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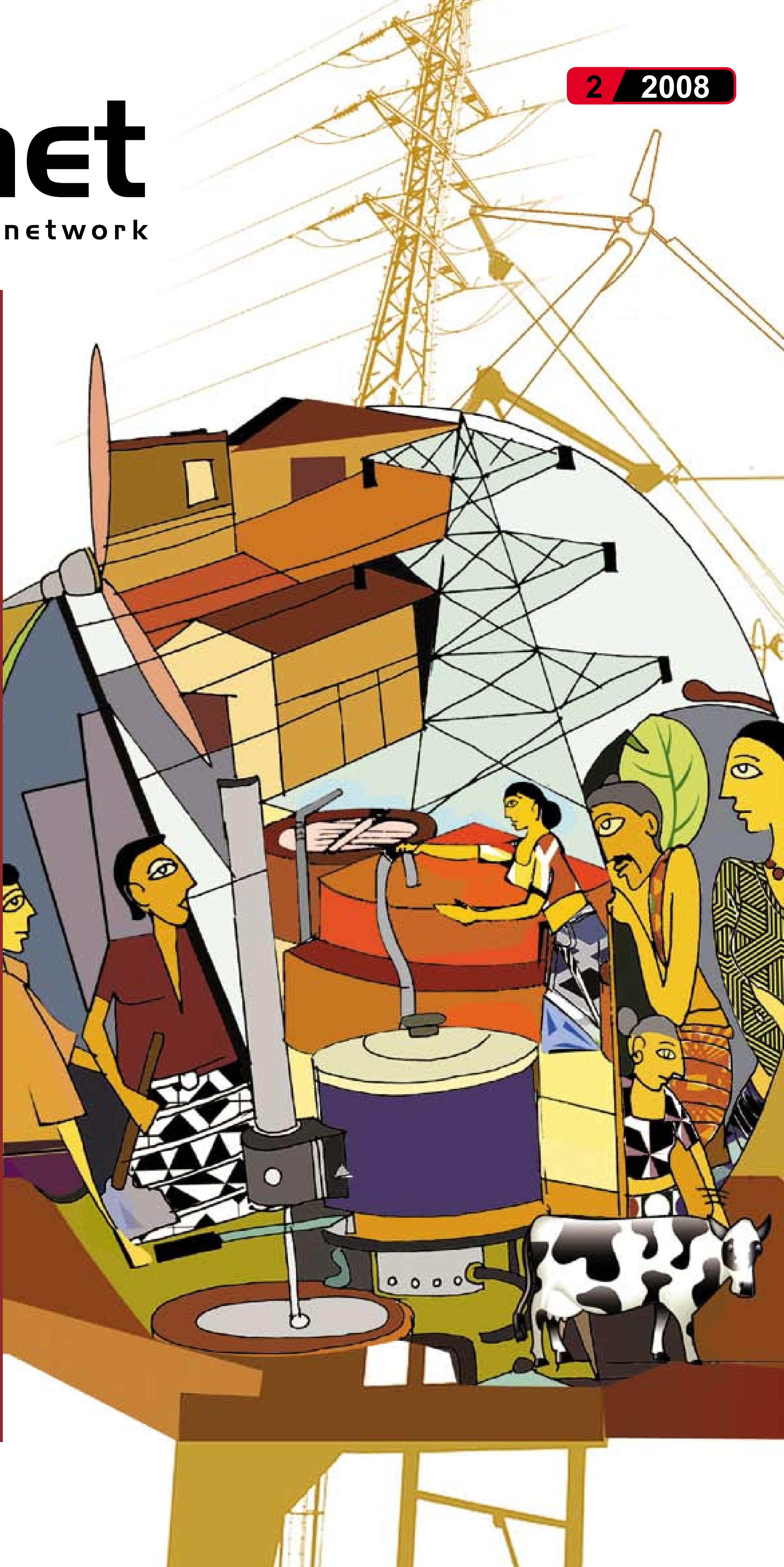
2 2008

FEATURES

COLUMNS



editorial

The July 2008 issue of the **e**-net magazine focuses on emerging technologies in the renewable energy sector for community based initiatives. In the context of the world energy crisis and competing demands for resources these initiatives show how the burgeoning energy needs of the world's populace can be met. Articles within this issue feature technology solutions aimed at enabling the poor to meet their energy needs. We are happy that we have a contribution from Bhutan for this issue along with valuable contributions made from India, Sri Lanka, Nepal and Pakistan.

The articles highlight emerging technologies which are being managed, or have potential to be managed by community based institutions to address their energy needs. Mr. Punchibanda's article describes a biomass rice cooker developed by NERDC Sri Lanka that can cook rice and keep it warm using coconut shells and reduce a household's increasing fuel cost burden. Dr. Chanakya's article on biomass based biogas (3B) introduces a new development in biogas. It explains how biogas can be produced from organic wastes other than cow dung and offers biogas to communities not owning cattle. The issue also carries an article from Nepal describing how communities have benefited from the improved water mills. The contribution from Bhutan is about the e8's micro hydro project that meets the energy needs of the rural poor. Geeta Vaidyanathan and Ramani Sankaranarayanan share the experiences of CTxGreEn in biodiesel production at the village level and make a case for supportive policies, and community structures as strong enabling mechanisms.

Of key importance to the introduction of any technology to a specific area apart from its technical viability are the socio-economic and cultural considerations which need to be taken into account to make the technology a success. Nusrat Habib's article which looks at the need for cook stoves and ovens in Pakistan highlights such compatability.

The **e**-forum conducted in June, as part of **e**-net's initiative to promote collaboration and the sharing of experiences in the South Asian region, focused on information needs of communities. The contentious question was whether the South Asian region had the expertise, knowledge, and resources to meet this gap. An excerpt of the outcomes of this forum is included in this issue.

We hope that you find the contents of this issue relevant to your information needs. Please let us know what you think by filling in the feedback slip attached with this issue or write to us at e-net@sa-energy.net. This issue as well as previous issues are available on the e-net website www.sa-energy.net.

IMPRINT

e-net is a magazine for the dissemination of information on decentralised and renewable energy technologies, implemented using a community based approach.

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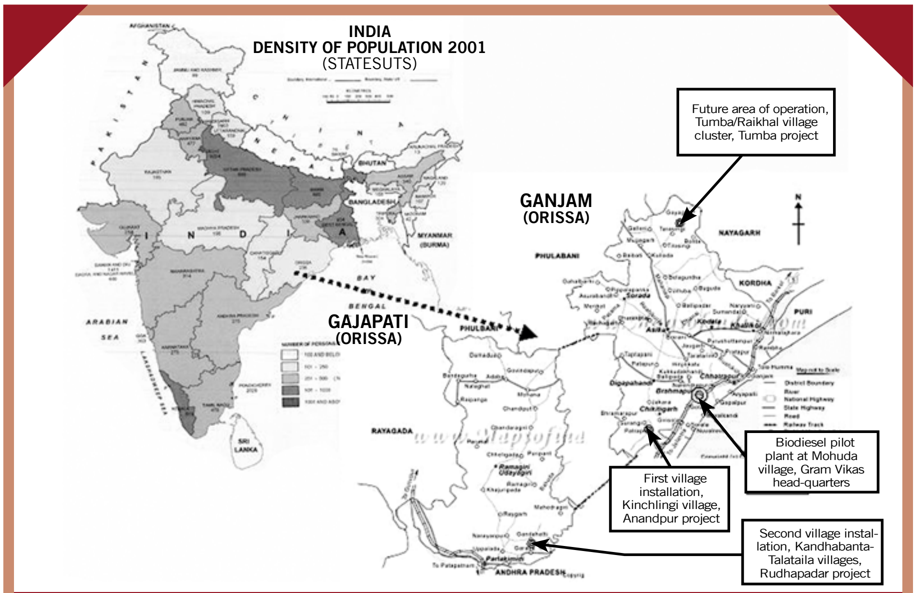
TECHNOLOGY AND ECONOMICS WHERE PEOPLE MATTER

By Geeta Vaidyanathan and Ramani Sankaranarayanan

This article deals with village-level biodiesel production in rural India using locally available and under-utilised oil seeds. Challenges faced when introducing technology and complementary implementation systems that are "new" to the villagers are explained. Apart from technical feasibility, other key factors that ensure the robustness, replicability and sustainability of such a technology system are also highlighted.



Map of India indicating the three areas of operation of the Gram Vikas-CTxGreEn Biodiesel project in the state of Orissa (Source: www.censusindia.net/maps/popden.html, viewed on 28/09/2005)

Today, biodiesel is in the centre of the food-fuel conflict. While the tension between food and fuel has to be better understood what cannot be ignored is that growing your own food and meeting your energy needs in a decentralised manner with renewables both face macro-policy challenges that make it difficult for "Small is beautiful" to be sustained economically. Independently producing energy and growing food for personal use cannot be assessed at their face-market-value alone. They should both account for the non-market exchange aspect of their production and use, and be accredited for their environmental soundness and contributions to lowering of greenhouse gas emissions.

Biodiesel from non-edible oil seeds when used for fuelling livelihoods in a decentralised/dispersed manner, can lead to stronger local economies without creating any conflict with food security. When used as a community-tool for productive livelihoods instead of fuelling more personal transportation (tantamount to consumption) there will be enough renewable-fuel that can be grown in addition to sufficient food. In the context of rural economies of developing countries, biodiesel could translate into fuel for pumpsets and thus assured irrigation for a high value second crop. The Gram Vikas-CTxGreEn Biodiesel project launched through a World Bank Development Marketplace Award (WBDM 2003) is an example of how biodiesel could be produced and used locally in rural communities. The collaboration between Gram Vikas and CTxGreEn has completed four years in February 2008 and has since advanced beyond its initial focus of serving up an addition to the renewable energy toolkit for the water and sanitation program into an integrated livelihood service. The "village level biodiesel production" is a 'no-conflict' model[1] (Biodiesel - no conflicts here! 2007) that does not promote large-scale mono-culture plantations but relies on under-utilised locally available indigenous oil seeds.

The term biodiesel is used very loosely today and could mean anything from straight vegetable oils (SVO) to a 5:95 mix of vegetable oil and diesel, and is even sometimes confused with ethanol, which is also a biofuel but not biodiesel. Biodiesel is prepared from vegetable oil but involves a chemical transformation - triglycerides to esters - in the presence of alcohol (99.5% pure ethanol or methanol) and lye (sodium hydroxide or potassium hydroxide). Such a change results in the formation of biodiesel, which can be used directly in diesel pumpsets and gensets. The glycerin which is a by-product of the production process can either be composted or converted to soap. The attractiveness of this option from the engineer's point of view is that oil, which is acidic in nature, is neutralised in the process and can be used directly in diesel engines without any deterioration of mechanical parts. Thus the users are not required to do any modifications to their familiar end-use device. For the villager it is perhaps the only renewable energy fuel that could be stored easily and used as and when needed, without incurring great expenses, while maximising local value-addition with very low "cash-outflow" from the village economy.

Most biodiesel efforts in India that rely on promoting Jatropha curcas, which is a non-indigenous plant species (suspected to have

[1] Biodiesel when produced from under-utilised oil seeds does not lead to diversion of land previously allocated for producing food and so does not create conflicts with food security. Additionally, since the fuel is produced and used locally for productive livelihoods it does not create huge demands of the nature and scale generated by consumptive transport fuels. Moreover, since the fuel and food are both produced and consumed locally, there is a much lower risk of these conflicts creeping up.

Kunnu Pradhan, Self Help group member, at the biodiesel reactor during a training session (Photo courtesy of CTxGreEn)

allelopathic effects on native species[2]). The GV-CTxGreEn biodiesel project is unique in that it sources only locally available and under-utilised seeds. The production schedule for this very small-scale technology (5L and 20L batch production on a bi-monthly or weekly basis requiring only 20kg to 80kg seeds/batch respectively) was developed in consultation with the community. The package includes good organic agronomic practices to supplement local forest seeds like karanja (Pongommia pinnata) and mahua (Madhuca indica) with niger (Guizotia abyssinica) an indigenous oil-seed, that can be grown in village community fallows. Biodiesel is produced in a pedal-driven reactor that can be maintained by anyone with basic bicycle-maintenance experience. The fuel thus produced can then be used in a regular pumpset, replacing diesel fuel.

The Mohuda Pilot Plant and Training Centre were established during May-June 2004. Biodiesel production units were set up in Kinchlingi in November 2004 and in the twin villages of Kandhabanta – Talataila in December 2004. Although the (bio)diesel-pumpset was installed in Kinchlingi early February 2005, daily water pumping could commence only in June 2005, after completion of the water tank in the village. In spite of several challenges, the village of Kinchlingi has succeeded in running the biodiesel pumpset for 690 hours using more than 452L of biodiesel to pump over 2,180,000L of water.

In the second set of villages, Kandhabanta and Talataila, a (bio) diesel pumpset alone was not suitable since the water table dips 35 feet below ground level in summer. A biodiesel-fuelled generator set was required to generate electricity, which could then power the ½ HP submersible pumpset.

The third area of implementation, is Tumba - a cluster of villages. Detailed assessment of natural resources and prevalent livelihood practices has led to an integrated micro-energy plan being designed for this area. The objective is to implement village-level biodiesel production in an entrepreneurial manner and ensure sustainability through local participation and local utilisation. Benefits will accrue to the entrepreneurs running the hand-operated oil mill, the biodiesel production centre, biodiesel livelihood services, as well as to the by-product value addition group. The community at large will also benefit in terms of increased agricultural productivity, progressive reversal of shifting agriculture[3] through stabler agricultural practices, more jobs in the local area, capacity building, and reduction in the cash outflow for purchase of edible oils and so on. As the first step, business profitability of the hand-operated oil press was demonstrated during the months of February-March 2008 at Raikhal[4], and potential entrepreneurs and Self Help Groups have been recruited for future implementation.

The biodiesel unit in Kinchlingi, which was initially planned as a "technology demonstration unit" and continuously functioned for almost four years is now the learning ground for further replication.

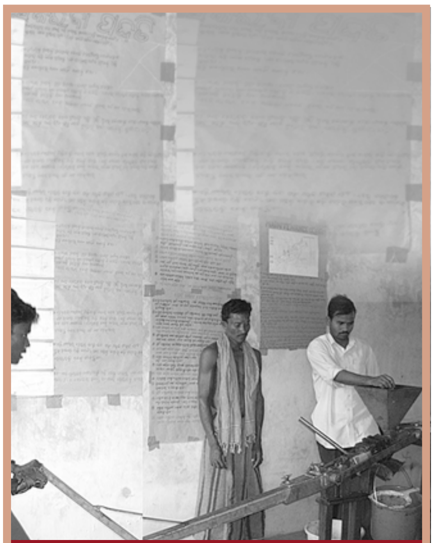
Biodiesel in Kinchlingi

Kinchlingi is a village of 16 families and a population of 73 belonging to an indigenous forest community called the Sauras. Almost all the families have income levels less than a $1 a day (source: www.wakeupcall.org). Only half of the families own land, mainly small-holdings ranging from 0.5 to 2 acres, while the rest earn their living through sharecropping or as casual labourers. The dependency ratio of the village is about 1:3, i.e., every earning member has roughly 3 mouths to feed. The Sauras practice a form of slash-and-burn agriculture with the difference being that they rotate between limited numbers of land and are back to the same plot 3 years later. Sometimes they use the same plot for two consecutive years, and even move to stable agro-forestry practices by growing cashew as a cash crop. Kinchlingi is attached to a reserve forest and the village has formed a Forest Protection Committee which jointly manages the forest with the Forest Development Agency. A forest assessment conducted in the vicinity of the village revealed that there was not enough feedstock for biodiesel. With the village having very little land (private or community owned), growing seeds was going to be an uphill task. The reason for choosing Kinchlingi for implementing the biodiesel system was that the NGO Gram Vikas felt that the small

[2]Pankaj Oudhia, "Bare facts about poisonous Jatropha curcas".

[3] Shifting agriculture in Tumba, also called Bogoda, uses the ash from the burnt biomass as fertilizer avoiding any chemical inputs. Oilcake can serve as a substitute for ash and in the absence of chemical fertilizers sustain the prevalent cropping pattern without slash and burn.

[4]Raikhal is one village in the Tumba cluster of 22 villages and is at 600m elevation. None of the villages in this cluster have access to electricity and all of them are accessible by foot only.



Mangala pressing niger seeds during the Mafuta Mali oil press demonstration in Kinchlingi on Feb 2007 (Photo courtesy of CTxGreEn)

village could be easily motivated. The village was to serve only as a demonstration - a test of the technical feasibility of the project. The only criterion was that the selected village should have a village committee for water-supply and sanitation, be willing to implement the program and build washrooms and a water tank. A readily available source for pumping water but no access to grid-power meant that to provide running water in the washrooms, an alternate energy source was needed and it is here that biodiesel fitted in.

Gram Vikas field staff decided to explore the idea with Kinchlingi villagers. Biodiesel appeared to fit the bill and the villagers felt that in future they could collect or barter seeds from neighbouring resource-rich villages in the future or even acquire community land and grow seeds.

As Kunnu, one of the women in Kinchlingi said on the day of the initial meeting "We should not rely only on the forest seed but cultivate our own seeds so that we can have control rather than rely on people outside." The women in the village immediately launched into the construction of the washrooms and most of the time filled in for the men who had migrated to the city for work, in order to complete the infrastructure on time. Biodiesel was produced in Kinchlingi using a pedal driven biodiesel reactor in record time - within nine months of the launch of the project.

In the meantime there was a regular exchange of information and opinions between the village and the biodiesel project team. These included inputs into the machine design (e.g. 'the oil press requires too much effort', 'the bicycle seat in the biodiesel reactor is too high', 'can the reactor tank where oil is poured be lowered?') and knowledge about availability, collection, drying and storage of local forest oil seeds. Land was identified for sowing niger communally and orientation and trainings were organised for the village youth in the hope of enlisting them as future biodiesel technicians. One boy from a neighbouring village was identified for intensive training in order to support the village in the operation and maintenance of the biodiesel unit. The Kinchlingi community decided that they would run the unit by volunteering time in the form of sweat equity[5].

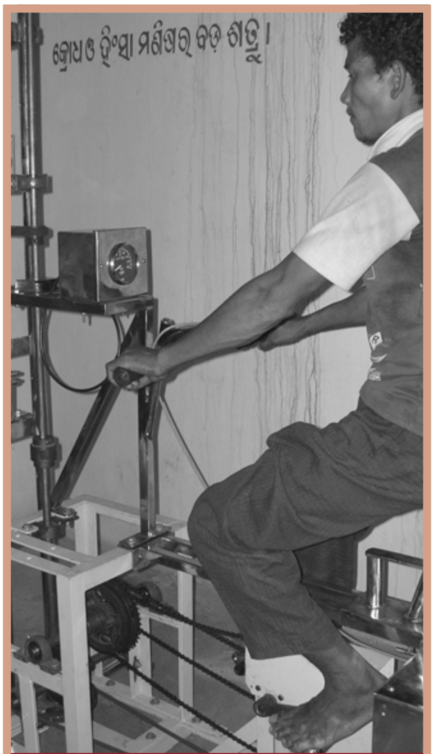
The village of Kinchlingi needs between 11-13 litres of biodiesel every month, which can be produced in roughly 2-3 batches, with each household providing one volunteer every month. The villagers have used community and private fallows belonging to other neighbouring villages to grow niger consecutively for the last three years. Cost of oil and therefore the price of oilseed have a great bearing on the final cost of biodiesel. Oil is over 80% of the raw material cost of biodiesel, while alcohol is 14% and lye 2%. In 2006, the village of Kinchlingi harvested about 141kg niger seeds through voluntary labour and were even able to get a fairly good harvest of about 80kg/acre in one of the four plots. The actual cash outflow for these seeds was nil, and so the cost of biodiesel was only about Indian Rs. 50/L.[6]

Every household is currently volunteering time (roughly a one hour shift once every month) to produce biodiesel and operate the pumpset. However, it is hard to sacrifice even one day in a month to provide sweat equity for making biodiesel when a community is dependent on a daily wage earned either from selling fuel wood lopped from forests, or from labouring in public works projects of the government, or worse still migrating seasonally in search of work. In spite of these challenges the village has been running the biodiesel pumpset since 2005 because of the enthusiasm of a handful of villagers.

Gravity flow water system has replaced biodiesel pumping in Kinchlingi as of May 2008. Since there may be a drastic reduction in flow from the gravity flow source during the hot/ dry season (May-June), biodiesel will continue to be a back-up energy source for water pumping. Discussion has been initiated with the community members of Kinchlingi on the future use of the biodiesel reactor and pumpset. Villagers want to retain the biodiesel system for another two years. Lighting through biodiesel-fuelled battery-charging of

[5]Sweat equity is a term popularised by Habitat for Humanity, for labour contributed in terms of voluntary-work that is assigned a monetary value equivalent to the opportunity cost. The Kinchlingi volunteer-run model was suggested by Gram Vikas staff working there as they felt that the community could contribute labour but might not have extra disposable income to pay tariff for water. A volunteer-run model was worked out and a base amount established for each household: sweat equity as contribution towards biodiesel production and for growing or collecting feedstock in addition to a basic tariff for other chemicals.

[6]The cost of biodiesel could be further reduced by approximately 15% with improved harvest (200 to 300kg/acre is the potential harvest) and better oil yields, both of which are possible with timely sowing and input of organic manure. If the seeds were fully paid at market price the cost would go up by 15% to 20%. However, 80% of that money would remain in the village economy.



Narsing Pradhan pedalling to produce 5L biodiesel in Kinchlingi on Dec 2004 (Photo courtesy of CTxGreEn)

LED lighting systems, irrigation and oil expelling are some possibilities for use of biodiesel, besides pumping during the summer months. Villagers have agreed to grow niger this year too. They will try to sow at least 4 acres of land including a patch of previously unused community land, in a timely manner.

The technical feasibility of village-scale biodiesel-fuelled water pumping has been established beyond any doubt in Kinchlingi. However the approach proposed by the CTxGreEn project looks at technology as only one among four other key elements essential for project sustainability, the other elements being:

1. Land - to promote optimum use of soil, water resources and avoid conflict of use
2. Robust community structures for management of the technology
3. Understanding the current energy use patterns and future aspirations of the villagers
4. Legal and policy issues to facilitate the grassroot processes.

The robustness of the biodiesel system and its replication will depend on these four factors and not on technology alone.

Another area of concern has been the gap between planning and implementation owing to the cultural milieu where village decisions are still male-dominated and often not beneficial to women. Thus gender-sensitive planning does not always translate into an actual gender-sensitive plan. Similarly, the literacy level within the village is extremely low, making the training process more challenging. Young girls are being recruited into the training process as they are less likely to migrate to cities. There is the risk of girls leaving the village after marriage, yet the chances of their being in the region and continuing to assist the development work is high. The ultimate test of the viability of the technology will be the ability of the local youth being trained as bare-foot technicians to independently operate and manage the technology.

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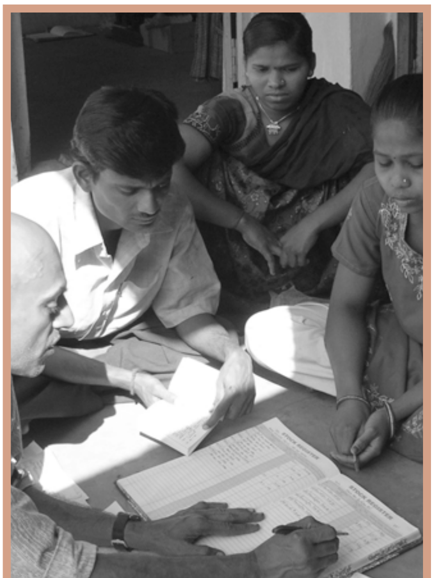
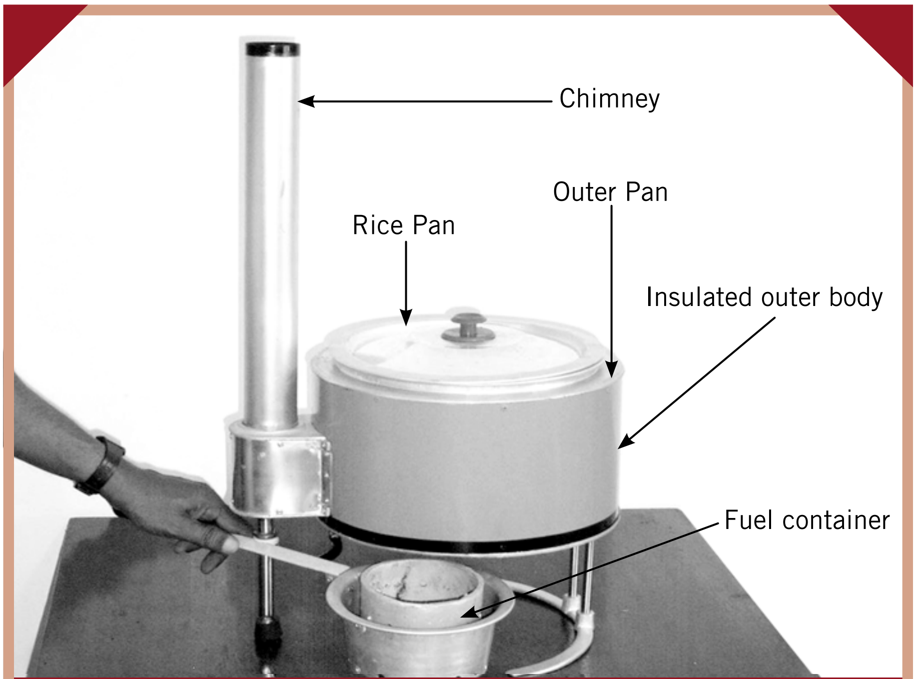


Kinchlingi youth being trained in stock and log keeping (Photo courtesy of CTxGreEn)

BIOMASS RICE COOKER

By D M Punchibanda

Cooking rice is a daily activity in almost all South Asian kitchens. It is the custom of every South Asian housewife. This is true irrespective of family status - whether belonging to the rich, middle or poor class. The only difference is the way they cook - whether using an electric rice cooker, gas cooker, kerosene stove or smoky fire wood stove. Cooking rice has not been considered a burdensome or costly activity until recently. Space limitations and high population density have forced many women including poor housewives living in urban areas to use expensive energy for cooking - such as electricity. The National Engineering Research and Development Centre of Sri Lanka (NERDC) has developed a biomass rice cooker in response to these energy needs to provide a more viable alternative.



1kg of rice can be cooked in 40 minutes using the shell of just 1 coconut (Photo courtesy of NERDC)

As the world energy crisis aggravates, the spiraling cost of household cooking energy affects the family economy adversely. Increasing oil prices in the world market has severely impacted the economy of developing countries such as Sri Lanka that depend heavily on imported fuels. In such a situation, one of the practical solutions for the problem is to develop innovative appropriate technologies to compete with high cost energy applications such as electric and gas cookers.

The domestic type biomass rice cooker unit consists of the following 5 main components:

1. Insulated hot box
2. Small chimney
3. Fuel container
4. Primary container
5. Rice container

The photograph above illustrates the main components of the cooker. As described in the summary, the shell of one coconut crushed into small pieces, is put into the fuel container and ignited on top. Then the fuel container is rotated and placed underneath the insulated main hotbox. The small chimney helps to provide a good upward air flow for smoke free complete combustion. One tea cup (about 200 ml) of water is poured into the outer container which ensures distribution of heat within the rice container and prevents over-heating and burning of rice.

The biomass rice cooker was specially developed to cook 1kg of rice at a time, using the shell of 1 coconut which is daily discarded or under-utilised by any coconut consuming family in the Asian region. This cooker is a technology developed and owned by the NERDC.

In addition to cooking rice, it can also boil up to 3L (litres) of water, boil any kind of grain, potatoes etc., and has the ability to keep cooked food warm for more than 7hrs without having to add any more fuel.

Rice, with the correct amount of water, is put into the rice pan, closed with the lid and placed inside the outer container, which is hit by the direct flame from underneath. Trapped water between the two containers (the rice pan and the outer container) becomes steam and provides the necessary heat for cooking. As no direct flame hits the rice pan, over-cooking and blackening of the rice container do not occur. One of the main features of this technology is that intense heat is generated by combustion of fuel during the first 10 minutes of operation. This provides the necessary heat for cooking and the heat capacity which lasts during the slow cooking period (for 30 minutes). A special layer of high heat capacity material has been used for the bottom area of the outer container.

Why use high quality fuels for low thermal requirements?

Cooking is a low thermal requirement. Once the temperature reaches boiling point, all that is required is to maintain the temperature above 70 degrees for completion of cooking. It is inappropriate to use a high quality energy source like electricity or LPG for such a low grade thermal requirement.

Importantly, South Asia is an agriculture-based region where there is a good potential for biomass. For instance, Sri Lanka, South India, Maldives Bangladesh etc. are high coconut consuming countries. As a result, the coconut shell and husk are often wasted or under-utilised especially in urban areas where rich and poor alike use LPG and electricity for cooking. The biomass rice cooker is an improved version with a nice appearance, for use in a modern kitchen, with improved convenience in operation. With these improved levels of appearance and convenience, this cooker is suitable for use in urban areas, competing with LPG and electrical cookers.

Technology development, field trials, and testing of the biomass rice cooker have been completed by NERDC, and the technology has now been transferred to outside manufacturers for production and marketing. At present it is available in the market in small quantities. Recently, the Government of Sri Lanka identified this item as a highly important product to be promoted as one of the solutions to the energy crisis. NERDC is currently taking the necessary actions to popularise this technology throughout Sri Lanka.

Demonstrating the use of the biomass rice cooker

Features

- Fuel is almost free
- Can cook 1kg of rice using the shell of 1 coconut
- Cooking time is 40 minutes
- No blackening of the rice pan
- Can keep rice warm for 7hrs
- Can boil up to 3L of water
- Can boil 100 nos of string hoppers

D.M. Punchibanda is a research engineer attached to NERDC. He has been involved in developing biomass technologies for about 20 years. This article describes his latest biomass technological improvement.
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e PAPERS

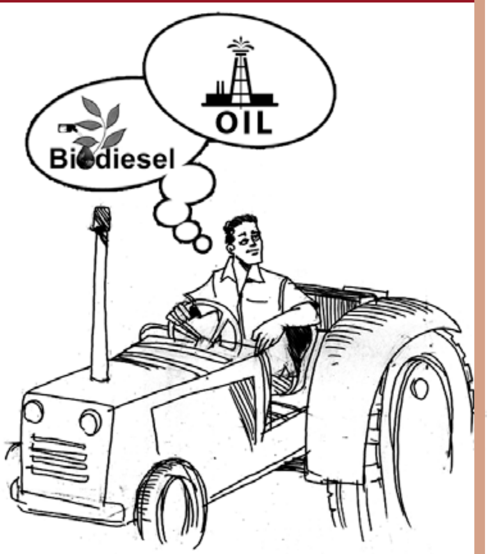
e-net welcomes articles for the next issue which will focus on **'Energy for Rural Transport'.**

Articles should ideally be based on actual case studies and look at the implementation/ potential implementation of a specific technology using community participation.

The length of the article can range from 1500-2500 words (inclusive of footnotes and references). Illustration, graphs, tables, and photographs are welcome (with sources acknowledged). Please include a brief description of the author and the organisation s/he represents.

Articles chosen for publication in the **e**-net magazine will be subject to editing. Contributors should make themselves available for any clarifications that may be necessary up to the point of publication.

Please e-mail all articles to e-net@sa-energy.net by 30th September 2008.



BIOMASS BASED BIOGAS (3B) PLANTS

By Dr. H N Chanakya

Between the mid-eighties and mid-nineties, at the peak of biogas plant dissemination efforts in Asia and especially India, it was found that biogas plants were a boon to rural women. It improved quality of life and removed drudgery - but the quantity and pattern of cattle dung availability could support only 10% of the required number of plants. The biomass based biogas (3B) plants evolved at the Centre for Sustainable Technologies (CST, formerly called ASTRA) was a response to the need for a non-dung based biomass plant. The following article provides a detailed description of this form of 3B plants which will provide gas for cooking and lighting while also providing households with revenue generating opportunities.

Construction of a 3B masonry vault with collapsible mould (Photo courtesy Dr. Chanakya)

Major research efforts were launched around the world in the mid-eighties and mid-nineties to evolve biogas plants for non-dung biomass feedstocks. Most of such biogas plant designs attempted to emulate the cow-dung based digestion in the form of a slurry and most of them failed because biomass feedstocks usually float and gave various operation or efficiency problems. A few groups however, attempted radically different designs that bore no resemblance to the traditional cow-dung based biogas plants. A few of these efforts employed alternative fermentation techniques and principles. The biomass based biogas plants evolved at the Centre for Sustainable Technologies (CST), has been a result of such efforts directed to rural Asia. It is a next generation and emerging technology because firstly these plants use new material as feed, and secondly it attempts to give greater benefits than merely biogas and compost as is given in conventional cattle dung based biogas plants. It is also an emerging technology in the sense that the biogas plant designs are still being tried out and the most ideal one is yet to be identified. Nevertheless, this particular plant design has now been tested for over 5 years in continuous operation before being disseminated.

A keystone technology

Biomass based biogas plants convert all forms of decomposable and easy to compost agro residues and other similar plant biomass (feedstock) to biogas in specially designed biogas plants. Any mix of fresh biomass feedstock needs to be fed on a daily basis and digested feedstock needs to be removed on a daily basis. Biomass feedstocks may be fed 'as found in nature' without the need to powder or convert it to a slurry - no pre-treatment is required. Further, these biogas plants need to be fed only biomass on a daily basis and there is no need for cattle dung or water on a daily basis. The plant needs to be started by adding the required bacterial population chosen from sewage sludge, biogas plant outlet slurry or even dilute cattle dung only on the first day (just as a household makes curds by borrowing a little curd from the neighbour only on the first day). After start-up, these plants will run without the addition of a single gram of cattle dung for years in a row. All normal biogas applications are possible with biogas generated from biomass – gas composition, namely 60% methane and 40% carbon dioxide is the same as is found with cattle dung based biogas plants. The digested waste is lignin rich and humus like manure that can be applied to soils straight away.

With this technology, the spread of biogas technology need not be limited by the availability of animal dung in households. By not being dependent on animal dung as feed, the extent of spread of biogas plants will be limited only by the availability of the feedstock - biomass. In the earlier dissemination programs for biogas plants, two outputs were shown; namely the biogas as fuel, and manure. New research has enabled the new biogas plants to produce many more useful and saleable outputs. These can therefore be the anchor to many outputs, sources of revenue and livelihood and thus may be called a 'keystone' technology. Digested biomass feedstock gives good mushrooms, vermi-compost, rooting medium while being excellent compost. The digester liquid (is not found as a slurry) may be used as a pest repellent against sucking insect pests.

Surplus gas is easily converted to electrical or shaft power through dual-fuel or 100% biogas engines, used to kill stored grain pests in grain silos, used as primary fuel for fuel cells, etc. Such biogas plants can thus be operated not only to provide biogas and manure but also for a variety of revenue/livelihood earning avenues which can be derived from it, making them attractive to end users.

What can be fed into a 3B plant

All simple to degrade plant biomass and agro-residues that will normally be digested to compost within 60 days are suitable for biogas production as well. This includes land weeds such as parthenium, eupatorium, grasses, agro-wastes such as sugarcane trash, bagasse, paddy straw, maize cobs, etc. horticultural wastes such as garden trimmings, hedge trimmings, fruit and vegetable wastes, uprooted flowering shrubs and herbs, etc. non-edible oilseed cakes, such as that from pongemia, castor, Jatropa, etc. oil seeds. This biogas plant can also accept small quantities of biodegradable domestic and kitchen waste. Highly lignified wastes such as coconut shells, coir pith, tree bark, saw-dust, paddy husk etc. are not suitable for conversion to biogas. Such lignified materials will not harm the digestion process if small quantities of indigestible material are added inadvertently. Cattle dung should be added to this plant only at the start and never on a daily basis. Adding cattle dung to a biomass fed plant will result in a stratification of the fermenting mass and digester liquid into 2 clear layers and the suppression of gas production.

Biogas production from different feedstock varies significantly, so much so that providing a single value of potential biogas production, as provided for cattle dung, is often very difficult. However, as a rule of thumb it may be convenient to assume the following: Green leafy and herbaceous materials, that have about 85% water, generally yield 50-60 litres biogas per kg of the feedstock fed to the plant (kitchen wastes predominantly containing fruit and vegetable wastes also produce gas similarly). In the case of dry residues, the gas production would be in the range of 300-450 litres/kg dry feedstock. It is ideal to feed this biogas plant only green biomass or a mix of green and dry biomass. Feeding only dry biomass feedstocks for extended periods of time (>3 months) lowers the gas production from the biogas plant and could also make spent feed removal marginally difficult.

How it works

The biogas plant is designed to hold the fermenting biomass for a period of about 35 days, just as in the case of animal dung based biogas plants. It must however be remembered that due to the presence of some form of short circuiting of flow, it is possible that a part of the biomass spends a time shorter than desired and another part a longer time than 35 days. Ideal retention time is achieved only when the biogas plant is fed as per design specification on a daily basis and the spent material is removed from the digester on a daily basis. When digested material is not removed frequently or on a daily basis, biomass within becomes compacted and does not allow biogas to move upwards and instead leaks out of the inlet or outlet, and very little gas is collected in the biogas storage drum provided. This digester works on the principle of integrating a pre-treatment step into a predominantly floating layer type of decomposition. Biomass fed freshly into the digester is restricted from immediately floating because the previous day's feed is in the way. In this way the feed is held submerged for a period of 3-5 days under the digester liquid. In this period, a lot of simple to degrade material is removed from the biomass, becomes soluble compounds, diffuses through the digester liquid and is converted to biogas. When this happens a large number of decomposing bacteria get access to biomass and are trapped within spaces left from the early decomposition. The decomposing bacteria now attach themselves to these places and begin to decompose the leaf biomass. At this stage, because of a gradual movement towards the outlet, biomass begins to float inside the digester. However, because of the presence of the trapped bacteria, biomass continues to digest in the floating state. When digested feed is constantly removed from the outlet by manual extraction, this makes place for the next older material to move into the place just vacated.

Unlike other biogas plants, digested material needs to be manually removed to achieve continuous fermentation. This technique has been the key innovation in this digester and is responsible for the achievement of continuous fermentation. A figure depicting the manner in which material is found within the digester is shown below.

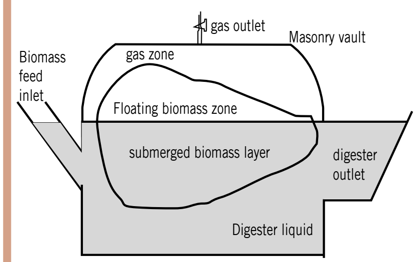


Figure 1: A sketch of the biomass based biogas plant showing various parts and zones within the biogas plant and its role in decomposing biomass
(Diagram courtesy Dr. Chanakya)

Different levels of degradation

The level of degradation achieved in a continuous digester like the above, varies significantly among feedstocks. This value of conversion could range between 45 - 98% of added degradable solids. For a dry feedstock like fallen eucalyptus/ acacia/syzigium leaves, the extent degraded can be as low as 45% and for an easy to decompose feedstock, such as paper mulberry leaves, fruit and vegetable wastes, etc. the degradation can be as high as 98%. On average, most biomass feedstocks degrade to the tune of 60% in a biogas digester. When the decomposition level is higher, most of the material is converted to biogas and there is very little compost recovered. This is common in the case of food and kitchen wastes. In the case of leaf litter, the extent of decomposition could be as low as 45% and therefore most of the added material is recovered as compost from the outlet.

The 3B tank

These biogas plants are constructed as long and shallow rectangular tanks where one end acts as an inlet for biomass feed and the other end as the outlet for digested biomass feed. This tank is covered by a masonry vault that is built with bricks and cement mortar. The biomass fed from the inlet suffers submergence for about 7 days and subsequently rises above the digester liquid and continues to move towards the outlet. Manually extracting the digested biomass ensures space is made for fresh feed to be fed. In this way

Plant with precast ferro-crete vault and simplified inlets
(Photo courtesy Dr. Chanakya)

continuous operation is achieved. Conventional biogas plants operating on animal dung require about twice the fermenter volume compared to its daily gas production capacity when planned for an average ambient temperature of 25°C. This means a small 2m^3 plant would occupy about a 2m diameter and some space for inlet and outlet. The conventional animal dung based biogas plants are designed as deep digesters that are oriented as vertical cylinders and sometimes as a sphere (Chinese types). A typical 2m^3 biogas/day plant would have a digester volume of 4m^3 and a foot print area of about 66 sq. ft. (6m^2). The biomass based biogas plants on the other hand would occupy about 84 sq. ft. (8m^2). While fixed dome plants will have only their inlet and outlet exposed, the biomass based biogas plants will have their inlet, outlet and gas storage device exposed. Sometimes even the biogas plant will be exposed.

Gas production capacity and household requirements

The daily biogas requirement is generally measured as litres of biogas required per capita and expressed as litres or cubic metre per head per day (m^3/cap/d; 1m^3 = 1000 litres). In typical rural families, cooking is carried out only twice daily and some of the biogas is used for lighting using mantle lamps. While planning a Gobar gas ('Gobar' is dung in Hindi) plant it is assumed that the per capita biogas requirement would be 0.25m^3/d wherein 0.2m^3 is used for cooking and 0.05m^3 is used for lighting mantle lamps. However, it is important to use the family as the unit of planning in determining the quantity of gas or size of plant to be constructed. No special value is used for calculating gas requirement when children are present in the family. Above 3 years of age, all children are considered and counted as members in the family. Currently plant sizes that have been standardised for use are in the following gas production capacities, namely, 1, 1.5, 2, 4, 8, 15 and 30m^3 of gas production per day. For convenience of understanding it is important to note that the gas production capacity on a daily basis is almost half of the total liquid holding capacity of a biomass based biogas plant.

'Continuous type'

The biomass based biogas plant is a continuous type, which means that it produces a specified volume of biogas on a daily basis. To achieve this, the biomass based biogas plants are fed a specified quantity of biomass daily which is measured on a wet (fresh) or dry weight basis. Without a constant and daily input of biomass feed there will be a lower quantity of digestible material within the digester and the rate of daily biogas production will fall gradually. On average, and unless otherwise specified, these plant designs can accept 1.6-2kg dry biomass feedstock or 10-12kg fresh biomass per cubic metre of digester volume.

A 3 cubic metre biogas per day plant
(Photo courtesy Dr. Chanakya)

This feed rate is arrived at from the key limiting factor that only between 250-300kg of wet mass can be held per cubic metre of biogas plant. The plant is designed for an approximate solids retention time of 35 days. There is very little advantage of holding biomass feedstocks longer in the reactor. Biomass feedstocks are fed in an intact and 'as found in nature' state. Biomass feedstock as found in nature needs to be pushed into the reactor through its inlet. Therefore only the size of the inlet pipe limits the maximum size of the biomass feedstocks that can be fed into the reactor.

Maintenance

There are very few maintenance needs for a biogas plant other than its daily feeding and spent feed removal. In this biogas plant only biomass feedstock is fed on a daily basis – it need not be mixed with water as is done in a cow-dung biogas plant. When there is a gradual evaporation of digester liquid from the inlet and outlet of this plant, the water level needs to be maintained such that the gas inside the reactor does not escape from the inlet and outlet. As soon as the liquid level in the biogas plant falls 25mm below the recommended level, it may be topped up by adding water into the outlet until the level is brought back to the required level. Unlike the earlier floating drum plants made of mild steel (MS), there is no corrodible part in the construction of this biogas plant. Therefore it does not need frequent painting to maintain it corrosion-free. Along with biomass a small extent of mineral matter such as clay and sand inadvertently gets into the digester along with the feedstock. This accumulates in the digester along with some sludge and may need to be emptied once in 3-4 years. This is usually achieved by lowering the water level in the digester till there is no free floating water within. The settled digested biomass is then scooped out and piled in such a way that the freshly fed digester contents reach the top of the temporary pit. A few days later (<5 days), the partially decomposed biomass is fed back into the digester and the remaining volume is filled with water. The presence of an adequate number of bacteria adhering to biomass obviates the need to use a fresh inoculum of bacteria during such a cleaning process. The down time for initiation of gas production is as low as 3 days for the above conditions.

The 3B plant modified for garbage. Each module takes 0.5 tons feed (Photo courtesy Dr. Chanakya)

Continuous development of the 3B technology

Large biogas plants similar to the above biomass based plant designs were first disseminated for treating urban solid wastes. Many large plants of similar designs were also developed and disseminated for dual use of coffee wastewater treatment as well as use with leaf biomass on coffee plantations. After this experience, small plants for domestic level operation have been evolved and are being disseminated in India. The long term operation of a few biogas plants have also been evaluated to enable using brick masonry vaults as the ideal material and shape for the biogas plant roof. While construction of the reactor portion has been found to be quite easy and simple, the construction of the brick vault requires some skill and training. Biomass based biogas plants are about 50% more expensive than its equivalent of cattle dung plant. Attempts are also being made to evolve low cost designs for various soil conditions. Biogas is a clean energy source and when there is adequate gas, biogas may be used for cooking using biogas burners as is done for other biogas plants. However, the best outcomes from such plants can be achieved by exploiting all the avenues indicated above for revenue/value addition. The technology needs to now be tried out at a variety of locations and operating conditions so that newer versions suiting dissemination and location specific needs could emerge.

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An 8 m^3 biomass based biogas plant under commissioning trials, operated largely with parthenium as the main feed. A larger biogas bag was used to store the biogas produced and when needed to be transmitted to houses, a weight was placed on the bag to increase the line gas pressure. This plant could not be operated for long due to a shortage of biomass at the village. (Photo courtesy Dr. Chanakya)

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RURAL ELECTRIFICATION THROUGH MICRO-HYDRO IN BHUTAN UNDER THE KYOTO PROTOCOL CLEAN DEVELOPMENT MECHANISM (CDM)

Submitted by the e8

The inhabitants of the remote village of Chendebji, nestled in the Himalayan Kingdom of Bhutan, are now enjoying the benefits of clean, modern electricity generated by a micro-hydro power station built by the e8. The 70kW run-of-river type facility was inaugurated in August 2005 in the presence of officials from the Bhutan Department of Energy and the National Environment Commission.

Project inauguration ceremony, Chendebji, Bhutan, August 2005 (Photo courtesy of e8)

The project, carried out in close collaboration with the Royal Government of Bhutan, local authorities and villagers, was registered under the Kyoto Protocol Clean Development Mechanism (CDM) in May 2005, as the first CDM project for both the Kingdom of Bhutan and the e8. The first Certified Emission Reduction credits (CERs) resulting from the project CDM registration were validated in January 2007 and 474 CERs were issued in April 2007. These CERs were shared between the Royal Government of Bhutan and the e8.

The small-scale hydro power station is located on the Lamchela River, at 2,500 metres above sea level in an area of steep mountains approximately 150 km from the country's capital, Thimphu. The run-of-river type facility generates an output of 70kW and supplies electricity to households, a dispensary and a school in the village of Chendebji. The project aims to promote rural electrification in the Kingdom of Bhutan, where the electrification rate remains as low as 35%.

During public consultations held in Chendebji in 2003 and 2004, the villagers expressed their desire to have access to electricity and explained that they had witnessed the economic development brought about by electrification in other villages in Bhutan. Access to electricity brings major improvements to the lives of the villagers, including:

- Lighting to allow studies and cottage industry activities, such as weaving, after sunset;
- Better health conditions by reducing indoor smoke from firewood and kerosene use;
- Powering of the local dispensary and medical devices;
- Decreased firewood collection chores, allowing more time for agriculture and other income-generating activities;
- Access to new electric-based learning devices,including television and computers, to facilitate education for children and adults.

For the development of the project, the e8 conducted an environmental impact assessment and drafted the design and construction works. A Bhutanese contractor, Bhutan Engineering Company, was selected after an international call for tender and began construction in August 2004.

Construction plans respected the villagers' traditional land uses for farming and animal husbandry. The powerhouse was built in the traditional Bhutanese style. At the request of the villagers, excess energy produced by the plant will be used to heat water which will be made available, at the powerhouse, to all the village's families. Finally, additional transmission/distribution lines were added to the original project scope to ensure electrification of several remote houses and a local temple.

To further reduce the use of wood for cooking and heating, the e8 has facilitated the purchase of rice cookers and water boilers for each household in the village. Not only do these actions have a positive impact on the health of particularly women and children, who spend many hours a day in poorly ventilated houses with open fires, it also frees up time spent in gathering wood.

Upon commissioning in August 2005, the project entered a two-year monitoring phase. Environmental, socio-economic and technical monitoring activities were undertaken by Bhutanese institutions under the guidance of e8 experts to ensure maintenance and sustainability of the hydro-power station.

To date, 50 households in the village have been connected to the power station, affording the local community better quality of life. The onset of electricity generation contributed to the development of small enterprises, including a store and a restaurant built near the village, all contributing to the local community's development.

The e8 is a non-profit international organisation, composed of 10 leading electricity companies from the G8 countries, whose mission is to play an active role in global electricity issues within the international framework and to promote sustainable energy development through electricity sector projects and human capacity building activities in developing and emerging nations worldwide.
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Website: www.e8.org

IMPROVED WATER MILL, A MEANS FOR SOCIO-ECONOMIC DEVELOPMENT IN RURAL NEPAL

By Bhupendra Shakya/ Mahendra Chudal

There is strong relation between energy consumption and development. Nepal is a country which has low energy consumption levels, having an energy per capita of 14.8 GJ which is amongst the lowest in South Asian countries. The Improve Water Mill programme featured in this article works towards improving the efficiency of the Traditional Water Mills increasing their efficiency and performance levels, and thereby benefiting rural millers and users.

Women operating an Oil Expeller coupled in a IWM
(Photo courtesy of the IWM Programme, CRT/N)

Energy is the basic need of human life. It is necessary for daily survival and a requirement to sustain and improve people's living standards. At present the main sources of energy that have been used to meet the energy demands are through conventional (fuel wood, agricultural residue and animal dung) - 87.71%, commercial (petroleum, coal, electricity) - 11.76% and renewable energy sources (micro hydro, biogas, solar, etc.) - 0.53% (Energy Synopsis Report: Nepal, 2006) in Nepal. Commercial energy sources are out of the reach of the rural people because of a fragile economy, absence of physical infrastructure and lack of opportunities. Hence, rural people are highly dependent on less efficient traditional sources of energy such as fuel wood, agricultural residue, and traditional watermill for cooking, heating and agro-processing needs. In order to balance between the possible environmental degradation and growing demand of energy there is a need to promote and mainstream renewable energy in the rural context. Some of the renewable energy technologies being promoted in the country are solar, micro/pico hydro, improved water mill (IWM), biogas and improved cook stoves etc.

It is estimated that there are more than 25,000 existing Traditional Water Mills (Ghatta) being used (for centuries) as an energy source. Among them more than 90% can be improved to provide diversified services in rural areas. IWM is an intermediate, simple and indigenous technology that increases the efficiency of traditional water mills resulting in increased energy output thus helping both the millers and its users. Technically, it can be categorised under impulse type turbine and is suitable for low head (5 to 15 m) and high flow (30 to 80 litre per second). The possible power generation from the IWM is up to 3 kW taking overall efficiency of 50%. The improvement covers basically the replacement of wooden parts (rotor and shaft) with metallic parts and can be manufactured locally by using local expertise and resources (which are designed differently with engineering practice). IWM is not limited to traditional agro processing works e.g. grinding of grains, as it provides facility to diversify the range of services such as paddy-hulling, paddy de-husking, rice polishing, saw-milling, oil expelling, lokta[1] beating, chiura[2] making, etc. Furthermore, it offers the opportunity to generate electricity for lighting and operating communication devices such as TV, radio, computer and other household appliances.

[1]Lokta: Skin of the plant used for hand made paper
[2]Chiura: Beaten rice instantly edible, popular in villages for snacks

In addition to fulfilling household demand for electricity, the IWM helps the owner to start up a micro enterprise at local level by using generated electricity and available motive power to run the different machines in processes such as saw milling, oil expelling, etc. The IWM users are known to be from the poorest strata of society and socially excluded groups. 73% of them are from various ethnic groups and Dalits, while 27% are from other relatively better off people of the society (CRT/N, 2008).

With the objective of improving livelihood of traditional water mill owners and local community users, mainly women, the IWM Programme has been implemented in 16 hilly and mountainous districts of Nepal since 2003. The Programme has been supported by the Government of Nepal (GoN) through Alternative Energy Promotion Centre (AEPC) and Government of Netherlands through SNV/Nepal. The Centre for Rural technology, Nepal (CRT/N) implemented the Programme. The Programme has Service Centres, Manufacturers and Water Mill (Ghatta) Owners' Associations (GOA) as the main service providers. The Programme has so far been able to improve around 4000 watermills (Data Analysis from Project Completion Certificate (PCC) report, June 2008) during the programme period from 2003 to June 2008. The Programme has helped to uplift the economic and social status of ghatta owners and their customers, especially women, particularly from indigenous, dalits and marginalised groups. Women and children are getting direct benefits from this initiative by saving their substantial time in agro processing and reducing their drudgery. In this way IWM is being used as a sustainable rural energy source that meets the diversified energy needs of rural people. A success story on water mill improvement is presented below.

Ram Bahadur Dangols'daughter busy at work with Chiura (beaten rice) making (Photo courtesy of Mr. Bhupendra Shakya)

Mr. Ram Bahadur Dangol, and his wife Mrs. Seti Dangol, are residents of Thanapati - 7, Nuwakot district (three hours drive from Kathmandu) – and have 3 children. Previously Mr. Dangol had two traditional water mills at the same stream, named Likhu. The income from these two water mills was nominal as they were engaged only in cereal grinding, which was inefficient. Within the framework of the IWM Programme, they were contacted by the local Service Centre which offered to improve one of their traditional water mills. Mr. Dangol and his wife were convinced and decided to take up this offer. In October 2006, they improved one of their water mills with Long Shaft[3] and installed chiura (beaten rice) Beater, Saw Mill and Rice Husker.

Thanapati village is rich in production of rice, wheat and maize. The village has 400 households. The village had no other option of paddy processing services except electric and diesel mill. The cost of processing by electric and diesel mill is expensive i.e. 1.4 times more expensive than using IWM processing. Mr. Dangol installed IWM with a provision of end uses with the subsidy support of Nepal Rupees (NRs.) 18,000 from the IWM Programme and credit support of NRs. 100,000 (@ 12 % per annum) from Agricultural Development Bank. His total investment for the improvement activities was about NRs. 198,060. After the improvement of the water mill (Ghatta), most of the customers of diesel mill and electrical mill have started to visit IWM in order to process their agricultural products as well as to get sawing services. The main reason why it attracted more customers was due to cheaper service cost than diesel and electric mills. Other reasons behind the preference were longer product storage period, better taste of the product and less risk of damage of chiura if the electricity goes off mid-way of processing in electric mill etc.

From the operation of IWM, the socio-economic status of Mr. Dangol's family has improved. The annual income has increased from NRs.17,250 to NRs.140,500 with an annual net profit of NRs. 44,452. The earned money from IWM was utilised for better food, education and health for the family members. Part of it was also used for loan repayment (about NRs.25,000 has already been paid to the bank). The social status of the owner has been changed from "Ghattera[4]" to "Entrepreneur". His neighbours are happy with the services provided by his mill. The legal status of his water mill has been changed to cottage industry by registering the IWM into Small and Cottage Industry Development Committee. Mr. Dangol is also very happy that his wife has become one of the Executive Members of the district level GOA, Nuwakot, and has received training on Association Management. She has been participating in GOA meetings regularly. The children have been getting better opportunities for study They occasionally help their father in the operation and maintenance of the water mill during their free time. The IWM has created an additional full time job for one person and part time job for 4 persons including two women.

Mr. Dangol is planning to provide more services to his neighbours by installing an oil expeller in his IWM in the near future. He expressed his gratitude to IWM Programme for the support provided.

[3]Long Shaft mainly for end uses other than grinding

[4]Term used for low skilled labour class water mill (Ghatta) operator

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Water and Energy Commission Secretariat, 2006 Energy Synopsis Report: Nepal, Government of Nepal,

Database analysis from baseline study unpublished report of Centre for Rural Technology (CRT/N), 2008

Database analysis from Project Completion Certificate (PCC) report Centre for Rural Technology (CRT/N) as of June 2008,

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USAID/SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY (SARI/ENERGY) BRINGS THE TOPIC OF ENERGY TO HOMES

Submitted by USAID

A U.S Agency for International Development (USAID) SARI/Energy workshop on clean and efficient energy for South Asian women put new emphasis on the unique role of women in the household energy sector. The "Women in Energy" workshop provided women working in the energy sector from the region an opportunity to exchange ideas on how women can help conserve energy and use renewable energy at home. South Asia currently has an electricity supply deficit of up to 30%. Energy conservation measures and renewable energy are measures that can help to bridge the gap.

The workshop spurred interest and participants unanimously agreed for increased interaction on the subject and will soon begin an 'online communication system' for facilitating discussions and interactions among the network. A South Asia Women In Energy (SAWIE) Network has been formed to take the message and actions forward. Four Working Groups were formed focusing on (a) Renewable Energy Technologies/Green Architecture (b) Capacity Building/Best Practices/ Information Sharing (c) Gender Streamlining and Auditing (d) Micro Financing and Income Generation. A follow up workshop is planned to be held in Bangladesh in early November 2008.

The workshop was sponsored by USAID/SARI/Energy, and organised by PA Consulting Group, with the knowledge partnership of Energy Management Center (EMC) Kerala. The 5 day workshop held in April 2008 in Trivandrum/Kerala/India was attended by approximately 32 women delegates from the South Asian countries including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka; and the U.S. Participants were from the government sector, private sector and NGOs.

Women assembling a thermal cooker during a site visit for the "Women in Energy" workshop (Photo by Reba Paul, Bangladesh Renewable Energy Association)

For information on the workshop, please contact Mercy Thomas: methomas@usaid.gov.
Please visit SARI/Energy website: www.sari-energy.org for details and proceedings on the SAWIE workshop.

EVENTS

Workshop on Biofuels

Date: 22 – 27th September 2008
Venue: Dambulla, Sri Lanka
Hosted by: Sri Lanka Sustainable Energy Authority

This workshop will impart training to selected participants from SAARC member states to help them acquire hands on experience on the application of the latest available bio-fuel producing technologies from available resources or those to be developed within the region.

For further details contact Sri Lanka Sustainable Energy Authority, Tel +94 (0) 11 2677445, Fax; +94 (0) 112682534, e-mail info@energy.gov.lk.

Conference on 'Financing for Climate Change - Challenges and Way Forward'

Date: 15 - 17th August 2008
Venue: Dhaka, Bangladesh
Organised by: Unnayan Onneshan, Dhaka, Bangladesh

The conference will discuss both traditional and innovative approaches for, and dimensions of, financial mechanisms relating to climate change adaptation, mitigation and technology. It will bring together academicians, researchers, managers and planners from government and private sectors across the globe to find sustainable Climate Financing options to ensure environmental sustainability and ecological justice.

Further details available on www.unnayan.org .

Renewable Energy India 2008 Expo

Date: 21 – 23rd August 2008
Venue: New Delhi, India
Organised by: Exhibitions India Pvt. Ltd.
Supported by: Ministry of New & Renewable Energy Government of India, GTZ
Knowledge Partners: United Nations Educational, Scientific and Cultural Organization and Ernst & Young

Renewable Energy India (REI) 2008 Expo is India's showcase to display innovations in the renewable sector. A global business exhibition and conference on wind, solar photovoltaic and thermal, hydro and bio energy sectors, REI 2008 Expo showcases opportunities in the Indian market, and encourages global suppliers to showcase the potential of power generation using renewable resources.

Further details available on http://www.renewableenergyindiaexpo.com/ or e-mail rajneeshk@eigroup.in

International Conference on Energy for Sustainable Development 2008

Date: 10 – 12th August 2008
Venue: Dawood College of Engineering and Technology, M.A.Jinnah Road, Karachi- Pakistan
Organised by: Dawood College of Engineering and Technology, and COMSATS Institute of Information Technology

This Conference is aimed to provide a forum for professors, researchers, policy makers, investors, professionals in the industry and other stakeholder to share the latest research and innovations and review achievements and shortcomings relevant to the international efforts to counter looming energy crises and future direction for enhancing the global energy security, focusing on developing countries with special emphasis on Pakistan.

Further details available on http://www.dawoodcollege.edu.pk/conference.html, or e-mail Mr. Abdul Wahid Bhutto at awbhutto@dcet.edu.pk or abdulwaheed27@hotmail.com.

THE WAY AHEAD IN HOUSEHOLD BIOMASS ENERGY

By Nusrat Habib

Biomass or bio-fuel (fuel wood, twigs, cow dung) is the biggest source of household energy, especially for use in cook stoves or ovens (Tandoor) in South Asia. However, in such usage a high portion of energy is wasted. Certain stakeholders initiated programmes in an attempt to prevent excessive use of biomass. This article gives a few examples of the premature programmes in the agriculture based economy of Pakistan. It emphasises that the cookstove and oven technology should be introduced in a manner which is conducive and responsive to the needs of the users and through appropriate marketing channels. The article also projects the need for emerging technology for community based Roti making

Cook Stoves

Cook stoves which use different energy sources (ranging from biomass and biogas to kerosene and natural gas), are available in various designs for community or household use. Stoves designed by an expert are optimally designed and can save a reasonable amount of biomass, as understood through experiments at the Regional Office, Pakistan Council of Renewable Energy Technologies (PCRET), Peshawar. Field tests on stoves of various designs were carried out by PCRET for cooking 1.25 kg pulse, and revealed that the chimney-coupled two-pot soil stove is fuel and time saving when compared with other design soil stoves (as given in the data below).

Given the frequency and intensity of its use, a reasonable amount of biomass can be saved with alteration in cookstove designs. Certain state leaders and stakeholders in Pakistan have made efforts to conserve biomass. However, these have not achieved the desired goals, due to cultural barriers, cooking habits, and biomass availability coupled with the fact that stove designs have not incorporated user needs.

The Fuel Efficient Cooking Technologies (FECT) Project (established by GTZ in late 1980s) for the improvement, development and dissemination of stoves and ovens, disseminated 25,000 Multi-pot Steel Stoves (MPS) in North West Frontier Province and Murree and Gujar Khan tehsil of Pakistan. In his opening address at the seminar on 'Environmental Awareness Raising in Pakistan' (1999), Cornie Huizenga, Team Leader, FECT said that "in the past our Project disseminated a stove (MPS) which in the laboratory had a fuel saving of almost 60%. Twenty five thousand (25,000) of these stoves were sold. However, when we looked after some time how many stoves were really being used, it turned out that only 2,500 (10%) were used. This illustrates very well the point that a target group has to understand the technology and the reasons why the technology can be of benefit to them". Regarding the same stove, the author of this report found no such stove, even with the main stove dealers in Khawaza Khela and Hangu (the ex-FECT Project areas) during her visit in 2005. The reason was inferred to be that the MPS could not compete with the indigenous stoves (steel stoves) of Pakistan, referred to as traditional stoves by the donors.

After making an evaluation of the Inagi-II stove of the Regional Wood Energy Development programme in 1995, in Sri Lanka, Dr. Habib Gul (of PCRET) attempted (with the assistance of his colleagues and a potter), to introduce and disseminate this technology in some parts of Swat District in Pakistan, where rice is the main dish for dinner. However, the stove could not create a place for itself in the area due to differences in diet and biomass availability.

This is why Clarke (WoodStoves Dissemination, 1985) says "it is increasingly recognised that it is not just the design of the stove that matters, but also the way it is disseminated or promoted". There is a marked tendency in recent stove programmes to move away from free or heavily subsidised distribution of stoves through direct intervention, towards the use of normal marketing channels.

Oven

The Tandoors (ovens) at household level also consume excessive energy but a more efficient alternative technology has not yet been developed, as far as the author knows. Bellerive Foundation's (Switzerland) project to disseminate a tangible bakery design in Afghan Refugees Camps with the assistance of United Nations High Commissioner for Refugees (UNHCR) and other donors in the 1980's was handed over to FECT, before it was discontinued. The bakery design recommended by Bellerive Foundation and FECT was also not useful in Pakistan after FECT assessed that it did not conserve fuel.

Field Marshal Muhammad Ayub Khan, President of Pakistan (1958-69) was interested in reducing the wastage of fuel in the household preparation of Roti (bread) and conserving fuel through community Tandoors/bakeries. Ayub Khan's dream was brought into reality by Zulfiqar Ali Bhutto in 1973, the then President/Prime Minister. Twelve large sized bakeries, based on modern technology, were established in the country's biggest cities for supplying cheaper Roti. However, it was shocking to learn after a few days experience that the large size energy conserving bakeries could not compete

Fuel and time consumed by Different Designs Stoves

S.No.	Description	Single-pot chimney attached band stove	Single-pot chimney-less traditional stove	Two-pot non band chimney-less stove	Two pot chimney attached Stove,
1.	Fuel Wood consumed (Kg)	1.825	2.75	1.50	1.100
2.	Time taken (minutes)	70	120	73	75

SOUTH INDIAN STOVE BUSINESS WINS 'ENERGY CHAMPION' TITLE IN INTERNATIONAL GREEN ENERGY AWARDS

Source : www.ashdenawards.org

On 19th June 2008, at a ceremony in London, the world's leading green energy prize awarded the top accolade of 'Energy Champion' to Technology Informatics Design Endeavour (TIDE). The Ashden Awards prize of £40,000 was presented to Svati Bhogle, Chief Executive of TIDE, by Kenyan Nobel Prize laureate Wangari Maathai.

Many of South India's small businesses rely on wood as their main source of fuel, which causes pollution and deforestation, besides unhealthy working conditions when boilers and stoves are badly designed. Building on the track record of stove design at the Indian Institute of Science, TIDE disseminates efficient woodstoves and kilns which save at least 30% of fuel and are tailor-made for specific small industries. To date 110,000 workers enjoy better conditions thanks to the 10,000 products TIDE has supplied, saving around 43,000 tonnes of wood each year.

Founded in 2001 by the Ashden Trust, one of the Sainsbury Family Charitable Trust (SFCT) the Awards are an internationally recognised yardstick for excellence in the field of sustainable energy. They are aimed at celebrating and rewarding

Svati Bhogle from TIDE with HRH the Prince of Wales
(Photo courtesy Ashden Awards)

visionary champions who are finding solutions to climate change that are also bringing real social and economic benefits to their local communities.

Sarah Butler-Sloss, founder and chair of the Ashden Awards said, "Our judges were impressed that TIDE provides much-needed support to small businesses across Southern India, assisting a sector that is often overlooked and involving them in the design of affordable, practical and appropriate technology. TIDE's stoves and boilers are highly fuel-efficient, improve working conditions and bring great environmental benefits, as well as saving money. The scheme has huge potential to expand, and the Ashden Awards is delighted to be supporting TIDE in bringing these manifold benefits to thousands more small industries."

His Royal Highness The Prince of Wales, Patron of The Ashden Awards, personally congratulated this year's Ashden Awards winners at a separate meeting. A Clarence House spokesperson said, "The Prince of Wales was deeply encouraged to learn of the solutions demonstrated by the Ashden Awards that can reduce our dependency on a carbon economy. His Royal Highness was particularly impressed by the local sustainable energy initiatives recognised and promoted by the Awards, which not only meet the needs of communities, but tackle climate change and further sustainable development."

Further information on the 2008 Ashden Awards international finalists (including case studies) can be obtained from www.ashdenawards.org

e-net warmly congratulates TIDE on its outstanding achievement.

THE WAY AHEAD IN HOUSEHOLD BIOMASS ENERGY (contd. from page 17)

with traditional tiny bakeries. This and the increased popularity of baking Roti in tiny household bakeries saw the failure of all the large sized bakeries, which were scrapped after some time.

It is important that people realise the external benefits of conservation - the protection of natural resources, positive impacts on biodiversity, indirect increase in farm productivity (reflected in the increasing number of cattle) and the reduced chances of landslides, erosion and heavy floods. While many of the earlier programmes to design energy conserving cook stoves and ovens have had their technical problems (the design of good stoves is not as simple as it was at first thought) several recent programmes, such as the Kenyan Improved Jiko (a charcoal burner), and the Ouaga Metallique in Burkina Faso have developed successful second generation technologies. Viable cook stove and oven technology which respond to the socio-economic requirements of the users should be introduced after adequate research and using appropriate marketing channels to avoid the wastage of resources. It is in this manner that technology should be introduced into areas where previously they have not been used.

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e-FORUM on www.sa-energy.net, June 2008

The first e-discussion on our **e**-net forum had many commentators forwarding their viewpoints on the current energy crisis and its effects on South Asia. The crucial question was whether **we, energy professionals, are ready to address the information needs in Renewable Energy (RE)? Do we have the required information, mechanisms to disseminate the information to all interested groups, and strategies of doing it?** The contributors highlighted how pressing the issues are, and how we need to act with urgency, communicating key messages and practices to a wide audience - ranging from students, communities, technocrats and policy makers.

Below is a summary of the key ideas that were discussed:
Our work in the energy sector must take into consideration two fundamental issues; 1) there is a large population in South Asia that has no access to basic energy, and therefore needs priority attention 2) there is a small but wealthy population within the same region that consumes the majority of the power that is generated.

Suggestions raised for overcoming these issues –
a) develop, use and invest in alternate energy sources (preferably RE generated using the resources we have in the Region)
b) promote reduction and conservation of energy through efficient energy management
c) more government investment and commitment to mitigating energy poverty
d) intergovernmental cooperation within the Region
e) pursue Private sector partnerships that have benefits over loans from International Financial Institutions which carry heavy interest.

Other key points:

• Energy Equity - Equity in energy implies reaching a sustainable level of energy usage by all. This means we need to provide sufficient access to poor communities and also reduce demand by high energy users.

• Setting a per capita minimum energy requirement -There is a need to have clear indicators to identify the 'energy poor', and targets and strategies to provide them with energy access to meet basic needs.

• What do we mean by development? Is the current crisis due to a cultural factor, people's expectations and existing energy use patterns? We are perhaps heading in the wrong direction with 'development', and should learn how to live with less energy. A counter argument was that our countries still need energy to keep up with industrialization to secure jobs for the poor. Industrial development would require large amounts of energy, and concern was raised on whether RE can provide price-competitive and feasible energy alternatives.

• A common grid for South Asia was recommended for consideration by the SAARC leaders. However, South Asian countries need to first provide 'energy access for all' within their own borders, before channeling energy outside.

• Caution on current and future Research & Development was made, with recommendations for R&D to concentrate on promoting energy efficient lifestyles and environmentally friendly technologies rather than high energy consuming technologies.

• Inputs of a wide variety of actors are essential to the energy debate to help us understand energy issues from the perspectives of politics, international relations, globalization, global governance, sociology and psychology etc.

Key messages:

• Energy is not only about electricity – 'energy' also means access to food, clean water, education, and medical care etc.

• Do not wait until others begin to save energy. Begin by changing your own practice, today.

• We need to educate younger generations on energy and environment, and pass on sustainable technologies and efficient energy usage to them as soon as possible.

• We need proper Leadership and collaboration to deal with the energy crisis. We should set targets for the whole region, to plan and act collectively. Let us attempt to pass on our message to the SAARC leaders at the next summit to be held in August 2008 in Sri Lanka.

Thank you to all those who participated in the e-discussion. Let's keep the dialogue alive!

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