. She has worked all over the world but keeps ending up in Africa because she likes it so much each time she visits.

Understanding the links between energy, poverty and gender

Dr Hilary Standing, Institute of Development Studies, University of Sussex, Falmer, Brighton BN1 9RE Tel: +44 (0)1273 877147; Fax: +44 (0)1273 691647 Email: H.Standing@ids.ac.uk

Comprendre les liens entre énergie, pauvreté et genre.
Les stratégies de réduction de la pauvreté diffèrent selon le genre. Les comportements ainsi que le rapport avec l'énergie ne sont pas les mêmes selon les genres. Les femmes sont impliquées aussi bien dans les activités productives que les tâches domestiques. Proportionnellement, l'utilisation de la biomasse et son impact sur la santé touchent plus de femmes que d'hommes. Quoique les tâches pénibles soient généralement effectuées par les femmes, la mécanisation de certaines tâches peut affecter leurs revenus si les équipements échappent à leur contrôle. Une politique effectivement centrée sur la pauvreté doit considérer en priorité les revenus, la sécurité et le renforcement des capacités.

Introduction

To explore the relationships between energy, poverty and gender two related aspects can be distinguished:

- poverty and gender
- gender and energy

Poverty and gender

Poor women and poor men do not necessarily become poor in the same ways through the same processes – nor do they save money for when times are hard in the same ways. The impact of migration on poor rural areas is a particularly clear example of this. Whilst able-bodied men may move to work in other rural or urban areas (sometimes sending money home), women may be left managing both food production and household-based work. Increasingly women are the heads of households, with too much work to do and too few resources – leaving them vulnerable.

Within the household, women and men will have different access to goods and resources. Data from households may reveal hidden discrimination based on gender or age. Because of the different ways in which both women and men experience poverty, a person's status within the family is one factor which should be considered in determining poverty reduction strategies.

There has been a tendency to equate men with production-based needs and women with welfare-based needs. An analysis of poverty, based on gender, should not just look at welfare needs for women, but also address both women's and men's capacity to access ways of gaining an income.

Gender and energy

There is a relationship between the sexual division of labour and the reliance of the poor on traditional energy sources. The division of labour affects women and men, boys and girls differently. Women generally work in both productive activities and in tasks associated with child-rearing, food processing and cooking, care of the sick and caring for the house. Girls are more likely than boys to provide support in these tasks. The poorer the household, the greater the time, and the physical and health burdens associated with these tasks. The absence of basic labour saving devices and 'clean' technologies – such as fuel-efficient stoves – not only burdens poor women in these ways, but also prevents them from doing other productive activities. The disproportionately high levels of ill-health experienced by women, girls and young children caused by traditional biomass stoves is a further consequence of the division of labour.

Women and girls also work in production, often as unpaid family labour in physically arduous and/or time consuming tasks such as food processing for local markets. The greater the differences in men's and women's activities in rural areas, the greater the drudgery for women and girls. A similar pattern is found in income generating activities; women generally have less access to ways of making an income, such as labour, loan guarantees, credit facilities, information and training. These inequalities stem from household, social and cultural discrimination. Hence, women's capacity to increase their labour productivity and improve their incomes is limited.

It has also been pointed out that because of their reliance on 'traditional' industries, women's employment can be threatened by the introduction of more efficient forms of energy. For example, in Bangladesh, the replacement of traditional paddy huskers operated by women, with small-scale mechanised milling has reduced the number of poor women earning income in this field significantly – men have largely taken the jobs in milling. This case underlines the need to analyse energy-related impacts on the poor in ways that show the effects on women and men.

Because of their different and unequal roles in the division of labour, women and men have different needs and may have different priorities and make different trade-offs of their time and energy. For example, Dutta found that women valued smoke reduction on health grounds and to reduce the drudgery entailed in cleaning smoky pots. Men, on the other hand, valued fuel savings above other considerations. 'Community' level interventions need to take particular note of this. It is important to look at who speaks for communities, how decision making takes place, and to ensure that the voices of minorities and women have been heard.

The energy chapter in the World Bank's draft PRSP (Poverty Reduction Strategy Papers) Toolkit explicitly recognises these themes. While making little reference to gender, its energy-poverty framework highlights income, capability, security and empowerment as the key elements required of a poverty-focused energy policy.

Hilary Standing is a social scientist working on development issues in the Health and Social Change Programme, Institute of Development Studies, University of Sussex

Participatory approaches for alleviating indoor air pollution in rural Kenyan kitchens

by Elizabeth Bates[1], Nigel Bruce[2], Alison Doig[1], Stephen Gitonga[3]
1. ITDG, The Schumacher Centre for Technology & Development, Bourton on Dunsmore, Rugby CV23 9QZ UK Tel: +44 (0)1926 634465 Email: lizb@itdg.org.uk
2. Department of Public Health, Whelan Building, Quadrangle, University of Liverpool, Liverpool, L69 3GB UK Tel: +44-(0)151–794–5582 Email: ngb@liv.ac.uk
3. ITDG Kenya, PO Box 39493, Nairobi, Kenya Tel:00 254 2 719313 Email: itkenya@itdg.or.ke

Approches participatives et réduction de la pollution dans les cuisines en milieu rural kenyan
Une approche participative pour la diminution des émissions de fumée à l'intérieur des foyers a produit un impact positif à la fois en matière de réduction des émissions et d'amélioration de la qualité de la vie dans deux communautés rurales au Kenya. Les communautés ont été associées à toutes les étapes y compris la conception et le choix des équipements pour la réduction des émissions. Des réductions de l'ordre de 75 % et de plus de 60 % ont été possibles respectivement lors de l'utilisation des hottes et des techniques de ventilation. Par ailleurs, d'autres avantages y sont associés comme les économies d'énergie, meilleur confort, prestige social et meilleures relations familiales.

Introduction

How do we make sure that the impacts from a project are long-lasting and valued by a community? What factors will lead to really successful outcomes? We may think we know best – but if complete outsiders came to our kitchens and started telling us the best way to organize them, would we welcome them and heed their advice? – even if it proved completely irrelevant to the problems which we knew were causing us inconvenience?

The participatory approach being adopted by ITDG works with communities, discussing with households the known scientific risks of indoor air pollution, and working with them to find solutions which both reduce smoke, and at the same time enhance the comfort and quality of their lives. By applying technical know-how to potential solutions identified by the community, acceptable technologies have been designed and proven to be effective.

Background

Around 80% of people in rural sub-Saharan Africa depend on biomass (wood, dung, crop residues) for domestic energy. There is mounting evidence that the resulting indoor air pollution increases common, serious health problems, and attempts to reduce this pollution have often failed due to lack of community involvement in developing appropriate, sustainable solutions. The ITDG Smoke Project has been working with 50 households in two rural Kenyan communities, using *participatory methods* to alleviate smoke pollution.

Two study areas were chosen: Kajiado where ITDG is involved in the Maasai Housing Project and in West Kenya where ITDG is working on the *Upesi* project. These two areas are totally different climatically and geographically, as well as culturally (lifestyles, cooking habits and house types).

Community participation

Community participation has been a fundamental component of this project. This is built on experience over many years which shows that the target community are best placed to express their own needs and to identify potential solutions which suit their cultural, social and economic needs. Indigenous knowledge has been highly valued throughout this work, and the community's (mostly women's) views and opinions have been listened to at all stages of the work (Figure 1).

Commons themes and principles in participatory methodology include an understanding of the following

- that the community is the main actor in any development initiative
- that the outsider's role is basically supportive to the local efforts
- that the development activities should be oriented towards needs as perceived by the community
- that the indigenous knowledge has an important role to play as a basis for action, support and strengthening
- that the key challenge is to tap the potential of interaction between indigenous knowledge and that of the outsiders.

Participatory activities

In this project, these principles were adopted by:

- involving women's groups in house selection
- empowerment of communities by making them aware of the risks associated with household smoke and enabling mechanisms for its alleviation
- carrying out baseline assessment of pollution and exposure, fuel use and house structure, which included questionnaires and discussions
- initiating discussions on ways of alleviating indoor air pollution through development and installation of interventions
- evaluation of changes in pollution and exposure, and community views of the process used, and acceptability and affordability of the interventions
- other key activities have included individual interviews, time activity studies and focus group discussions.

Benefits of participation

During the project, participation has helped the communities to understand some of the problems of smoke in their houses and, importantly, it has empowered women to be actively involved in formulating solutions for smoke alleviation.

Figure 1 The community's views and opinions have been listened to at all stages of the work (photo: ITDG East Africa)

Both men and women participated in technology development and appraisal, deciding on the appropriate option that suited them best. The final design and materials used for the interventions was determined by the women themselves and availability of materials. In this way, local skills were used and the interventions are well accepted, key factors in promoting future replication of the interventions in the area.

The community also provided labour, and contributed in cash and kind in all the activities undertaken by the project team. Group leaders from the community called meetings and discussed issues of concern and communicated the same to the project team.

Effectiveness of interventions

Unsurprisingly, the selection of interventions was different in each area.

Smoke hoods

In the early part of the project, only one or two women in Kajiado were willing to try smoke hoods to alleviate smoke (Figure 2). Once two had been installed, just over half the women in the Kajiado region elected to have them. Photographs of the smoke hood working convinced five of the women in West Kenya to choose them too. The smoke hoods have proved extremely effective in both areas, reducing the particulate levels to a fraction of their original levels – from a mean of 4383$\mu g/m^3$ to a mean of 1075$\mu g/m^3$. Likewise, the carbon monoxide levels in the room (another key indicator of indoor air pollution) fell from 48 ppm to 10.7 ppm.

Eaves spaces

These have proved popular in West Kenya where, although less successful than smoke hoods, they have been particularly successful in removing a large proportion of the smoke in those households which had suffered from very high levels of smoke prior to having eaves spaces installed. For example, increasing the size of the eaves spaces from small to large reduced the particulate levels from 2042$\mu g/m^3$ to 766$\mu g/m^3$ (the lower figures overall are because West Kenya does not have such high pollution levels). In Kajiado eaves spaces have not been adopted – it is difficult to get eaves-spaces cut into the tightly-woven and mud-smeared walls close to the roof.

Windows

The Maasai community in Kajiado were keen to have windows, which could be closed with a wooden 'door' at night. In West Kenya, the women wished to have windows enlarged and fitted with mesh and a 'door'. Although the measured reduction in pollution has not been great, women are aware that opening the window improves fire combustion, and in Kajiado the windows brought light into the houses for the first time. This has improved the overall quality of life immeasurably; various vectors of ill-health (rats, bedbugs, snakes, etc.) have been expelled, women talk of being able to do craftwork and housework when it is raining, men enjoy drinking beer in the kitchen, children do their homework.

Stoves

These were adopted only by the women in West Kenya, where there is a strong tradition of *Upesi* stove use. All those who did not have stoves prior to the project had them installed. Those using the *Upesi* stoves have

Figure 2 Woman cooking, using smoke hood installed in Kajiado (photo: Nigel Bruce)

Figure 3 Eaves spaces and Upesi stove installed in West Kenya (photo: Nigel Bruce)

experienced very little improvement in pollution levels but all have benefited from reduced fuel use, shorter cooking time, increased safety and ease of use. In Kajiado, none of the women wanted to have stoves installed, though some have a shielded fire rather than the more traditional three-stone fire.

Poverty impacts

The poverty impacts in the table reflect the observations made by the beneficiaries themselves – often during group discussions.

Discussion

Throughout the project, the community members, who are the main stakeholders, have held brainstorming sessions with the facilitators and have engaged in exchange visits to examine the interventions selected by others involved in the project. The post-intervention discussions have shown the communities to be overwhelmingly positive in their response to the interventions.

Limitations

These discussions have provided a chance to identify limitations, and to discuss ways in which improvements can be made.

One area is finance; although all the smoke-alleviating technologies have been developed in consultation with all the project stakeholders, the cost of smoke hoods, particularly, is higher than most women (in particular) can afford. In terms of assets within the Maasai community, it is the same cost as two goats. Two routes can be adopted to make the smoke hoods more affordable. The first is reducing the cost of raw materials; using scrap metal rather than new sheet metal; making some parts of the hood from clay etc. Another vital route is to promote the hood to men within the community – not in terms of improved health, but in terms of 'comfort'. Reflecting the comments of some of the women in the project – 'Men can drink their beer in the cool of the kitchen'.

Another concern is the temperature of the room when a lot of new openings have been made. This is more important when people are intending to sleep in the room. Providing a 'door' on the windows, and ensuring that the eaves spaces are no larger than is required to alleviate the smoke are two approaches to addressing this problem.

Ongoing community participation

The communities have continued to share their experiences and suggest how best the various technologies can be made appropriate for their households. The support of the owners of the households cannot be over emphasized since they have unstintingly offered their time and houses to help the study be successful. Looking into the future:

Figure 4 Women in Kajiado can do craftwork in the house (photo: Nigel Bruce)

- Some of the project families have already expressed a need for more interventions (windows and smoke hoods) in their main/living houses – this will provide employment for the artisans who have been trained by the project. The project women have requested training by the team on how to go about with dissemination of interventions where they will be acting as the key lead.
- Members of the women's groups who were not involved in the project have made representation that they had not been trained on indoor air pollution extraction techniques. They have suggested training local artisans (among the community members) to ensure sustainability.
- Neighbours of the women involved in the project feel that a bigger group needs to be targeted to meet the demands of the community – this will be addressed in future project work.
- The improvements have prompted several inquiries from neighbours of the household owners. One of the husbands, for example, has had many visitors inquiring about the chimney installed in his kitchen and the improved fire efficiency realized from the improved cook stoves.
- The Kenya office has used the national press to highlight the dangers of indoor air pollution, and to describe the project activities. It will now be seeking to inform the general public through this medium.
- Videos have been made in both regions, and these will be useful dissemination tools, allowing the women to discuss their own impressions of the changes which the interventions have made to their lives.
- The project has shared experiences with Institute of Cultural Affairs of Tanzania (ICA – TZ), that was developing a proposal working with the Maasai community in Tanzania.
- The smoke team is collaborating will the Maasai Integrated Development Partnership Project (MIDPP) on their Urban Livelihoods and Shelter (ULS) Programme.
- The project has worked with Cross-border Bio-diversity project

Table 1 Poverty impacts

Increased income and savings	Increased income through training of artisans to make and sell interventions Reduced kerosene use due to reduced need for lighting (quoted by one householder in Kajiado; 4 litres now purchased monthly instead of every two weeks by another) Reported savings in time and money spent through ill health and in hospitals with burns, coughs, eye and chest pains Reduced losses caused by attacks on domestic fowl by wild cats, due to grills/mesh on window Use of windows providing light have given household members more time to engage in other economic activities such as pottery, basket weaving, beadworking, collecting medicinal plants and leisure activities when weather unsuitable out of doors Food stays longer without spoiling Can find lost items
Health	Coughs, dizziness and chest pains relieved Reduced sweat and heat, so better sleep Less headache, malaise Reduction in aching eyes, tears and running nose Safer – smoke hood acts as a shield, preventing children and goats falling onto fire Snakes and rodents cannot hide in the house where there are windows
Improved comfort	Cooking is possible using daylight through the windows Less soot on walls, ceilings, hair, sheets, children's books, clothes Easier to wash the children and do the housework Fire cooks faster, is easier to light, uses less fuel and can use any type of wood with smoke hood, so faster to collect Can stay longer in the house (this allows tasks to be completed more quickly) Able to watch over calves through the windows Less smoke in room makes it more comfortable Improved lighting and visibility through window installation Less smells Fresh air circulation The hood prevents rain getting onto the fire when the roof leaks Men can drink beer in the cool of the house Led to the introduction of new ideas: e.g. creation of more space, improved fireplace, introduction of cupboards Food free from soot contamination
Empowerment	Women have gained confidence in decision making on house and kitchen improvement, intervention designs and installations They have organised group meetings on their own to discuss the indoor air pollution reduction benefits The beneficiaries have been empowered through involvement in design, development and production of desired interventions An increased confidence of project participants through participatory training was noted by the project staff Project participants at the community level have been empowered to disseminate project outputs through e.g. exchange visits, carrying out demonstrations and installing interventions (e.g. improved cook stoves) with their sub-contracted artisans who can install windows, chimneys and eaves spaces for interested households Improved children's grades at school, as they can work indoors
Prestige	Increased social capital; project women have reported more visitors in the kitchen and more willingness to welcome them The group members feel their status in the society has been raised as other community members keep sending requests to the respective representatives
Gender aspects	The project targets women and children but the whole family benefits. Both men and women were involved in the project at all levels Women have gained confidence through disseminating knowledge to their neighbours Husbands became supportive of their wives' initiatives when they realised how much the comfort of their kitchens' were improved Interpersonal relationships built up among the women as they worked on the project Spouses now spend more time in the kitchen in West Kenya, sitting by the fireplace while women work, and eating food there, provided the children have left

in their planning sessions, and has influenced the project to involve ITDG in the energy component on conservation of energy at Namanga Hill, Kajiado district.

- The project has liaised with the local office of AMREF.
- The project has influenced the Ministry of Health (MoH), Ministry of Culture and Social Services (MOCSS), and Maendeleo ya Wanawake (an organisation set up to empower and improve the status of women) to participate and to campaign for indoor air pollution reduction.
- Local leaders have been involved in indoor air pollution reduction campaigns.

On a wider front, ITDG has just embarked on a second project, this time working with communities in urban Kenya, a high cold region in Nepal and working with displaced persons in Sudan. It is hoped that the methodologies which proved so successful in the project described above can be adapted to work with communities in these regions to reduce the health impacts of household smoke over a wider geographic area.

None of this work could have taken place without the unstinting efforts of the field teams in both Kajiado and West Kenya, and the enthusiasm and cooperation of the households taking part in this work.

The impact of energy infrastructure projects on poverty

by Rona Wilkinson, IT Consultants, Schumacher Centre for Technology and Development, Bourton on Dunsmore, Rugby CV23 9QZ, UK Email: ronaw@itdg.org.uk

Projets d'infrastructure énergétique et leur mpact sur la pauvreté: étude de cas de micro centrales hydro-électriques.
A partir d'une méthodologie définissant un cadre d'analyse pour des revenus durables, des projets au Kenya et au Népal ont été analysés afin d'établir leur impact sur la pauvreté. L'absence de marché est considérée comme une contrainte essentielle pour les communautés isolées. L'acquisition du capital physique (par exemple la micro centrale) peut ne pas conduire à une augmentation de revenu. Une évaluation devrait également prendre en considération les coûts-avantages, sociaux et environnementaux.

Introduction

What effect do 'infrastructure projects', such as micro-hyrdro installations, have on poverty? More particularly, what impact do they have on the communities, and on the environment in which they are installed? When, for example, a village has access to electrical or mechanical power, *how* does energy contribute to economic development at village level? Who are the beneficiaries – who is empowered by energy supply? And exactly what benefits does energy bring? Moreover, how can perceived benefits, and indeed potential negative outcomes, be assessed? There is now ample evidence that when traditional sources of energy have been augmented by modern energy systems, economic development does not always follow. The key need is to plan local energy infrastructure so that it has the maximum impact. What are the pre-conditions for it to be able to do so?

This article is based on two case studies of micro-hydro installations in Nepal and Kenya, carried out within an overall project managed by Intermediate Technology Consultants (ITC). Fieldwork for the case studies was carried out by ITDG staff in Kenya and Nepal. The project looked at the relationship between energy and poverty, using the 'Sustainable Livelihoods Framework' (see *BP46*, page 30). This framework is centred on people and their lives, and provides a checklist of important issues – how these are dynamically linked – and the influences and processes at work.

The Kenyan project

Tungu-Kabiri project is located in Mbuiru village in the Eastern province of Kenya, around 200 km from Nairobi (see *BP 45* – Page 6). The Meru people, one of Kenya's smaller communities, constitute most of the population. People from other communities have moved into in the area, however, resulting in an ethnic mix. Residents have coexisted for a long time and form an integrated, cohesive society. The vast majority of people, around 90%, are under 40 years of age.

With an average annual rainfall of between 600 and 900mm, the area is hot for most of the year, experiencing temperatures up to 33˚C. It is hilly and soils exhibit poor water retention. The vegetation consists of low bushes and scattered trees that have survived cutting for firewood or making charcoal.

At the time of this study, the project was in its early stages. Though significant preparatory work had taken place with the community, the turbine had not been installed. The goal is enterprise creation for income generation via electrification of a commercial centre.

The Nepal project

To reach Pinthali from Kathmandu is a two-hour drive east followed by thirty minutes steep uphill walk. Residents of Pinthali all belong to the Tamang ethnic group.

Implementation of the project began in 1997 through the Rural Energy Development Programme (REDP). This programme assists rural communities to establish local energy systems and develop productive end-uses that generate income. REDP take a community-based approach, identifying mobilization as a precondition for assistance. Thus the approach is more holistic and akin to the Sustainable Livelihoods approach.

The scheme has been running for some time, and provides domestic lighting and entertainment services.

Gathering data

Kenya

Both studies took their unit of reference as the household. The Kenyan study considered a household as 'a person or group of persons, generally bound by kinship ties, who live together under a single roof, are answerable to the same household head and share a common source of food.' A household is defined as poor if it cannot meet the basic needs of its members. The Kenyan study employed a range of formal and informal research methods:

- interviews with local opinion leaders, key informants and other stakeholders
- a questionnaire survey of selected households
- participant observation
- focus group discussions
- a wealth ranking exercise.

Figure 1 Micro-hydro scheme at Chuka, Mbuiru Village. Canal taking water from the river to the penstock and then the power house (photo: ITDG East Africa)

Nepal

The fieldwork used the following research methods:

- a structured questionnaire to conduct a household survey
- two focus group discussions: the first about the MHP and livelihoods; the second – with women only – on gender issues and the MHP
- key informant interviews
- observation and photographs.

A representative sample of one third of households in Pinthali were selected for the household survey.

Comparison of communities

Pinthali is the smaller and the more isolated from infrastructures – roads, health facilities, markets and administrative centres. Many health problems are a result of poor quality drinking water, and health facilities are inadequate in both cases. A lack of irrigation restricts agricultural production. With regard to energy, both villages are dependent on a combination of biomass for cooking and kerosene for lighting (Table 1).

Analysis of case studies

Table 2 compares what the communities wanted to achieve through the micro-hydro installation. It can be seen that many of their aspirations are similar

Impacts in Tungu-Kabiri Project

Results so far indicate that the main benefit is an increase in *social capital*. (Social capital means an increase in linkages between people – membership of more formalized groups, relationships of trust, sharing and exchanges.) The formation of a Project Management Committee has boosted community confidence, promoted mobilization and increased solidarity of purpose. Through the committee, finance has been raised from residents of Mbuiru to pay for necessary government permits to allow installation of the MHP. Women are, for the first time, taking a role in formal decision-making processes. Local government structures, meanwhile, are aware of the project and are responding with increased cooperation and support.

In Mbuiru, at the present time, the Project Management Committee cannot plan household connections for electricity from the MHP, because, under current Kenyan utility law, they are not allowed to sell electricity to a number of households. Ingeniously, the committee and project partners circumvented this law by obtaining a dispensation to supply their commercial centre as one large 'house'. This is not

Table 1 Comparison of communities

Feature	Mbuiru	Pinthali
Local economy	Subsistence agriculture	Subsistence agriculture
Crops/staple foods	Maize, beans, vegetables	Potatoes, maize, rice, black gram
Livestock	Cattle, goats, sheep, pigs, chickens. Typically 2 large beasts/household	Buffalo (only 2.4% of households sell milk)
Cash crops	Tobacco	Garlic, dairy produce: milk & ghee
Constraints on agriculture	Irrigation, especially for tobacco & cotton growing. Soil erosion	Irrigation, inhibiting increased cash-crop garlic production. Soil erosion
Off-farm activities & income	Important: A range of activities & forms of employment contribute 72% of annual household income	Marginal: 'Thanka' painting & labour on the highway supplement farming income by up to 20%
Population	1,800	709
Typical educational attained	Primary level, basic literacy 90%	Primary level, basic literacy 73%
Household composition	Typically, husband, wife, 4 children	Average 6 people per household
Houses	300, 'improved' traditional – no thatch roofs	118, partially improved traditional, 36% thatched roofs
Drinking water quality	River water. Poor quality, seasonal disease risk	River water. Poor quality, seasonal disease risk
Direct road access	Poorly maintained roads impassable in rainy season	None (highway 30 minutes walk away)
Produce market	Kaanwa Market, 2 km away: food, tobacco, household goods	Traders come to village to buy garlic. Dairy produce sold at side of highway
Healthcare provision	2 health centres very poorly equipped within 2 km. Hospital with maternity facility 12 km	No village clinic
Administrative centre	Local administration at Kaanwa Market (2 km)	District HQ in Dhulikhel, 27 km away
Fuel use	100% of households use fuelwood for cooking. Kerosene lamps for light. (An estimated 90% of energy needs are purchased)	Firewood & agricultural residues as domestic fuel. Wood scarce, long collection times. Kerosene lamps for light
Electricity grid connection	None	None. Not expected within 50 years

Table 2 Comparison of community aspirations

Mbuiru	Pinthali
Higher income through opportunities to engage in enterprise	Increased economic activities and income, principally via irrigation for production of more cash-crop garlic
Increased well-being via better access to water for domestic & farming uses	Increased well-being from the provision of electricity for households
Enhanced food security via increased production & more affordable (grain) milling	Increased food security (undisputed top priority) via irrigation scheme
More sustainable natural resources via using electricity for productive activities	Decreased drudgery through spending less time sourcing kerosene and fuelwood, husking rice, milling and expelling oil
Increased social participation – people have already seen the advantage of organizing and working together	Better infrastructure, particularly road connection to markets, telecommunications and a village health centre

ideal in terms of technical efficiency – people will charge batteries and carry them home to provide lighting. It is hoped that, as a result of lobbying on behalf of the project and the commitment of the Ministry of Energy, Kenyan law will be changed.

Impacts in the Pinthali Project

Overall, the acquisition of micro-hydro power has had a positive impact on livelihoods in Pinthali. It was not, however, the use of electrical or motive power that had the greatest effect. Additional irrigation water, a by-product of canal infrastructure to supply the turbine, promoted a significant increase in agricultural production. This boosted financial assets via increased sales of cash-crop garlic. From 649 kg per annum, community garlic sales have risen to 864 kg. The proportion of houses selling garlic has grown from 81% to over 90%.

Provision of electric light has permitted people to spend more time tending livestock. Reportedly as a direct consequence, sales of buffalo milk have risen from 800 to 1037 litres per household per annum. As with garlic production, the number of households able to produce a surplus for sale has grown from 2.4% to around 12%. A knock-on effect is that people increasingly use money rather than barter as their preferred form of trade. Combined with the availability of electric light, this has allowed village shops to develop, opening for longer hours and stocking a wider range of goods.

Electric lighting has also contributed to building human and social capital. Community and group meetings, as well as cultural events, can take place in the evenings. Hence they are better attended and more effective. Both children and adults, meanwhile, are reported to be benefiting educationally from the opportunity to study and hold evening classes under electric light. In 2001, the MHP Group registered as a cooperative company in which households are shareholders. The process of building – or rebuilding – natural assets, meanwhile, has commenced with the establishment of a tree nursery and a replanting programme managed by the Forest Users Group.

Overall then, the community's well-being has increased and its vulnerability decreased as a result of using the micro-hydro power to develop other physical capital – the irrigation scheme – as well as financial, social, human and natural capital.

The area where the project has proved least effective is in identifying productive end-uses for power from the MHP. According to the case study the community only utilizes around 50% of the available power, mainly for lighting. The principal problem has been in identifying and accessing markets that would encourage productive activities to flourish. The local 'internal' market within the community remains relatively cash poor. Abiding by a tradition of subsistence, people are more inclined to make rather than purchase goods they need. Urban markets, meanwhile, are distant and difficult to access.

Figure 2 Woman able to work at her sewing machine after dark – a positive impact on her financial assets (Caroline Penn ITDG)

The need to identify viable productive end-uses for power produced from energy interventions, and thence to provide appropriate training and support, is a critical observation from the Pinthali project.

What lessons can be learned?

One lesson from the Pinthali experience is that production must be market driven: there needs to be a proven – hopefully predictable and sustaining – demand for goods. Enterprise *is* risky and the successful entrepreneur will need good business instincts, based on a thorough understanding of the market. To give an example of some of the questions that should be asked:

- Which of these enterprises has the real potential to increase assets?
- What is the extent and nature of the market for the various products?
- Who are the competitors and who are the potential cooperators?
- What are the constraints on producing and selling proposed outputs?

A thorough understanding of technical and non-technical issues is required, implying close co-operation between professionals from a range of disciplines. There is a limit to the power available and thus to the number

and nature of enterprises. Other proposed activities also require further scrutiny. What, for example, are the implications of providing power to health centres that cannot afford essential drugs or the cold storage required?

Pinthali benefited more from the irrigation scheme than from the energy intervention. The irrigation scheme – though planned – was considered of lesser importance when the scheme was instigated. Energy supply projects can have innovation and spin-off effects that have more impact than the core intervention. In Nepal the proliferation of village-level micro-hydro schemes has contributed to the development of a manufacturing industry, and 'virtually all turbines' are now made nationally. When policy and decision makers consider energy interventions on any scale, therefore, the potential innovation effects should be taken into account.

Mbuiru is planning to install irrigation and water supply schemes, and the community is in the process of seeking funds to develop them. Micro-hydropower, irrigation and drinking water supply can be assessed and compared in terms of their potential contribution to building community assets. It may be, for example, that a scheme to provide safe drinking water may have a more positive impact than supplying power. An analysis of 'competing' benefits may serve to make the best informed choice of resources.

Conclusions

Markets and alternatives

A lack of market opportunities is patently a stumbling block to building assets in both Pinthali and Mbuiru, exposing what can be assumed to be a common problem for poor communities, particularly isolated rural communities. Three points stand out from the case studies:

- For geographically isolated rural communities, the starting point may be reversing a trend of decline. Markets have migrated further and further away – not just in terms of distance, but also in the nature of the demand.
- Generally, there is a surplus of what rural communities are able to produce when and where they are able to produce it. Agricultural produce enters seasonal markets when there is a glut and demand is low. Meanwhile, those in need of food are typically those with the least ability to pay. Traditional craft production, similarly, tends to be what too many people turn to as a first option for earning off-farm income – the market is saturated.
- It is difficult to see what can be done at project level, in the short to medium term, by communities and their development partners, about the dearth of opportunities that result from macro-level political and economic constraints on markets.
- When, as part of a participatory process, people identify outcomes they hope to achieve, there is often a mismatch with the resources they have access to – including markets. There may be other outcomes that could be more readily achieved and which would have a greater positive impact on livelihoods – such as using the micro-hydro power to pump potable water, improving health and hence human capital, rather than to power woodwork shops in the pursuit of financial capital. Development professionals need to be able to guide communities in matching their assets with viable livelihood outcomes that have the maximum positive effect. To do this, professionals need to be informed about the constraints on people's aspirations, particularly perhaps constraints on markets and building financial capital.

Achieving a positive impact

- To have a positive impact, acquiring physical capital (in this case – micro-hydro), does not necessarily lead to building human, social or other physical capital; it certainly does not lead directly to building financial capital.
- The majority of energy supply projects will, almost by definition, be designed for a long operating lifetime. The micro-hydro schemes in Pinthali and Mbuiru will have an impact on livelihoods that changes over time and is difficult to predict. The fact that the Pinthali scheme is currently unable to fully utilize energy to generate income does not mean that will always be the case.
- Feasibility studies must include both the design of technically feasible interventions *and* an evaluation of the social, economic and environmental costs and benefits. A Sustainable Livelihoods Approach should be ideal for performing such studies.

References

Albert M. & R. Hahnel (1991) *The Political Economy of Participatory Economics*, Princetown University Press, USA

Chambers R. & G. Conway (1992), *Sustainable Rural Livelihoods: Practical concepts for the 21st century*, IDS Discussion Paper 296, IDS, Brighton

Chigaru P. (1990) *Greenline*, Issue No. 17, Zimbabwe

Daly H. & J. Cobb (1990) *For The Common Good*, Greenprint Press, London

DFID (2001) Sustainable livelihoods guidance sheets; Copies available from: DFID, 1Palace Street, London SW1E 5HE, Tel: +44 (0) 20 7023 0000, Fax: +44 (0) 20 7023 0016, Email <livelihoods@dfid.gov.uk

Hvelplund F. & H. Lund (1998) Feasibility Studies and Public Regulation in a Market Economy, Aalborg University, Denmark

IT-EA (Intermediate Technology Development Group East Africa) (December 2001), Energy and Sustainable Livelihoods: Mbuiru Village Micro–Hydro Project, Intermediate Technology Consultants report

IT-Nepal (Intermediate Technology Development Group Nepal) (November 2001), Pinthali Micro-Hydro Project: A sustainable Livelihoods Case Study, Intermediate Technology Consultants Report

Lund H. (1996) Elements of a Green Energy Plan which can Create Job Opportunities, SiD, Denmark

Mandela N. (1999) The Sacred Warrior, *Time*, December 31st

Turner K., D. Pearce & I. Bateman (1994), *Environmental Economics*, Chapter 8: Valuing Concern for Nature, Harvester Wheatsheaf

Rona Wilkinson is Energy Programme Manager for ITConsultants. Rona has worked on hydropower and software feasibility studies in Sri Lanka and in the electricity power sector, including energy sector modelling and tariff analysis, electricity network regulation, power sector legislation and sectorial economic evaluation.

Improved stoves as a means of poverty alleviation

by Didier Bazile, Chef de projet, Programme National d'Economie de Bois Energie, BP 5248, Antananarivo 101, Madagascar Tel: 261+ 32 070 38 01, Fax: 261 + 20 22 415 99, Email: bazile@dts.mg

Foyers améliorés comme un moyen de lutte contre la pauvreté à Madagascar

Madagascar est classée parmi les pays les plus pauvres. Une étude mesurant l'impact économique d'un programme à grande échelle de foyers améliorés montre que les économies d'énergie représentent environ un mois du salaire moyen d'un travailleur de cette région. Le modèle informatique utilisé pour cet exercice peut être extrapolé pour étudier l'impact de programmes de foyers améliorés dans d'autres villes.

Introduction

Fuel wood (charcoal and firewood) is the main source of household energy in Madagascar; a situation which is alarming because the country's forest areas are decreasing by 2.5% per year.

Madagascar is ranked economically among the poorest countries of the world, and therefore substitute fuels, such as gas or oil, are not affordable for the majority of households. Given the absolute necessity for the population to use fuel wood, it is important to have an energy policy which aims to limit depletion of the country's natural resources. The two main objectives of the Woodfuel Energy Saving National Program (PNEBE) are:

- to reduce consumption of wood fuel
- to alleviate the cost of household energy.

This study is designed to measure the economic impacts of the massive dissemination programme of improved stoves throughout the country. Only direct impacts for the beneficiaries (households) resulting from improved stoves dissemination will be measured.

Study framework and methodology

The group SOFRECO, a French consulting office, and Hery Vao, a Malagasy company, are carrying out the study on behalf of the PNEBE. The study is part of a project run by the Ministry of Energy and Mines of Madagascar, co-financed by the Malagasy Government and the World Bank.

The PNEBE is disseminating improved stoves in 16 cities throughout the country through training craftsman, animation, sensitization etc. The populations of the cities range from under 5000 people to over 200 000 in the largest city, totalling over 850 000 people (136 000 households) in the 16 cities.

Figure 1 Dry forest near Toliara, Madagascar

Methodology

The research analysed changes in household expenditure following the introduction of fuel-efficient stoves. A baseline measurement of fuel wood consumption for each city in the study was undertaken. Secondly, variations caused by price fluctuations in monthly fuelwood costs in each city were calculated per household. Finally, based on the number and characteristics of the stoves, the savings due to the fuel-efficient stoves were determined.

Monthly cost of woodfuel

A socio-economic survey was conducted on high-income, middle-income, and low-income households using a representative sample of more than 3500 people in the 16 cities. The results of the survey are shown in Table 1.

Changes in monthly fuel costs

In order to evaluate the change in household wood fuel expense attributable to fuel-efficient stoves, it was assumed that, prior to their introduction, the quantity of consumed fuel used by a given household was fixed; only the variation of fuel price affected the household expenditure. The fuel price was kept under observation in the 16 cities to analyse specific variations.

Table 1 Monthly cost of fuelwood per household (FMG[1])

	Main users		Costs (FMG/month)	
City	Charcoal	Firewood	Charcoal	Firewood
Ambatolampy	69	27	37862	25955
Arivonimamo	66	34	35825	28752
Miarinarivo	44	53	45882	33069
Tsiroanomandidy	63	33	31826	25955
Toamasina	69	12	32183	36811
Ambatondrazaka	62	31	21956	31526
Vatomandry	14	81	21364	18173
Mahanoro	25	72	17448	18083
Toliara	79	18	48284	51635
Tolagnaro	71	28	39314	26070
Betioky	50	50	28397	41266
Ambovombe	23	77	45075	48278
Fianarantsoa	71	26	31688	24265
Ihosy	51	48	45382	36807
Ambositra	47	51	36467	13429
Ambalavao	66	34	21745	30097

[1] As per April 1, 2001, 1USD = 6750 FMG (Malagasy francs)

Theme

Saving from fuel-efficient stoves

The PNEBE team spent two years developing 20 prototypes of improved stoves in their laboratory. These comparative tests within the laboratory try to simulate typical stove use in the home. Each stove was tested several times against a Malagasy traditional stove. The results are shown in Table 2.

Because the laboratory results do not reflect perfectly the observations made by Malagasy families using stoves, 500 improved stove prototypes (for fuel wood and charcoal) were tested for acceptability in a representative sample of households from a variety of the traditional homes.

In addition to various parameters on acceptability of stove, the effect of specific types of cooking was studied (Bazile D., 2001). Table 3 compares household use with that determined in the laboratory for each city. A Weighted Index less than 1 indicates that for the studied fuel, food preparation in the household is more energy consuming than during tests in laboratory. Conversely, an index more than 1 indicates that the cooking practices in this city are an improvement on the performance of the prototype in the laboratory.

The saving made by a household depends on the type of stove and the style of cooking in a particular city. Using these weightings (based on household measurements), the laboratory results were adjusted to reflect cooking practices in each region. From this, the monthly savings obtained by using fuel-efficient stoves in the 16 cities where PNEBE is conducting its dissemination campaign were calculated.

Finally, the extra investment needed for purchasing a fuel-efficient stove compared to the price of a traditional stove was determined. The investment in a fuel-efficient stove is usually less than US$2 (close to 10% of minimum monthly salary) The lifetime of the improved stoves was found to be double that of traditional stoves, giving an overall cost reduction over the lifetime of the stove.

Results, discussion and perspectives

The PNEBE has trained 475 craftsmen in 225 training centres between May 2000 and October 2000 in the selected 16 cities of the project. These craftsmen were responsible for disseminating more than 30 000 fuel-efficient stoves by the end of February 2001.

The production rate of improved stoves vastly exceeds the targets set by the Ministry of Energy and Mines and the World Bank. The dissemination target of 30 000 fuel-efficient stoves by the end of the project (end of December 2001) was reached in February 2001 – half-way through the campaign. Dissemination levels are now stabilising at around 4000 fuel-efficient stoves per month. Overall, the large-scale dissemination of fuel-efficient stoves has contributed to a saving of more than FMG 1.87×10^9 as a result of reduced woodfuel purchase for household use. To this are added FMG 241×10^6 savings from the purchase of more durable stoves. The overall saving in the 16 cities of the project is thus about FMG 2.11×10^9.[6]

Household savings depend on various parameters, which differ from city to city. The main parameters include:

- the price of the fuel-efficient stove: a high price still prevents initial purchase by some Malagasy households
- the price of fuel wood: a high price for household energy in a particular city makes households more conscious of the benefits of a fuel-efficient stove

Table 2 Results of fuel saving with improved stove prototypes tested

	Type of stove	Saving	Pot Size (cm) ■ Best size ▒ Acceptable											
			24	26	28	30	32	34	36	38	40	45	50	60
Firewood	LAFATRA métallique PM	45%			■	■	■							
	LAFATRA métallique GM	48%						▒	■	■	■			
	LAFATRA terre cuite Ambatondrazaka	43%						■	■	■				
	FOUR MACONNE monomarmite	26%							▒	■	■	■	■	■
Charcoal	Dago métallique PM, UPED	20%	▒	▒	■	■	■	▒	■	■	■			
	DAGO Métallique GM	31%					▒	■	■					
	FE Terre Cuite Mitsinjo, UPED	8%		▒	■	■	■	▒						
	FE 'SERPENT' Terre Cuite PM Ambatondrazaka	34%	▒	▒	■	■	■	▒						
	FE 'LEZARD' Terre Cuite PM Ambatondrazaka	39%	▒	▒	■	■	■	▒						
	DAGO Mixte PM, UPED	35%	▒	▒	■	■	■	▒	▒					
	DAGO Mixte GM	64%						▒				▒		
	MITSITSY Be, UPED	26%	▒	■	■	■	▒							
	MITSITSY MM, UPED	30%			▒	■	■	■	▒					
	MITSITSY GM	63%						▒				▒		
	MITSITSY TGM	30%												
	MITSITSY TTGM	38%									▒			
	MITOMBINA GM	60%						▒	■	■	■	▒		

Table 3 Weighted index of laboratory results compared to those in the field

City	Fire wood	Wood Charcoal
Ambatolamby	1.00	0.93
Arivonimamo	1.00	0.80
Miarinarivo	1.00	0.81
Tsiroanomandidy	1.00	0.89
Toamasina	1.16	1.24
Ambatondrazaka	10.06	1.00
Vatomandry	0.81	1.33
Mahanoro	0.779	0.88
Toliara	0.87	1.00
Taolagnaro	0.99	1.01
Betioky	1.11	1.21
Ambovombe	1.12	0.97
Fianarantsoa	0.77	0.99
Ihosy	1.44	1.22
Ambositra	0.73	0.98
Ambalavao	1.31	1.03

Table 4 Benefits in each city obtained by the use of fuel-efficient stoves (FMG x 10^3)

City	Reduction due to woodfuel saving (FMG)	Capital cost of more durable stove	Total benefit
Ambatolampy	45 016	778	44 238
Arivonimamo	99 905	5197	94 708
Miarinarivo	224 466	12 656	221 810
Tsiroanomandidy	40 967	4	40 963
Toamasina	327 506	2800	324 706
Ambatondrazaka	63 565	−3 100	66 665
Vatomandry	16 664	697	15 967
Mahanoro	4013	957	3056
Toliara	159 124	−1037	160 161
Taolagnaro	25 984	1026	24 958
Betioky	9736	−380	10 116
Ambovombe	31 917	1349	30 568
Fianarantsoa	747 505	−237 186	984 691
Ihosy	44 339	−1 266	45 605
Ambositra	18 198	1649	16 546
Ambalavao	10 688	27	10 661
Total	1 869 591	−241 141	110 732

- the choice between fuelwood and charcoal. Charcoal must be bought, whereas the poorer households, living in the outskirts of the city, will collect fuelwood at no cost
- the appropriateness of available stoves.

Follow-up studies will allow the impact of dissemination of fuel-efficient stoves in each city to be measured, supported by a computer-simulated model.

Conclusion

Overall there was a saving of over two billion Malagasy francs during the 9 months of dissemination in these 16 cities. The economic impact is very important at household level, where household savings have averaged between FMG150,000 and 200,000 per annum, which is equivalent to the minimum monthly salary (The monthly minimum salary in Madagascar is FMG160 000, that is US$24). Even if one part of the saving is straight away allocated to new energy use (Bazile, 2001), this is itself an improvement in the standard of living for deprived households. The large-scale dissemination of fuel-efficient stoves is thus an efficient means of reducing poverty at national level.

This project has measured impact for selected cities and has proved a useful tool for informing future work. For energy planning in Madagascar, this model can be used for any large-scale stove dissemination in any city. So, from this one model, it is possible to predict the effect of the introduction of improved stoves and to measure the economic impact of a training and dissemination campaign in other cities. In addition, it is theoretically possible to match an intervention with specific parameters required in a particular context with a particular type of fuel-efficient stove within the PNEBE range of products.

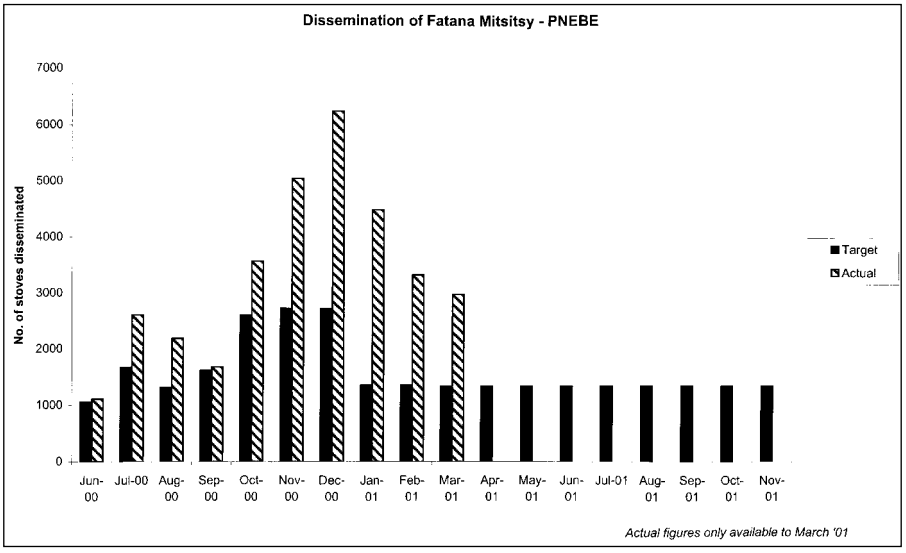

Figure 2 Dissemination of improved stoves by PNEBE approved craftsmen

References

Anonyme *Testing the efficiency of Wood burning Cook stoves: International Standards*; ISBN 0–86619–229–8, 1998

Bazile D. Improved stoves for deforestation preventing: myth or reality? *Boiling Point* 46, 2001

Bazile D. La gestion des espèces ligneuses dans l'approvisionnement en énergie des populations. Cas de la zone soudanienne du Mali. Ed: Presses Universitaires du Septentrion (Lille), ISBN 2–284–02112 –3, Tome I et Tome II, 2001

Bazile D. et Rabearivelo W. Rapport des tests de foyers à la Base Technique Foyer Amélioré du PNEBE, avril 2000.

Bazile D. et Razafimanantsoa M. Rapport des tests de foyers à la Base Technique Foyer Amélioré du PNEBE, mars 2001.

Massé R. et Rabearivelo W. Les fourneaux économes de Madagascar, UPED Rapport Final de Synthèse, 1994

The Indian stove programme: an insider's view – the role of society, politics, economics and education

by Bhaskar Sinha, National Institute of Science, Technology & Development Studies (NISTADS), CSIR, New Delhi
Email: sinhasun@hotmail.com

Le programme indien de foyers améliorés: role de la société, de la politique, de l'économie et de l'éducation
L'Inde est sévèrement affectée par la pression sur les ressources ligneuses pour la satisfaction des besoins énergétiques. Afin d'atténuer cette tension, un foyer amélioré à bois a été promu par le Gouvernement indien avec cependant un succès mitigé, notamment à cause de la bureaucratie, des subventions mal ciblées et le manque de ressources. L'article aborde les facteurs ayant conduit à des programmes réussis dans d'autres parties du monde et dont les enseignements pourraient être utiles à l'expérience indienne. Une approche participative est considérée comme une condition évidente de la réussite de tout projet.

Introduction

The dissemination of improved biomass stoves throughout the developing world began in the early 1980s. Since an average 75% of biomass energy is used for cooking, widespread rural dissemination of improved cooking stoves was seen as a promising way to reduce the overall firewood requirement.

India has an extensive firewood shortage problem. Per capita consumption of firewood has been steady for the past two decades, while the total population has grown alarmingly by nearly two thirds. A rapid increase in the price of commercial fuels (kerosene, coal and charcoal) over the last two decades has led to poorer groups depending on firewood/biomass as the means of household energy. Again, the firewood shortage in various rural areas has caused many families to turn to burning dung and straw for fuel – thus steering them *down* the energy ladder.

Today India still relies on firewood to satisfy 24% of total energy consumption. India's forests can sustainably provide 41×10^6 m^3 of firewood per year, even though current annual demand for wood remains at 241×10^6 m^3. (World Resources Institute, 1994). In India, in the household sector, the bulk of energy is spent on cooking. According to 1991 census, about 30% of the urban population uses firewood and twigs whereas in rural sector, about 78% of the population rely on firewood and twigs. According to the NCAER (National Council of Applied Economic Research) survey, conducted in 1978/79, cooking accounted for 85.2% of the total energy consumed in the rural domestic sector. The women in rural India, especially the poor, have to trudge long distances to forage for scraps of firewood.

The Indian National Programme on Improved *Chulhas* (NPIC)

Hoping to reduce this need for firewood, the Indian National Programme on Improved *Chulhas* (NPIC) was launched in 1983, to be implemented in all states and union territories. The programme aimed to disseminate improved clay and mud stoves (equipped with chimneys) in order to increase the fuel efficiency of traditional stoves and reduce indoor air pollution. It was managed by the central governmental bureaucracy, along with six regional officers and numerous other state and district officers (Barnes et al., 1994). By September 2000, 32 million stoves of various types had been promoted, touching 25% of the total potential of 120 million households. A 1995–96 survey conducted by NCAER in 18 states indicated that 71% of the cook stoves were in working order and 60% were in use.

NPIC in confusion

The Indian Government invested in a lot of promotion to disseminate the improved stove in rural India through NPIC. Ten-day demonstration camps were held to encourage and engage villagers, local government collaborators and students in the speedy dissemination effort. A key element of the dissemination policy was the provision of a government subsidy to all households purchasing an improved stove. A minimum of 50% subsidy was available, reducing the cost of new stoves from US$10 to US$4.30 (Kammen, 1995; Barnes et al., 1994). However, the primary drawback in this method gradually became evident as multiple levels of government bureaucracy complicated the initiative. Programme administration was truly cumbersome and fragmented (Kammen, 1995). In addition, the budget was insufficient for the level of supervision and assessment which the programme required. Problems were not noticed and rectified in good time. Lastly, the programme was soon scaled down, being only one of several national campaigns occurring at the time.

Effect of subsidy

The presence of a large government subsidy was a big discouragement for the success of the NPIC. As the government automatically paid builders for half the cost of stoves, producers' motivation for building improved stoves was directed more towards the government than towards the consumers (Barnes et al., 1994). Stove producers were only concerned about government specifications and did not respond to the need for consumers' preferences or an aggressive marketing strategy. As a result, local stove construction was often hasty and technically faulty. Many stoves did not accommodate the household cooking pot, or could not withstand the heat

required for cooking. Many of the stoves plainly did not offer the assured savings in household firewood consumption. The heavy government subsidy for cook stoves also suppressed efforts by private entrepreneurs to disseminate their own improved stoves, as they could not possibly compete with the highly subsidized government price.

Failure to target resource-poor regions

Another limitation was that NPIC failed to target regions where fuel scarcity were especially severe, or where firewood was a very expensive. Many rural households could not afford, or were not willing to pay for, the highly subsidized improved cook stove as they were collecting the firewood/biomass for free. The purchase of a new improved stove is never seen an interesting option to those who are very poor in India.

Need for maintenance

Another reason was the lack of interest of women towards maintenance, as they did not perceive the usefulness of the stove. A national survey in 1992–93 noted that some households opted for the stove only for the subsidy in the form of pipes, metallic sheets, etc. In a number of cases, chimney pipes were re-used as links for the sanitary latrine, irrigation channel or even sold in open market, after being removed from the stove.

NPIC in Maharashtra

Appropriate Rural Technology Institute (ARTI) has been working as the Technical Back-up Unit (TBU) for NPIC for Maharashtra and Goa states since 1996. According to Dr Priyadarshini Karve, of ARTI, the State Government was supposed to implement the programme, but the government officials were totally disinterested. This was the root cause of a lot of problems. In states like Maharashtra, where at least the TBU was active, some things got done in spite of the lack of governmental encouragement, but the TBU had to take up many tasks that were not originally included in its mandate. Secondly, MNES hardly ever consulted the TBU or tried to assess users' needs before taking policy decisions.

Indoor air pollution as a factor

Indoor air pollution (IAP) was never a key driving factor of NPIC up until the last 3–4 years. Unfortunately, when MNES finally decided to incorporate IAP concerns in the programme, it went for a 'short cut' solution. Instead of giving time to the TBUs to come with user-friendly easy-to-install non-polluting stoves, and to make systematic efforts to make the *chulhas*-users aware of the hazard of IAP, it simply sent a directive that every fixed stove installed under NPIC henceforth must have a chimney.

The consequence in Maharashtra state was as follows: The choice that was offered under NPIC was between fixed stoves with a chimney (Figure 1) and metallic portable stoves (Figure 2). Due to various practical problems associated with installing a fixed stove with a chimney, the state government's implementing agencies went in a big way for metallic portable stoves. Consequently, most of the users ended up with having to accept the portable stove due to 'non-availability' of the fixed one. Traditionally in this region the portable stoves are not used as the main day-to-day cooking stoves. The result is that the government 'target' for stoves has been fulfilled, but the 'beneficiaries' continue to use their traditional stoves for daily cooking. Also, the rural potter-entrepreneurs (who make the fixed stoves), and who have been trained and nurtured over the years, have lost a lot of business that they used to get through the NPIC, while the city-based industrialists, who fabricate the metallic stoves, have earned handsome profits.

It must be pointed out that, at the same time, there has been a good demand for several inexpensive and chimneyless 'low smoke' stoves (not approved under NPIC) that local potters sell in the open market.

Lessons learnt from other countries

In developing countries, many programmes that had potential for alleviating indoor air pollution and reducing women's labour met with limited success because of the lack of consideration for women's needs and preferences

Figure 1 Government-approved chimney stove, Maharashtra state (photo: ITDG)

Figure 2 Metallic portable stove being demonstrated outside house, Maharashtra state (photo: ITDG)

(Ramana, 1997). The women's choice of continuing to use traditional biomass stoves in a fuel scarce region may be quite rational if the design of the alternative product is not user friendly and if a repair service is not available when they need some assistance.

Experience from other countries

Kenya

In Kenya, a custom-made improved stove failed because women had neither time nor the patience to cut the wood to the small size required by the stove's restricted box. In fact, many of the women who adopted the stove ended up enlarging its firebox, knowingly sacrificing energy efficiency for convenience (Barnes et al., 1994). Kenyan efforts to disseminate improve stoves were first made in rural areas, but they had an early monitoring programme and found out the faults and quickly started disseminating a second generation of cook stoves after getting feedback from the women. They started working through private craftspeople, did market surveys and did marketing in urban and semi-urban areas. Again, the ITDG's RSWK (Rural Stoves West Kenya) project (1993/94) had focused on working with women potters as stove producers in order to deliver benefits to stove users. The logic of the work was that establishing a supply of *Upesi* (also known as *Maendeleo*) stoves has major benefits for many women in terms of reduced fuel wood costs or collection time, savings in cooking time, improved health through lower smoke emissions, etc.

Indonesia

In Indonesia, women were not willing to accept stoves in which the fireboxes were placed one behind the other. Women wanted these fireboxes to be adjacent to each other as it was more convenient to them during cooking (Hulscher, 1997).

China

In China, improved cook stoves have been well accepted, partly because of the involvement of women in the programme. By 1995, 172 million households had efficient stoves that accounted for 70% of the total rural households. Women were involved in extensive field-testing and discussion concerning what they wanted in a stove. For instance, in one region, shelves for spices were added at the request of the women. In China, the country chose an improved stove programme as it tried to move up the energy ladder (Smith et al., 1993). At this time, due to the liberalization of rural economy (early 1980s), the average income of every rural family was going up. For the mass dissemination of improved stoves, the government played an important but limited role by providing up-to-date latest technical knowledge, designs, training, and indicating potential areas where stoves can be disseminated. The subsidy was limited and stoves were created to suit local community. By and large local producers were aggressive for dissemination of the improved stoves.

Honduras

In Honduras, energy-efficient earthen stoves have become very popular. One researcher attributed the acceptance of this innovation to the fact that women were trained to make them and, therefore, women were introducing this technology to other women. Also, credit facilities through a co-operative made loans available for which the monthly payment for both the stove and the kitchen shelter amounted to the same as the monthly savings on fuel (Elmendorf, 1980).

Other country initiatives

A stove project proposed for Nepal has suggested sending Nepalese women to India to learn to build stoves; they would then teach other women these skills at home. In Niger, government planned to introduce improved stoves to urban women through a women's organization.

Stoves must be appropriate

But, no matter who introduces the stoves, if they are not appropriate to local conditions they will not be accepted. A stove project in Ghana that was reported to be very successful at the time, was found a decade later to have been a failure. It turned out that stoves had not been designed for making the local dishes and that they sometimes used more fuel than the traditional and supposedly less efficient models. In certain areas of Upper Volta, the government has put great emphasis and pressure on women to build stoves, and the women's extension service was promoting the project.

In Tanzania, stove makers are involved in the sale of stoves, and the programme has been quite successful (Kinyanjni, 1991). Both in China and Kenya, commercialization of the improved stoves is key for long-term, self-sustained cook stove dissemination.

Household income – the most important aspect?

In considering the various factors in household energy use, the most important is held to be the level of household income (Smith et al., 1992). Within this concept, however, is another serious issue – the lack of value generally placed on women's labour. If women are involved in income-generating activities that will value their time and make it more profitable to purchase firewood than collect it, improved stoves will have higher chances of success. Where employment is available, it may be preferable to earn cash as a labourer and buy wood, rather than collect it. If women have no alternative income-earning opportunities for the potential labour time saved by improved stoves, then even if they are the household decision makers, they will not choose to spend money in acquiring improved stoves. This may possibly explain why, even in matrilineal communities like those in eastern Bhutan, stove programmes have failed.

A sustained change in patterns of fuel use cannot depend on continuous subsidies. What is required is a change in the role of women's labour, or increasing the possibility of women's income-earning opportunities (Nathan, 1997).

Some positive aspects of the NPIC

Despite all the problems, overall, there are three good visible signs in favour of the NPIC programme.

(1) Women are raising their voices in various fora to demand improved cook stoves.
(2) Some states have promoted improved cook stoves through people's programmes. For example, Andhra Pradesh is popularizing cook stoves under *Janambhoomi* and Karnataka under *Panch Sutry Yojana*.
(3) Several non-governmental organizations and local bodies, such as *Gram Panchayats*, are actively participating with the government in raising awareness among women to use improved cook stoves.

Poverty and marginalization

A quarter of India's population belongs to communities classified as Scheduled Castes and Scheduled Tribes (SCs/STs). The levels of human development among these communities have remained below that of the rest of the population. NCAER estimates show that infant mortality rates were 98 and 99 per 1000 live births among STs and STs, respectively, nearly 45 per cent higher than the rate for the rest of the population. Similarly, according to the 1991 census, only 24 per cent of women in SCs and 18 per cent in SCs were literate. A literacy rate among rural women belonging to STs was as low as 4 per cent in Rajasthan and 9 per cent in Andhra Pradesh.

Empowering women

Suppressed economic conditions make men more dominating within the household. According to the Planning Commission in 1999–00, the estimate of rural poverty was 27.09%, where as for urban households it was 23.62%. The Human Development Report for 2000 estimated that in 1989–98, over 40% of people lived below the poverty line.

There are other problems like early marriage and the low education level of rural women folk that are hampering the progress of India. A shortage of modern communication technologies mean that people are less connected to the modern world. The NCAER rural household sample survey reported that only 43 per cent of rural households have electricity connections. The proportion of houses connected with electricity varies from 9.8% in Bihar to 15.6% in West Bengal.

Conclusion

Adopting a 'bottom-up' approach

Nonetheless, faced with aggravating population pressures and fuel shortages, India has no other option but to look for improved *chulhas* which can play an important role in mitigating firewood demand. The government has to reverse the 'top-down' approach, as well as beginning to integrate positive aspects of some successful cook stoves programmes from other parts of the world (say, China, Kenya, etc.).

Supporting local differences

There is an alienation of local manufactures for making improved stoves and this should be corrected immediately. There is a need to conduct a market survey and incorporate important regional differences in cooking habits in the stove programme. There should be a proper follow up mechanism as well as women stakeholders' participation.

Empowering the economically vulnerable

The rural poor are too vulnerable economically to give voice to their needs and inform the market of their needs. But is intervention in promoting improved stoves in developing countries necessary? I personally do not think so. India needs basic things first, which I believe are sound income policies, proper education, and good health for all her children. Major advances in poverty alleviation can be achieved with relatively small inputs of energy (Goldemberg et al., 1985). If we empower people to express their needs and develop accordingly, things will change automatically. We should not pressurize them with our own agendas. There should be a free flow of knowledge and people must see all the positive and negative impacts, using all available resources and then decide about their adoption.

In developing countries, leaders should have to show the way – but it is not possible in India. Constitutionally, India purports to be democratic, but the country is deeply divided by caste, religion, language, etc. and leaders choose to believe in a policy of 'divide and rule' . The country needs a visionary leader able to active the strength of democracy and lead the country out of her current crisis.

References

Barnes, D. F., Openshaw, K., Smith, K. R. and van der Plas, R. (1994) What makes people cook with improved biomass stoves? A comparative international review of stove programmes, World Bank Technical Paper, ISSN 0253–7494; No. 242, Energy Series.

Elmendorf, M. (1980) 'The human dimension: energy survey methodology,' National Academy of Science International Workshop.

Goldemberg, J., Johansson, T. B., Reddy, A. K. N. and Williams, R. H. (1985) Basic needs and much more with one kilowatt per capita, *Ambio*, 14 (4–5): 190–200.

Hulscher, W. S. (1997) Fuel ladder, Stoves and Health, Women, Wood Energy and Health, *Wood Energy*, Vol. 10, No. 2, p 10.

Kammen, D. M. (1995) Cook stoves for the developing world, *Scientific American*, July.

Kinyanjni, M. (1991) 'Tanzania charcoal stove project,' Report to the World Bank, Washington D. C.

Nathan, D. (1997) Economic factors in the adoption of improved stoves, *Wood Energy News*, Vol 12, No 1.

Ramana, P. V., (1997) ed., 'Rural and Renewable Energy: Perspectives from Developing countries,' Tata Energy Research Institute, New Delhi.

Reddy, A. K. N. (1999) *Economic & Political Weekly*, Dec 4.

Smith, K. R., Gu, S., Huang, K. and Hiu, D. (1993) 'One hundred million cook stoves in China: how was it done?' World Development.

World Resources Institute. (1994) *World resources 1994–95, a guide to the global environment*, Oxford University Press, Oxford.

This article is based on work done by the author when he was associated with the National Institute of Science, Technology and Development Studies (NISTADS), New Delhi. Currently he works for the Environment Division (under TQM) The Associated Chambers of Conmmerce and Industry of India (ASSOCHAM), New Delhi.

Energy efficient housing to benefit South African households

by ir W.E. Klunne, P.O. Box 420 / 7500 AK Enschede / the Netherlands. Tel: +31 6 28964969 Fax: +1 360 3432421
E-mail: wim.klunne@microhydropower.net Web: http://microhydropower.net

Efficacité énergétique des maisons et leur apport aux ménages en Afrique du Sud

Les ménages pauvres en Afrique du Sud consacrent une grande partie de leur revenu pour satisfaire les besoins d'éclairage, cuisson, et chauffage. Le charbon et le bois, sources d'énergie particulièrement polluantes, sont utilisés pour les besoins de chauffage. Une architecture prenant en considération l'efficacité énergétique permettrait de réduire substantiellement la consommation d'énergie domestique tout en maintenant la même qualité de service. Des mesures relativement simples comme l'orientation des maisons, toitures et planchers adaptés peuvent apporter des avantages conséquents aux ménages. Ces mesures permettraient de diminuer les dépenses de chauffage tout en contribuant à améliorer la qualité de l'air à l'intérieur des maisons et à réduire les émissions des gaz à effet de serre.

Introduction

Poor households in South Africa spent a large proportion of their income on energy services, for lighting, cooking and heating their houses. In particular, space heating is mostly done using fuels like coal and wood, which cause indoor air pollution.

By designing houses with energy efficiency in mind, the amount of energy needed to keep the house comfortable can be reduced dramatically. Typically, the low cost housing provided for those on small incomes in South Africa are of poor quality, with inferior thermal performance characteristics. Relatively simple interventions like orientation for new houses (the direction which the property faces), or providing ceilings in existing houses, can bring huge benefits to the inhabitants. These benefits are not only in the form of reduced expenditure on space heating fuels, but also on improved indoor air quality, as well as global benefits accrued by reducing the emission of greenhouse gases, such as CO_2.

Passive solar design

Passive solar design involves applying energy flow principles and climate characteristics of a region in the design, construction and management of houses, so as to achieve thermal comfort with minimal conventional energy input. The basic components of passive solar design incorporate the orientation of the house, optimising the use of direct natural sunlight, and utilising thermally efficient building materials. Applying these principles provides a low cost or no cost intervention and is applicable in all climatic regions.

Orientation of the house

Passive solar design can reduce the energy requirements to keep the house comfortable. It implies that houses in the Southern Hemisphere should face towards geographic north (±15°) in order to obtain optimal solar benefit. Houses which point north have most windows facing north, would have the least heat gain in summer and the least heat loss in winter, keeping the indoor air temperature comfortable. The orientation of houses should be an integral part of planning and design and any deviation from this rule should be for a good reason.

Building materials

Passive thermal design also entails using appropriate building materials, such as materials with a high thermal

Figure 1 Principles of passive solar design (source: IIEC – Passive Solar Design Brochure)

Table 1 Overview of projects targeting energy efficiency in low cost housing in South Africa (Klunne 2002)

name of project	province	rural/ urban	density	number of houses	other sustain-ability aspects	orientation	roof overhang	ceiling	wall insulation	alternative materials	user education	new/ retrofit	energy moni-toring
All Africa Games Village	Gauteng	urban	medium	1799	yes	yes	partially	yes	no	no	no	new	no
Krugersdorp Housing project	Gauteng	urban	low	18000	yes	yes		yes	no	no		new	no
Kutlwanong Eco-housing project	N. Cape	urban	low	200	no	yes	yes	yes	yes	no	yes	new	partially
Ivory Park, mud brick house	Gauteng	urban	low	1	yes	yes	partially	yes	no	yes	yes	new	no
Ivory Park insulated ceiling	Gauteng	urban	low	30	no	no	no	yes	no	yes	yes	retrofit	no,
Mohlakeng, Ext. 2, Randfontein	Gauteng	urban	medium		yes	yes		yes	no	no	yes	new	no
Thermally improved shacks, Mabopane	Gauteng	urban	shacks		no	no	no	no	yes	yes		retrofit	yes
SEED housing Cape Town	W. Cape	urban	low	2300	yes			yes				new	no
Tlholego, Rustenburg	North West		rural	low	yes	yes	yes		no	yes	yes	new	no
Alexandra East Bank Housing Development	Gauteng	urban	low	1200	no	yes	no	no	no	no	no	new	no
SOWETO eco home	Gauteng	urban	low	1	yes	yes	yes	yes		no		new	ongoing
Shayamoya – Cato Manor, Durban	KZ Natal	urban	medium	320	yes	yes	no	no	no	no	no	new	no
Missionvale, Port Elizabeth	KZ Natal	urban	medium		no	no	no	no	no	no	no	new	no
Waterloo Development	KZ Natal	urban	low	2	no					yes	yes	new	no
Dutch AIJ (Benoni, Kimberley, Cape Town, Lady Grey)	Gauteng N. Cape W. Cape Free State	urban	low	4 * 4	no	yes	yes	yes	yes	yes	no	new	ongoing

* low density refers to stand alone houses, medium density to multiple units combined in one physical structure

mass, which are able to store heat during the day and release this heat slowly at night. The current trend in low cost housing in South Africa is to use hollow cement blocks for walls and concrete flooring, which both have reasonable thermal capacities. Alternative materials such as earth bricks have much higher thermal capacities, but have been rejected by communities in earlier projects, as they are perceived to be inferior materials (Walker, 1999). Recently earth bricks seem to be enjoying better acceptance.

Position and size of glazing

Daylighting refers to optimizing natural sunlight through glazed areas during daylight hours in such a way that heat gain is minimized in summer and heat loss is minimized in winter (Irurah, 2000). Solar radiation transmitted through glass converts to heat when it strikes materials, such as concrete floors, and is then re-radiated as heat. According to Holm (1996), the size of glazing should be approximately 20% of the total floor area (exact figure depending on the climatic circumstances), on the northern side of a house for 'solar collection' to provide the most favourable thermal efficiency. There should also be a minimal window surface facing the south, east and west.

Double-glazing is a thermally efficient principle, which is a common practice in areas where winters are long and cold. In South Africa this technology is rarely used because of the prevailing English tradition of single glazing in residential housing coupled with the perception that energy is cheap.

In the inland areas of South Africa the material used for the window- and doorframes is metal, which conducts heat. In the coastal areas, where corrosion is a problem, wood is used. In general it can be said that wood provides a much better insulation than steel, but is seldom used inland because of the unavailability and cost of this material.

Roof overhang

The northern orientation of houses should be coupled with a roof overhang on the northern side of the houses throughout South Africa, designed according to the summer and winter angles of the sun. The size of the roof overhang depends on the roof geometry, but should be about half a metre in length to shade the northern windows from the sun during the summer months and to allow the sun's rays to penetrate in winter, when the sun is lower on the horizon (Garner, 1999). Roof overhang should ideally be combined with a strip of grass or vegetation around the houses to prevent the surface from warming up. This is a low to moderate cost intervention.

Ceilings

Installing ceilings is critical in order to achieve a thermally efficient low cost house. With their ability to trap air, ceilings ensure a reduction of heat flow into or out of the house. As a result, the house is warmer in winter and cooler in summer. The cost of a traditional ceiling is in excess of 37 Rand (US$3.7) per square metre (Baloyi 2000), while new innovative low cost ceiling can be as cheap as 18 Rand (US$1.85) per square metre. Ceiling insulation is a moderate to high cost intervention, but an absolute necessity.

Insulation

There are various methods to insulate a wall. Building a cavity wall (two parallel walls with an air gap between) is seen as the most effective method of insulation, but it is also the most expensive method and therefore not widely applied. Another method is to plaster walls, or to use panels (also called *construction boards*). These panels are either used as an add-on to the walls and thus function as in insulation layer or fulfil the wall function themselves and have a structural function.

Flooring

Floors are an important component to achieve thermal efficiency in houses. Flooring material should be of high thermal mass, such as concrete, bricks or clay, to trap heat and solar radiation coming in through the windows. The heat is slowly released at night. Single storey residential units can basically use the high thermal mass floor slabs and the soil underneath it as thermal mass. Multi-storey residential blocks have the disadvantage that they only have the ground floor with this thermal advantage. Adding thermal mass to upper storeys by adding heavyweight material beyond constructional requirements involves high costs and is often considered to be too expensive.

Shared walls

Shared walls, either in the form of a row of houses or semi-detached houses, saves on the costs of the housing shell as well as on energy consumption. When units share walls, they provide more insulation against heat loss in winter and heat gains in summer than the single housing units. However, some communities do not accept shared walls and argue that 'One must be able to walk around one's house, otherwise it is not a house'. Fortunately the new policy of the Department of Housing shows a shift from stand-alone units to multiple dwelling units.

Current energy-efficient housing initiatives

Various small and larger projects have been executed in South Africa, trying to address energy efficiency in residential housing. Many of them also include other aspects of sustainable living such as water or waste related issues. Unfortunately all these projects are stand-alone activities with limited or no interaction. Table 1 summarizes these projects.

Surprisingly none of these projects has been evaluated properly for the effect of the interventions on energy use, except for the Mabopane project on shacks. For houses, we have to judge the cost effectiveness of the interventions available, based on computer simulations. After the no-cost, or low-cost principles of passive solar design, ceilings with insulation are the most promising intervention, followed by insulating the wall by applying insulation material (like polystyrene) on the outside (Klunne, 2002).

What is needed?

Action is needed at two fronts. First, all new low cost houses to be built should feature at least the principles of passive solar design, supplemented by installation of a ceiling. On the other hand existing structures need to be made more energy efficient by installing ceilings or applying insulation material.

As such actions are currently not common practice, a support programme needs to be developed in which energy efficient houses are eligible for some type of financial incentive. The South African Department of Housing is currently developing such a program in collaboration with the GEF.

References

Baloyi, R. (2000). *Solar water heater systems projects for households*. Midrand, South Africa, Midrand Ecocity Trust.

Garner, G. (1999). *A model for green housing – The All African Games Village*. Alexandra, South Africa.

Holm, D. (1996). *Primer for energy conscious design*. Pretoria, South Africa, University of Pretoria.

Irurah, D. K. (2000). Environmentally sound energy efficient low-cost housing for healthier, brighter and wealthier households, municipalities and nation, evaluation of performance and affordability of intervention technologies. Johannesburg, University of Witwatersrand, University of Pretoria, Energy and Development Research Centre University of Cape Town, PEER Africa.

Klunne, W. E. (2002). Energy efficient housing in South Africa. Overview of current state of affairs, possible interventions and the role of carbon emissions related funding to address the situation.

Walker, J. (1999). A sustainability assessment method for low cost, cement block housing on the Cape flats. Environmental engineering. Cape Town, South Africa, University of Cape Town.

Wim Klunne is consultant on renewable energy and climate change. He implements projects on rural electrification, grid connected renewables and energy efficient housing, in southern Africa mainly. He is currently with the Energy research Centre of the Netherlands (ECN).

E-mail: wim.klunne@microhydropower.net
Internet: http://microhydropower.net/klunne

Harnessing solar stove technologies in South Africa to promote improved household energy provision

by Erica de Lange and Marlett Wentzel, Palmer Development Consulting, PO Box 11906, Queenswood, South Africa 0121, Tel: +27 12 349 1901, Fax: +27 12 349 1901 Email: erica@pdevc.co.za; marlett@pdevc.co.za

Promouvoir les technologies solaires pour la cuisson en Afrique du Sud et l'amélioration de l'approvisionnement en énergies domestiques.
Cet article traite d'une diffusion réussie de cuisinières solaires à travers un projet comprenant deux phases. Au cours de la premiere, 70 familles ont bénéficié de cuisinières solaires. Un questionnnaire a été remis à chaque famille afin d'évaluer l'utilité des cuisinières. Une fois fois qu'il a été prouvé qu'elles étaient bien acceptées, la seconde phase a été consacrée à la commercialisation, par des détaillants, de ces cuisinières. L'accès a davantage concerné des familles relativement aisées du fait que les familles pauvres avaient tendance à collecter le bois. Les économies réalisées ont été utilisées differemment selon les communautés

Introduction

Successful dissemination is a complex undertaking that involves many actors and activities. The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) supported by the German Government, decided to investigate the dissemination of solar stoves, from production to household use. The Governments of Germany and South Africa provided joint support to a solar stove pilot programme that included a comparative field test under real-life conditions to determine the social acceptance of solar stoves, as well as testing the commercial dissemination of solar stoves.

Background and methodology

Data was collected on the socio-economic background, cooking habits and energy use and expenditure of 200 randomly selected households out of a potential 6800 households in five pre-selected communities in the North West and Northern Cape Province of the Republic of South Africa.

Phase 1 methodology

Phase 1 comprised a field test in three areas for selected households, including the measurement of fuel use. Based on the results of the baseline study, the three test areas selected were: Onseepkans, Pniel and Huhudi. They represented deep rural, rural and peri-urban areas with related fuel use patterns. A total of 100 families made up the test sample, 70 user families (with solar stoves) and 30 'control' families (i.e. those without solar stoves). A set of questionnaires was designed to be completed on a daily, weekly, monthly and bi-monthly basis by:

- the households using solar stoves, such as the stove shown in Figure 1
- control households without solar stoves
- Area Monitors (people living in the study area who have been trained by the programme to do project monitoring)
- participating institutions
- project supervisors.

The level of use of the stoves by the households was measured, in part, by end-user acceptance.

Once it was found that end-user acceptance was sufficient to warrant large-scale dissemination, the second phase of the project got underway.

Phase 2 methodology

During this phase solar stoves were sold through selected retailers on the open market, and end-user contact details were obtained through returned warranty postcards. Fuel consumption was not measured, but those using solar stoves were asked to report on their fuel use.

Figure 1 T16 – a fast cooking stove that also bakes bread

Due to the respondents being widely dispersed geographically, a group of 54 people who bought stoves and sent in the warranty postcards were interviewed by telephone. A smaller end-user group of 9 people in the Huhudi township were interviewed by Joseph Koosimile, the Area Monitor who had provided after-sales service during Phase 1. The results from these two groups highlight the differences between the behaviour of various solar stove users.

Phase I results

Fuel saving

Despite this strategy, the poorest families in the study were spending up to 26% of their monthly income on fuel. The variation in spending on fuel is largely due to the amount of *collected* wood that families use, as families with a very low income often collect wood to reduce fuel costs. By using solar stoves the consumption of other fuels were reduced as shown in Tables 1 & 2.

The average saving per household was 38%, which translates to approximately US$60 per annum. These figures were calculated using actual measurements before solar stoves were introduced in winter 1996 and 1997, and for both users and the control

Table 1 Fuel savings per household per annum

Kerosene	33%	30 litres / annum
LPG	57%	30 kg / annum
Wood	36%	0.9 tonnes / annum

Table 2 Average monthly savings in the different test areas

	Rand (ZAR)	US dollars ($US) (1997 rates)
Deep rural	12	3
Rural	17	4
Peri-urban	26	5

group in summer 1997. Users indicated that these savings were significant and promoted the continued use of solar stoves.

Time saving

It is mainly women who do the cooking in the household; therefore it is their time that is being saved using a solar stove. There are two potential time-saving elements associated with the introduction of solar cooking:

- time saving which results from the reduction in wood gathering
- potential time saving in the actual cooking process itself.

Although most solar stoves cook more slowly than fuel stoves, they require very little attention once the food is in the stove. Freed from the time-consuming tasks of cooking and wood collection, women may concentrate more on childcare and domestic activities, training and educational programmes, social networking (an important rural livelihood strategy), as well as leisure. Where children are the main wood gatherers, the time saved can be spent on school work or play.

Time-saved from *reduced wood collection* because of solar stoves was calculated as 36%. Since households spend, on average, three hours collecting wood per trip, in theory, families can save up to 33 hours per month if they collected fuel daily prior to using a solar cooker.

Time-saved through *cooking* using a solar stove was calculated as follows: a family saves 15 minutes in supervision time per solar cooked meal, this amounts on average to 5 hours per month. This estimate is only valid if the user does not have to come home specifically to start cooking.

Impacts on poverty reduction

Where fuelwood shortages encourage the use of fossil fuels for cooking, this aggravates poverty and impacts negatively on local economies. Solar cooking is an emission-free, environmentally-friendly technology which could reduce firewood shortages – provided that the technology is acceptable to end-users, and that the stoves are both appropriate and affordable.

The economic benefits associated with time savings can be significant if the time is spent on productive, income generating activities. Since it is primarily women who are involved in cooking and wood collection, the potential for economic benefits depends on the opportunities available for increasing earnings and output.

The impact of solar stoves on the household economy is dependent on the organization of the household economy and the extent to which the household is linked to the wider economic network. In Onseepkans and Pniel, solar stoves became a valuable resource for social networks, as information on solar stoves and the preparation of food were exchanged. Savings achieved through the use of the solar stoves were invested in more food, which was shared among organized cooking groups. These cooking groups increased food security as well as variety in the daily diet (Figure 2), and indicated that the households greatly benefited from the solar stoves.

- In Onseepkans, Pniel and Huhudi, some of the money saved was given to the schools.

Figure 2 Cooking chicken stew in a village in North West Province

- In Onseepkans and Pniel, there was an increase in contributions to the church.
- Other resources that benefited by savings, and which helped with poverty alleviation are women's groups, savings clubs, and clinics.
- In Onseepkans, the time saved became increased labour time for subsistence agriculture.
- In Pniel, the increased time and increased savings was spent on transport to enable greater access to centres seeking job opportunities.
- In Huhudi, hawkers (entrepreneurs who prepare and sell food) saved money to buy fuel and food to sell.

Phase II results

Fuel savings

Telephone interviews

Very few respondents distinguished between energy saving and monetary saving, but it was clear from further discussions that energy saving was synonymous with monetary saving, thus these responses were counted together. From those interviewed, 52% of the respondents indicated that they were saving money by using a solar stove. The average monthly savings reported by the respondents who are mostly from urban areas is approximately ZAR110. Others (13%) could not say how much money they were saving. Of those who said that they were not saving anything, they admitted that they could save if they had used the solar stoves.

Respondents reported that the fuels most saved by using their solar stoves were electricity, gas and paraffin (kerosene), in that order.

Huhudi respondents

Most of the respondents said they saved money by using a solar stove. The only respondent who did not save money only used firewood which she collected and therefore spent no money on fuel. The majority save anything from ZAR20 – ZAR100 with an average monthly saving of ZAR45, which is only 41% of the savings identified by those interviewed by telephone.

The Huhudi respondents save mostly paraffin, gas and electricity/ wood.

Time savings

Telephone interviews

Saving time by using a solar cooker was reported by 44% of the respondents. On average these respondents save 26 hours per month by using a solar stove. Some respondents reported time savings but could not quantify it, while one respondent said you can only save time if you can leave the stove alone outside. One respondent said the stove is too slow to save any time, while another believed that you had to watch the stove all the time or it will burn.

Huhudi respondents

The Huhudi respondents all agree that they saved time by using a solar stove. They report saving from 18 hours per month to 84 hours per month, averaging 40 hours per month. The time saving is influenced by a variety of factors such as the type of fuel being used, the length of time for which they would normally cook on their stove/open fire (which also depends on the type of food cooked) and how many meals they cook per month. The Huhudi respondents save at least 35% more time than those interviewed by telephone.

Impacts on poverty reduction

The people interviewed by telephone were from the middle to higher income groups, and the Huhudi respondents from lower to middle income groups. The economic benefits associated with time savings can be significant if the time is spent on productive, income generating activities. Since primarily women are involved in cooking and wood collection, the extent to which they participate in agriculture and other economic ventures will determine the magnitude of the associated benefits – not yet measured in Phase II.

How solar stoves improve household energy provision

Poverty implies, amongst other things, limited access to energy sources. Energy is a required basic need for cooking, heating of water, lighting etc. Energy issues need to be viewed against the broader background of poverty which dictates energy choices of households. Poor households in the study areas (with an average income of less than ZAR500 per month) were found to spend up to 26% of their total household income to satisfy their energy needs, while richer households (with an income of a ZAR1000 or more) only spend up to 7%. Low and unreliable incomes perpetuate households' dependence on energy sources that are either free, or which can be purchased in small quantities on a daily basis. Livelihood and survival strategies form the bulk of the social economy and contribute to the complexity of accepting a new technology.

Solar stoves can improve household energy provision in the following ways.

- In poorer households where a larger percentage of monthly income is spent on fuels, more money is made available for buying other fuels, thereby enlarging the fuel mix available for the household.
- Besides enlarging the fuel mix, solar stoves also increase energy security. Once the household owns a solar stove, they will always be able to cook (as long as the sun is shining).
- The money saved, which would have been spent on energy, is now available for other things.
- By cooking with a solar stove, fossil fuels or electricity are accessible for other activities. For example, instead of using kerosene for cooking, it could be used for lighting.
- Foods that require a long cooking time use a lot of fuel, so they are ideally suited for solar cooking (e.g. maize, soup, beans, baking bread, etc.).

Conclusions

Solar stoves have had particular impacts on women and their access and control of resources.

- Monetary savings (due to less gas, paraffin and wood purchases) have enabled women to allocate finances to other things – the family (clothing, food), service providers (education, health) and the church (building fund, church groups).
- Saving time provides the opportunity for women to spend more time strengthening their social networks, undertaking household duties and, in some cases, activities such as knitting.
- The money and time saved can be used for more economic productive activities, thus reducing poverty.

Solar stoves have the potential to increase energy supply and security in rural households, but they must be affordable, accessible and of good quality. It is unfair to burden those on very low incomes with inferior quality products that do not work. Solar stoves require promotion to be believed, and some adaptation in cooking habits and planning may be required.

Field testing has been very promising, and the second phase has clearly showed the importance of the price and efficiency of solar stoves, and the importance of promoting the concept.

Bibliography

Wentzel, Marlett, 1999. Renewable Energy Technology Transfer: Socio-Cultural Impacts. Palmer Development Consulting.

Palmer, R., Kota, M., Wentzel, M., 2000. The DME/GTZ Solar Cooker Field Test in South Africa: A Study in End-User Acceptance and Pilot Commercial Dissemination. Palmer Development Consulting.

Palmer Development Group. 1997. Solar Cooker Field Test in South Africa: End user acceptance. Phase I, Main report, Vol. 1.

Palmer Development Consulting & GTZ. 2002. Solar Cooking Compendium. Vol. 2, preliminary draft.

Marlett Wentzel holds a Masters degree in development studies as well as a B.Comm honors degree in energy studies. She has worked in the energy and development field for the past eight years with specific focus on renewable energy.

Erica de Lange has qualifications in BSc Zoology, BSc (Hons) Environmental Management and MSc Applied Sciences with reference to Energy Management in houses.

Promoting solar PV for poverty reduction in Bangladesh

by Dipal C. Barua, Managing Director, Grameen Shakti, Grameen Bank Bhaban, Mirpur – 2, Dhaka – 1216, Bangadesh
E-mail: g_shakti@citechco.net; dipal@grameen.net

Promotion du photovoltaïque et reduction de la pauvreté au Bangladesh
Près de 80 % de la population du Bangladesh vit dans des villages. La majorité de cette population n'a pas accès à l'électricité. Grameen Shakti a joué un rôle de pionnier dans le domaine des énergies renouvelables au Bangladesh en diffusant des systèmes solaires photovoltaïques par le biais d'un financement adapté aux moyens de population à très bas revenu. L'électrification a permis de générer des emplois, favoriser l'éducation et les moyens de communication. Les conditions pour une large diffusion existent ce qui contribuerait à accroître l'impact sur la réduction de la pauvreté au sein des communautés villageoises.

Introduction

About 80% of the people in Bangladesh live in villages where the main source of income is agriculture. Most of these people are deprived of electricity, which is a necessity in today's life. Getting grid electricity to these villages has proved to be beyond their reach, thus making it much more reasonable to turn to renewable energy (which is available in abundance and cheaper) for electrification. Grameen Shakti (GS), the pioneer of renewable energy technology in Bangladesh, has worked tirelessly, and through a soft credit facility it has managed to bring solar electricity to these villages. GS emerged out of the Grameen family of companies in 1996. To date, GS has managed to install more than 8032 *solar home systems* (SHS) up to mid-April 2002 with a capacity of 400 kWp which provide electricity produced from sunlight.

There are mainly four components in a Solar Home System:

- solar panel: converts sunlight into electricity
- battery: stores the electricity
- charge controller: regulates charging and discharging of battery, and
- appliances: different types of electric appliances such as lamp, television, DC fan, mobile phone, computer, etc.
- other electric components: cables, cable clips, switches, switch boards etc.

These installations have completely changed the way of life in these villages.

Targeted areas

Bangladesh receives about 300 clear sunny days per year, and this is enough to produce an enormous amount of solar energy in a sustainable way. For this reason, venturing into SHS was a major step forward in the right direction. To develop the photovoltaic (PV) technology, GS targeted two types of areas:

- those with no current access to conventional electricity and which did not expect to have any access in the near future
- areas with low coverage by the Rural Electrification Board.

An increasing number of unit offices have been set up by Grameen Shakti, and there are currently 47 offices sited in Tangail, Mymensingh, Sherpur, Comilla, Motlob, Sylhet, Chittagong, Cox's Bazar, Bandarban, Noakhali, Khulna, Sathkhira, Morelganj, Patuakhali, Barguna and Panchagar areas. An in-house research and development department is complemented by a workshop to implement improvements. Most of the items used in PV technology (charge regulators, ballast, lamp holders etc), are manufactured within the GS workshop.

Figure 1 A fishing boat illuminated by solar power

Economic benefits

Increased use of PV technology in Bangladesh has lead directly to:

- improved rural economy by creating new jobs.
- a major new Bangladesh industry employing people to disseminate and implement the PV technology.
- reduced dependence on imported oil (kerosene/diesel) through the introduction of PV to charge the solar batteries and to light solar lamps at home.

Sustainable use of SHS

Solar energy has produced economic benefits including both self-employment and increased manpower hours. Rural people have realized that, with electricity at their disposal, there is a lot more that can be done to improve their welfare, education, agricultural production, to mention but a few. For example, new jobs have been created where technicians have been trained to

Figure 2 A tailoring shop doing business by solar-powered

Figure 3 A barber's shop under solar light

provide after-sales services to the customer, and educate the customer on how to operate and maintain the SHSs. Another example is the employing of more staff by small businesses, because of the extra hours they are able to put into the businesses after sunset. Teachers are also able to earn more money by providing after school lessons to students who can afford them.

Dissemination of PV technology

A programme run entirely by GS to sell, install, and provide after-sales services to the rural poor through a soft credit facility has turned out to be a very successful way of bringing much-needed electricity to the rural people. To popularize the PV technology, GS regularly organizes demonstration meetings in market places, schools/colleges and in the villages. Posters, leaflets, and brochures are also occasionally distributed to enhance the awareness of this technology.

Poverty reduction activities

Not only has GS helped in bringing electricity to rural people, but it has also helped in reducing poverty among them by allowing:

- business opportunities to spring up
- businesses to open till late in the night
- children to attend extra lessons after school hours
- engagement in extra activities, e.g. mobile phone charging shops, providing neon light traps for attracting and destroying insects, social TV halls, etc.

SHS success

When SHS got introduced in the rural areas, it turned out to be an opportunity for the villagers to open up small businesses like mobile phone charging shops, computer training centers, TV halls and mobile shops. The mobile phone shops have turned out to be a big success story that is yet to be told. In remote areas where electricity has previously been unknown, people are able to charge their mobile phones using the PV module purchased through a soft credit facility provided by GS. The shop owners also charge a small amount of money for receiving and making calls from their telephones.

Business takes advantage of SHS

People in the rural areas never thought it was possible to open up businesses that stayed open late until after the introduction of solar home systems. Today, most of the businesses stay open late in order to catch the late evening shoppers. A good example is a carpentry workshop that is able to increase its order book because it can open late and meet increasing customer demand.

PV technology brings IT to the people

In the rural areas a lot of students and other potential learners are deprived of the advanced education available to those in the towns. To address this need, GS is establishing computer education centres in rural and remote places to educate information technology professionals. GS has, to date, established eight-computer education centres in Kutubdia a remote island in the Bay of Bengal, Shakhipur, Kalihati, Patharghata, Dacop, Paikgasa, Cox's Bazar and Moheshkhali. With this education, students may improve the quality of their own lives as well as the community. At the same time they can make great contribution to the economy.

Improved quality of life

Before the introduction of SHS, families spent a lot of time by walking long distances looking for kerosene in order to have a small amount of light provided by the rather dangerous kerosene lamp. Today, all the families with SHS are able to utilize this time in a more positive way. Some examples of this are:

- women are now involved in women's empowerment activities, including fish farming, poultry farming
- men are now more involved in income generating activities e.g. fishing, river transportation.

Conclusion

Bangladesh is a country with enough solar radiation to provide potential for sustaining SHS projects. It is therefore a positive step forward to involve rural communities directly in SHS activities because this is the only guaranteed way of reducing (if not eliminating) poverty among these communities.

Dipal Chandra Barua is Managing Director, Grameen Shakti, and General Manager, Grameen Bank, Dhaka, Bangladesh. He is also the Director, Project Enterprise, New York, USA.

Figure 4 Installing a solar home system

Figure 5 Solar systems make television accessible

Rice husk – an alternative fuel in Perú

by Estela Assureira, Director of Biomass and Coal Research Programme, at the Pontificia Universidad Católica del Perú; Av. Universitaria cuadra 18 Lima 32 Perú Email: eassure@pucp.edu.pe

Introduction

This study investigates the usefulness of rice husk as an alternative fuel for household energy. The work included an analysis of the production of rice in Perú, visits to the productive zones, evaluation of rice husk, development and test of rice husk briquettes and the stoves that use them as fuel.

Rice husk in Perú

Currently, in Perú, the use of the agricultural wastes as fuel is limited and inefficient. In 1999 a study was implemented to identify those agricultural wastes with the most useful energy potential within Perú; rice husk, black coffee husk and cotton stalks were found to be best. This conclusion was reached through a study of the fraction of the wastes produced, and where they had been produced in the previous seven years. Other factors included the distance between the users and the point of waste generation, the economic and environmental advantages and disadvantages of its elimination, the use of the waste in non-power applications, and the registered worldwide experience of its use.

The species of rice that is cultivated in the Perú is *oryza sativa*. Between 1992 to 2001, production reached 1900 kilotonnes per year, as shown in Figure 1. Rice is processed in 471 mills, and 70% of them are located in the north of the country. The rice husk generated in the milling process represents about 20% of the rice casing. At present, only 5% of the rice husk is used as a fuel – in brick manufacture in Piura – the rest is burned or thrown into the river.

An analysis of the rice husk produced in northern Perú show that volatiles comprise nearly 60% of the total residue mass, with carbon accounting for over 30% (Table 1).

Maximum calorific values are similar to wood and other agricultural wastes. However, the low density of the husk makes it difficult to store and increases the cost of transportation.

Around 380 000 tonnes per year of rice husk are produced, which could provide 120 000 TOE (tonnes oil equivalent) per year of available energy. Of this, 60 % is very accessible because of its concentration and its proximity to local markets.

Rice husk briquettes

Briquetting is a technology which uses either a dry or a wet process to compress rice husks into different shapes. The dry briquetting process requires high pressure and does not use a binder. This process is expensive and recommended only for high production levels. On the other hand, using a wet process allows lower pressure equipment, but a binder must be used.

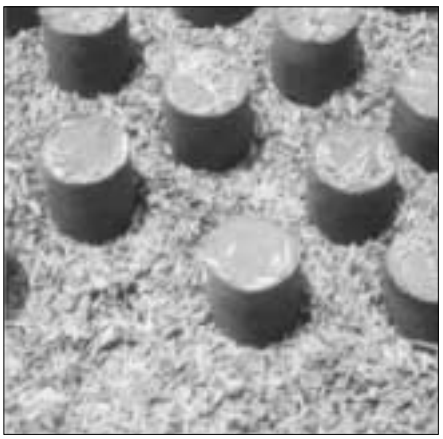

Figure 2 Rice husk briquettes

In this project, cylindrical briquettes were made using mechanical compression and including a binder in the mix (Figure 2). The mixture comprised well-rotted husk with a binder of clay, bentonite or yucca starch. The use of a binder allowed lower pressures to be used. The briquettes could be made in small quantities, and the skills needed to operate the equipment were easy to learn. In addition, the binders selected are available in the market, are not expensive and provide a strong bond.

The rice was ground to a fine powder in a hammer mill, then the binder and water were mixed with the rice husk to form a paste, which was put into a briquetting machine. Finally 'the briquette' was dried to reduce the humidity. This could be done either directly in the sun or in electrical drier. The pilot briquetting plant at the PUCP used a hammer mill, a vibratory sieve, a manual press machine and an electrical drier. Its production capacity is about 30 kg per hour.

The physical and thermal characteristics of rice husk briquettes are presented in Table 2.

Combustion efficiency is an important characteristic as it express the quality of combustion. It is calculated as the total burnt material (initial weight – weight of ash left) divided by the theoretical maximum of combustible material (Eq.1 and Eq. 2). The results are given in Table 2.

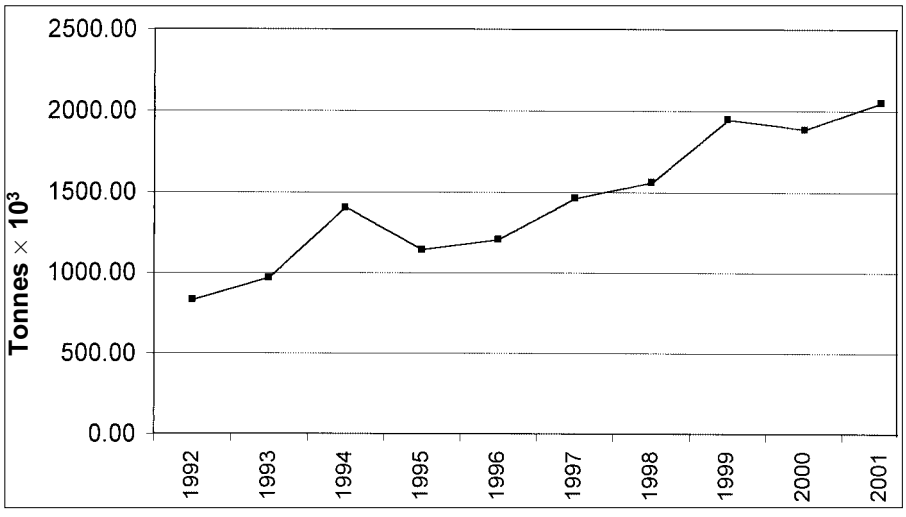

Figure 1 Rice production in Perú

Table 1 Analysis of rice husks

	Mass	Dry
Carbon (%)	34.61	38.43
Hydrogen (%)	3.79	2.97
Nitrogen (%)	0.44	0.49
Oxygen(%)	41.58	36.36
Sulphur (%)	0.06	0.07
Volatile matter (%)	55.54	61.68
Fixed carbon (%)	14.99	16.65
Ash (%)	19.52	21.68
Humidity (%)	9.95	0.00
Calorific value (kJ/kg)	13 800	15 324

$$\eta_{\text{combination}} = \frac{m_i - m_f}{m_{cb}} \quad \text{Eq. 1}$$

$$m_{cb} = \left[m_{rice}(1 - \%ash)\right] + \left[m_{yucca}(1 - \%ash\right] \quad \text{Eq. 2}$$

Briquetting the residues improves their burning characteristics and also produces fuel pieces that are similar in size and weight. At the same time, problems of dust are reduced during handling, transportation and combustion and handling and storage problems are alleviated.

Cost of briquetting

The technical study on rice husk briquettes has been completed, and work is now being done on the economical aspects. Although the final production costs, and selling price are not yet determined, indicative manufacturing costs are given below.

Item	Cost/Quantity
Plant production	30 Tonnes/month
Capital investment (approximately)	US$10,000
Fixed cost for maintenance and operation	US$1550 per month

The plant is mainly manually operated, to create employment in rural areas. Based on the above mentioned fixed operating costs, which would include the cost of employing six people each working an eight hour per day, the manufacturing cost for the briquettes is US$50 per tonne. This assumes that capital was available for the equipment and no depreciation on the machinery.

Rice husk stoves

Using information from the International Rice Research Institute in Philippines (IRRI), some models of rice husk stoves have been developed that use rice husk and rice husk briquettes as a fuel.

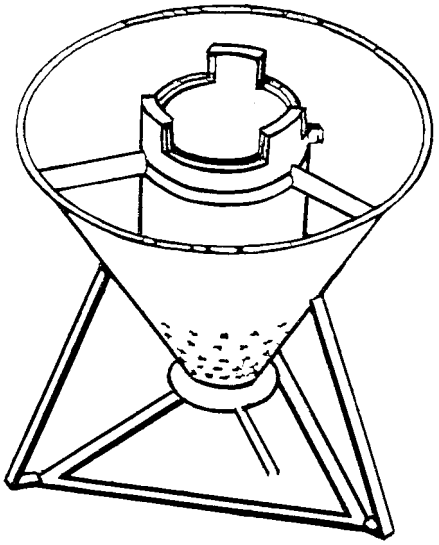

Figure 3 The Voila 2 stove

In 2001 the Voila 1 rice husk was built, similar to RHS-STD-001 IRRI stove. A further development, the Voila 2 rice husk stove (based on the Voila 1), consists of an open cone made of cast iron, with holes at the bottom, and an ash tray under it (Figure 3). A cylindrical flame guide, made of a refractory material, is placed into the cone. Pots are supported on the stove on three ledges welded onto the wall of the cylinder. To light the stove crumpled paper is placed at the ashport before filling with husks.

In operation, the flames and gases first heat the base of the pot and then the walls. Table 3 presents the main characteristics of the stove.

Stove testing

The testing procedures developed are in accordance with the International Standards for Testing of Woodburning Cookstoves. The efficiency of stove is defined as the ratio of the energy transferred to the water, divided by the energy liberated by the burning fuel. For the Voila 2 stove, the efficiency was found to be 20%.

Table 2 Technical characteristics of rice husk briquettes

	Briquette code	BR1	BR3	BR7	BR8	BR10	BR12
Composition	Rice husk(%)	100	70	70	60	85	85
	Clay (%)	0	0	10	0	15	15
	Bentonite (%)	0	20	0	40	0	0
	Yucca starch (%)	0	10	20	0	0	0
Shape		Cylindrical					
Diameter (mm)		40	40	40	40	40	50
Height (mm)		40	40	40	40	40	40
Pressure (PSIG)		6430	3570	5000	3570	5000	8000
Bulk density (kg/m3)		562	803	667	965.5	800	760
Time of ignition (min)		8	18	8.5	18	10	12
Max. calorific value (MJ/kg)		13 800	8280	13 000	13 000	11 730	11 730
Combustion efficiency (%)		97	94	91	80	97	98

Table 3 Voila 2 – a rice stove model

Dimensions	Diameter = 505 mm High = 520 mm
Weight (kg)	12.4
Materials	Iron and clay
Fuel	Rice husk

Plant-oil cooking stove for developing countries

by Elmar Stumpf and Werner Mühlbauer. Contact details: Dipl.-Ing. E. Stumpf, M.Sc. , Prof. Dr.-Ing. Dr. h.c. Werner Mühlbauer, Institute for Agricultural Engineering in the Tropics and Subtropics, Hohenheim University (495), Garbenstr. 9, 70599 Stuttgart, Germany. Tel: +49-711-459 2490, Fax: +49-711-459 3298. E-mail: muehlbauer @ats.uni-hohenheim.de

Plant oils as cooking fuel

Plant oils are a new alternative cooking fuel resource, providing a sustainable and independent cooking energy supply. Their use as cooking fuel can bring numerous benefits to both urban and rural communities in developing countries.

A vast variety of oil plants originate in the tropics and subtropics. Many oil-bearing plants, whose oils are often toxic to human beings, grow on low grade land or in marginal locations, which are unsuitable for food crops. Some of these plants are cultivated on waste lands in order to prevent further erosion and to inhibit desertification. Use of these oils for energy provision will not compete with food production in any way. Examples of these oil plants are the Physic nut tree (*Jatropha Curcas L.*), the castor oil plant varieties (*Ricinus communis L.*) and the babassú palm (*Orbignya phalerata Mart.*), among others. Some oil plants even grow in symbiosis with food plants and are used, for example, as shade trees.

In many regions of tropical and subtropical countries, traditional methods already exist for harvesting the fruits from the oil plants and extracting the oil. This local oil production strengthens decentralized supply, providing employment and income opportunities for the local population and ensuring sustainability. The presscake, a by-product of the oil processing, can be used either as fodder or as high-quality fertilizer. Utilizing this new energy source will therefore directly increase the living standard of the population.

In general, all plant oils which are liquid at ambient temperatures can be utilized as cooking fuel. They are biodegradable and handling is both simple and free of danger. Moreover, burning of plant oils is carbon dioxide neutral.

Liquid fuel cooking stoves

Liquid fuels can be burnt in wick stoves and pressure stoves. Due to their high viscosity, plant oils can not be used in common wick stoves. Therefore, research has been focused on combustion in pressure stoves.

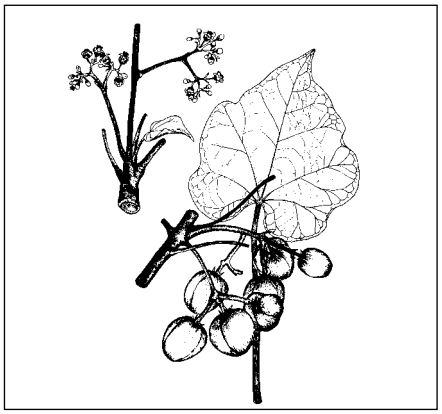

Figure 1 The Physic nut (www.raintree.com)

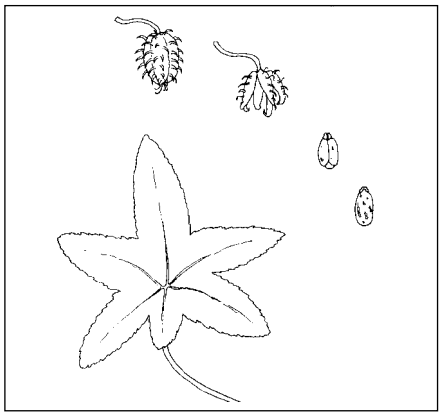

Figure 2 Castor oil palm (www.tapir.org)

Figure 3 Babassú palm

In pressure stoves, air is pumped into the fuel tank, the liquid evaporates in a vaporizer, and is emitted through a nozzle into a combustion area. Here, the jet rebounds at a rebounding plate, mixes with ambient air and burns in a blue flame. The combustion area is surrounded by a flame holder. The power output is adjusted with a valve regulating the fuel flow. For ignition, a small amount of ethanol is incinerated in a pre-heating dish beneath the vaporizer.

Kerosene is the commonly used liquid cooking fuel in developing countries today. Since the gross calorific value per volume of plant oils is only 5% lower than the corresponding value for kerosene, plant oils are suitable substitutes. Nevertheless, due to the differences in chemical structures, plant oils show very distinct physical, chemical, and combustion properties. These include elevated vaporization and flash points as well as higher ash residues.

Hohenheim plant oil stove

At the Institute for Agricultural Engineering in the Tropics and Subtropics of Hohenheim University, a plant oil pressure stove has been developed, which is believed to be the first stove so far which provides continuous operation with various pure plant oils. In addition to plant oils and plant oil mixtures, the cooking stove can also be fueled with plant oil esters, kerosene, diesel fuel and gasoline.

The new plant oil stove (Figures 4 & 5) can easily be introduced, even in rural areas of developing countries, since the operation of the plant oil cooking stove is similar to the known kerosene pressure stoves. Pre-heating is done by burning a small amount of ethanol in a dish. Likewise, the power is adjusted with a valve in the oil input tube. The power output range and efficiency of the plant oil stove is comparable to existing kerosene stoves.

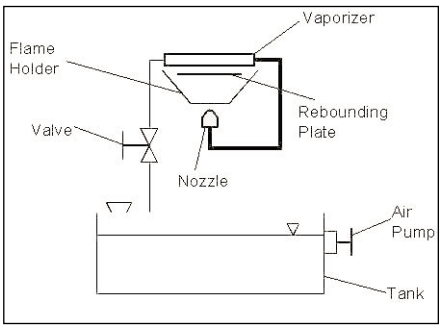

Figure 4 Schematic diagram of Hohenheim plant oil stove

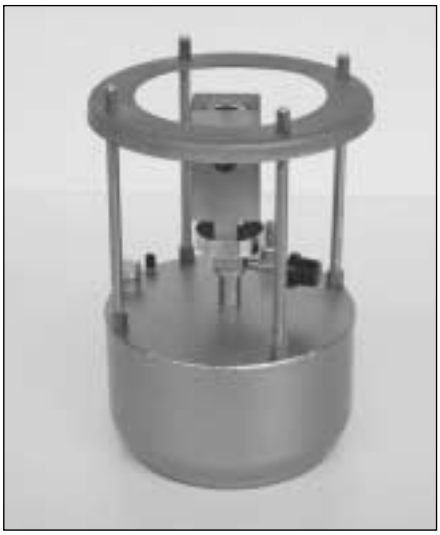

Figure 5 Hohenheim plant oil stove

A further benefit of plant oils as fuel is that they reduce the severe operating risks related to highly inflammable kerosene. The emissions of the plant oil stove are very much lower than the ones for open fires and are similar to the emissions of pressure kerosene stoves. For example, hydrocarbon emissions of the plant oil stove were measured to be 370 times lower than the emissions of an open fire with comparable power output. Likewise, the carbon monoxide and the nitrogen oxides emissions of the open fire are 120 times and 15 times higher than the emissions of the plant oil stove, respectively.

For the development of the plant oil stove, a completely new design of burner was required to maintain continuous vaporization as well as combustion. The vaporizer was redesigned to increase the retention time of the plant oils in the cooker flame sufficiently to reflect the high flash points of those liquids.

Because plant oil molecules start to dissociate at temperatures around boiling point, leaving cracking products at the vaporizer walls, the vaporizer can be released from the cooker frame and cleaned manually if necessary. For cleaning, a wire rope is pulled through the entire vaporizer tube. Nevertheless, the burner of the prototype already runs for more than 30 hours continuously on the test bench without cleaning.

In general, the new plant oil burner can be used independently of the stove's tank design and pot support. Nevertheless, common tank designs were analyzed and a new cooking stove prototype was designed. The stove can be manufactured using simple methods and materials at a very competitive price. The whole design is very robust and ensures that pots (Figure 6) or woks are seated securely during cooking.

The prototype has been developed as a one-flame cooker. However, the burner of the plant oils stove can be also used in cooking stoves with multiple flames. Depending on the required cooking task, the burner can be built in different sizes with distinct power outputs.

Current research is being carried out on the optimization of stove parameters, such as power range and efficiency. A first practical test of the cooking stove is planned in Guatemala. Later on, a field test of the plant oil cooking stove within a tropical or subtropical country will prepare the dissemination of this new technology.

Conclusions

A pressure cooking stove was developed which can be fueled by pure plant oils. Only a small amount of ethanol is needed for start-up. In addition, a new stove prototype was designed which can be built locally at competitive prices in developing countries.

Utilization of the plant oil cooking stove has numerous ecological, economical, and sociological benefits. Plant oils are a sustainable energy source ensuring a sustainable supply of cooking energy. Introduction of the new plant oil cooking stove can be readily acceptable to people in tropical and subtropical countries since its operation is similar to the familiar kerosene stoves.

Figure 6 Hohenheim stove with pot

Acknowledgement

The authors acknowledge their indebtedness to the Bellagio Forum for Sustainable Development, Osnabrück (Germany), especially their member associations German Federal Foundation for the Environment, Osnabrück (Germany), The Rockefeller Foundation, New York (USA), and The Toyota Foundation, Tokyo (Japan), for their financial assistance of this project. They would like also to express their deep gratitude to the European Natural Heritage Fund (Euronatur), Radolfzell (Germany) for their continuous support.

Useful literature

Andrews, G.E. and M.C. Mkapi, 1996: Vegetable oil as alternative household fuel to imported kerosene in Africa – Leeds African Studies Bulletin. No. 61, p. 48/52.

Kammen, D.M., 1995: Cookstoves for the developing world, *Scientific American* 273, No. 1, p. 64/67.

Kollar, M., 1999: Abgasemissionen und Betriebsverhalten beim Einsatz von Pflanzenölen im Wirbelkammer-Dieselmotor und Kochherd – Ein Beitrag zur Lösung von Energieproblemen in den Tropen und Subtropen. Fortschritt-Berichte Series 15, No. 217. – VDI-Verlag, Düsseldorf, Germany.

Peterlowitz, S., 1995: Pflanzenöle – Ein Beitrag zur nachhaltigen Energienutzung in Entwicklungsländern. – Der Tropenlandwirt, No. 53, p.131/135.

Rehm, S. and G. Espig, 1996: Die Kulturpflanzen der Tropen und Subtropen. – Verlag Eugen Ulmer, Stuttgart, Germany.

Elmar Stumpf is scientist and Werner Mühlbauer is head of the Institute for Agricultural Engineering in the Tropics and Subtropics at Hohenheim University, Stuttgart, Germany.

What's happening in household energy?

HEDON

In association with the Household Energy Development Organization's Network ***http://ecoharmony.com/hedon***

HEDON XI meeting

The eleventh household energy network meeting (HEDON) took place in Johannesburg, South Africa from 27 to 28 August, to coincide with the World Summit on Sustainable Development. The aim of the meeting was to finalize project proposals in a number of key aspects of Household Energy (Environment, Small Enterprise, Health, Forestry and Food & Energy Security). Project concepts were developed through an email dialogue in the run-up to the meeting. Projects were sought with real, tangible outputs wherever possible, to capitalize on our strengths as a global network (but not merely networking activities).

Contact: Grant Ballard-Tremeer, grant@ecoharmony.com

Ashden award winners

The winners of the Ashden Awards for Renewable Energy were announced on 14 March 2002 by HRH The Princess Royal at the Whitley Laing Foundation's annual awards ceremony in London.

Dr. Karve of the Appropriate Rural Technology Institute, India, won the first prize of £30,000 for discovering and implementing a unique technology that produces clean fuel from sugarcane waste (see *Boiling Point 47 page 16)*. The judges were impressed by the way in which his project turns a large-scale environmental problem (millions of tonnes of sugarcane waste are burned each year in open fields), into a huge income-generating opportunity while providing desperately needed clean and cheap domestic fuel.

Dale Lewis of Wildlife Conservation Society of Zambia was the winner of the second prize of £15,000 for his innovative use of solar powered electric fencing to prevent crop raiding by wild animals in Zambia.

Two runners-up each received £7,500: Margaret Owino of Solar Cookers International, Kenya and Irving Williams of AHEAD, Tanzania. Both projects use solar cookers; the first to alleviate severe fuel shortage in refugee camps in Northern Kenya, and the second to reduce illness from water borne diseases, the second highest cause of infant death in Tanzania.

Community Fund's International Grants Programme

Community Fund is the operating name of the National Lottery Charities Board in the UK, an independent organization that distributes money raised by the British National Lottery to support charities and voluntary and community groups throughout the UK, and to UK agencies working abroad.

Application packs for the new international grants programme will be available from mid-July. Applications can then be sent in on a continuous basis throughout the year as there will no longer be a fixed annual deadline. The international programme will make grants to UK NGOs for projects in developing countries to be carried out with local partners.

The new programme will focus on making a long-term difference to the lives of the most disadvantaged people by addressing the factors that make people poor and keep them poor. It is important that each project to be funded is based upon an initial analysis of all the causes of disadvantage in the beneficiary community, with a clear strategy for how the project will address a number of these factors.

HRH The Princess Royal at the Whitley Laing Foundation's ceremony to present the Ashden Awards for Renewable Energy

The funding will be targeted on work that contributes to **one or more** of the following outcomes **for the most disadvantaged people:**

- improved primary education
- improved health through community-based care
- improved allocation of natural resources
- improved human rights.

All applicants will be expected to show their understanding of why certain groups or individuals do not have access to resources, such as health or education – as a result of their gender, ethnicity or age, for example – and how the proposed project can bring about change.

Applications should also show how the most disadvantaged people can be enabled to take control of their lives and maintain the benefits brought about by projects. This means that **only** projects that combine service delivery with capacity building and influencing opinion, or ones where capacity building and influencing opinion alone contribute to the outcomes above will be funded.

More information about the programme can be found on our website: www.community-fund.org.uk

Charcoal fuel from bagasse – Chardust Ltd. in Kenya

Chardust Ltd., the small Kenyan company that developed and commercialized the briquette made from charcoal vendor's waste, has just launched a joint venture with the Chemelil Sugar Company to produce 'CaneCoal', a process which converts waste crushed cane, known as bagasse, into affordable charcoal fuel briquettes which can be burnt in a domestic 'Jiko'.

The Chemelil project will establish a foothold in the West Kenya charcoal

market by providing a direct substitute for wood charcoal – most of which is illegally harvested from the regions rapidly diminishing forests. Chardust would like to work with any organizations that are able to inform the public and increase awareness of the value of using substitutes to lump wood charcoal.

Chemelil produces up to 100 tonnes of surplus bagasse per day, accumulating in massive heaps before being hauled away to be burnt in fallow fields. All four operating sugar factories in Kenya have a similar bagasse disposal problem.

Sales of 5 tonnes of CaneCoal per day are anticipated by early in 2003, displacing an equivalent amount of unsustainably harvested lumpwood charcoal. Between 8kg to 10kg of live wood is required to produce one kilo of traditionally kilned charcoal.

The Chemelil CaneCoal project is co-financed by the UK's DFID Business Partnership Programme and seeks to provide a model of corporate social responsibility, sound environmental management and quality energy provision to low income consumers. Some 20 employees will be employed at the 5-tonne per day level of output.

Once proven commercially viable, the Chemelil CaneCoal venture has huge replication potential in East Africa and beyond. Chardust is confident that this technology can be used within the coffee and sawmilling industries as well. By salvaging the massive quantities of agri-industrial by-product that goes to waste in East Africa and converting it to a substitute for traditional wood charcoal, whole forests can be spared through a direct reduction in the demand for fuel.

Contact: Elsen L. Karstad, briquettes@chardust.com, Website: www.chardust.com
Nairobi Kenya

ICS Network in Nepal

ICS (improved Cook Stoves) Network in Nepal, supported by ARECOP and managed by Centre for Rural Technology, Nepal, has launched its own website. The website contains information on various activities of the ICS Network in Nepal, reports and recent publications of the network as well as organization profile of 38 member organizations involved in implementation of ICS programmes in Nepal. The web address is www.icsnetwork.org

Contact: Ms. Moon Shrestha, Network Officer, Centre for Rural Technology, Nepal Tel: 977 1 260165, 256819; Fax: 977 1 257922 Email: ics_net@ntc.net.np.

Zimbabwe: A new form of household energy

An article in the Financial Gazette in Zimbabwe reports that a local company, Firepack Products (Private) Limited, has developed an alternative energy source; an organic gel that is a mixture of water, alcohol and a stabiliser, which can be used for lighting and heating. The fuel costs consumers $45 per litre compared to a cost of $60 for kerosene. The fuel is convenient, non-explosive, odourless, cheaper and a cleaner fuel than others available in the country. The gel is manufactured in Chitungwiza and it is anticipated that 10 000 litres per month will be produced.

The organic gel does not produce carbon monoxide when used indoors, is already being utilised commercially, mostly in the hotel and catering industries, where it has become a substitute for methylated spirit, used to heat food.

Domestically, it is being used to cook food both in and outdoors and Firepack is also targeting tourists involved in outdoor camping, and truck drivers who use gas to cook during long journeys.

Solar Rice Cooker

A very compact, light weight and easy-to-use Solar Rice cooker has been tested at School of Energy Studies, Pune University, India.

Salient Features

- The device is a single dish cooker mainly for cooking rice, which is the staple diet for most of South and East India.
- The overall dimensions are 454 mm (diameter) and 185 mm (height), it weighs just 6kg and cooks four servings of rice.
- It can be used very successfully as a solar oven for roasting potatoes, eggs or meat.
- It is a slow cooker, with no mirrors, which cooks a meal in 3 hours when placed in the sun.
- However, it is not a replacement for existing solar cooker or conventional cooking.
- Heat losses are minimised by proper configuration of the components.

Solar rice cooker

The Institute is willing to supply a set of drawings free to any person who is interested.

Contact: K. Munshi, Professor, Indian Institute of Technology Bombay, Powai, Mumbai – 400 076, India Tel: 91 22 5767822, Fax: 91 22 5767803 Email: munshi@idc.iitb.ac.in, munshi999@yahoo.com

Tiny pollution particles may carry large consequences for earth's water supply

A study by NASA researchers at Scripps Institution of Oceanography at the University of California, San Diego, argues that particles of human-produced pollution may be playing a significant role in weakening Earth's water cycle. The research paper is based on results obtained during the International Indian Ocean Experiment (INDOEX):

'Through INDOEX we found that aerosols are cutting down sunlight going into the ocean. The energy for the hydrological cycle comes from sunlight. As sunlight heats the ocean, water escapes into the atmosphere and falls out as rain. So as aerosols cut down sunlight by large amounts, they may be spinning down the hydrological cycle of the planet,' Ramanathan concluded.

INDOEX researchers documented a brownish-gray haze layer of about 10 million square kilometers over the Indian-Asian region. The particles within the haze were causing a three-fold decrease in solar radiation reaching the Earth's surface as compared with the top of the atmosphere. The aerosols formed by fossil fuel combustion and rural biomass burning.

Website: http://ens.lycos.com/ens/dec2001/2001L-12-07-06.html