Biogas Sector Partnership Nepal 2005

the Ashden Awards for sustainable energy

Domestic biogas for cooking and sanitation

Summary

The Biogas Sector Partnership (BSP) in Nepal managed the installation of over 124,000 domestic biogas plants in Nepal between 1992 and 2005. The plants use cattle manure to provide biogas for cooking and lighting. In addition, about 75% of the plants incorporate toilets.

About 80% of the 4.2 million households in Nepal use fuelwood, cattle-dung cakes and agricultural residues for cooking, and kerosene for lighting. Demand for fuelwood substantially exceeds the rate of regrowth, and this is leading to degradation of the land and damage to vital watersheds. Cooking indoors over open fires, and lighting with kerosene, gives dangerous exposure to air pollutants and a high risk of fire, particularly for women and young children who spend much of their time indoors. In addition, women and girls have the drudgery of collecting fuelwood, which typically takes three hours each day.

The Ashden judges commended this project for the many benefits which it provides. The biogas plants replace nearly all the use of fuelwood, and make cooking easier, cleaner and safer. In 20% of houses biogas provides safer lighting as well. This saving of unsustainable fuelwood use also reduces carbon dioxide emissions. The provision of toilets improves sanitation; and the effluent from the biogas plant is a valuable organic compost.

The use of cattle dung to generate biogas is well known in the Indian subcontinent, but in no other place has it been used with such success as in Nepal. The scale of the programme is remarkable. Biogas already serves about one million people (4% of the population of Nepal), and the biogas sector provides about 11,000 permanent jobs in the country. If anyone needed to be convinced that 'small scale can be big' then they need look no further! The Ashden judges also recognised the excellent collaboration between different organisations (BSP, government, construction companies, donors, finance organisations) in order to achieve such outstanding results.

The organisation

BSP is a non-governmental-organisation (NGO) which was established in 1992 to manage the biogas programme in Nepal. Its prime roles are to provide training to users and biogas companies, ensure quality and long-term reliability of plants, and manage the programme of subsidies to assist users with the purchase of plants. BSP does not itself install biogas plants, but accredits the work of private installation companies, and this approach has enabled the private biogas sector to thrive. BSP has an independent executive board and currently employs 30 staff, including 14 professional staff. The main funders are the governments of the Netherlands (SNV), Germany and Nepal.

Contact name: Saroj Rai, BSP, Nepal
Email: srai@bspnepal.wlink.com.np

Website: www.bspnepal.org.np, www.biogasnepal.np

Technology and use

Biogas systems take organic material such as manure into an air-tight tank, where bacteria break down the material and release biogas - a mixture of mainly methane with some carbon dioxide. The biogas can be burned as a fuel, for cooking or other purposes, and the remaining material can be used as organic compost.

The design of the digesters used in this project was developed in Nepal based on the Chinese fixed-dome plant. The digester is built in a pit in the ground, near to the house. The body of the digester is an underground cylindrical tank, built from bricks and mortar. The fixed hemispherical dome, which acts as a gasholder, is made from concrete, cast over an earth mould on top of the tank. The inlet to the digester is a cylindrical brick-built tank with a hand-operated rotator, used to mix cow dung and water which is fed in through a pipe. The current designs of digester need the dung from at least two cattle (24 kg per day) to function properly. Villagers are used to handling cattle dung and using it as a fuel, since it has traditionally been made into flat dungcakes, dried and burned on the cooking fire. All digesters are supplied with a second inlet pipe to connect to a toilet. Even if this is not initially used, it is available so that a toilet may be added later.

The manure and toilet waste are decomposed anaerobically (without oxygen) by bacteria in the digester and produce biogas, which is a mixture of mainly methane (60-70%) and carbon dioxide (30-40%). The gas is piped to the kitchen inside the house, where it is used for cooking on specially-designed burners, and sometimes for lighting as well. The gas pressure pushes digested effluent out from the base of the digester into a reservoir tank, from where it is collected and used as fertiliser.

The digesters are made in four sizes, with total volume from 4 to 10 m^3, and each produces between 1.2 and 1.5 m^3 of biogas per day. The capacity and gas production depends on the number of cattle supplying dung, and also on the location of the biogas plant. In cooler places gas is produced more slowly, and a larger volume tank is needed.

BSP have also provided design guidance and other advice for the installation of around 100 larger (50 m^3) biogas plants in schools and hospitals in Nepal.

How users pay

A 6m^3 plant costs between £170 and £220 (21,000 and 27,000 Nepali rupees). The variation in cost depends on the location of the plant, since additional costs are incurred transporting materials and building plants in the more remote, hilly areas. The subsidy programme managed by BSP is designed to correct this difference by providing higher subsidies to families in more remote locations, so all owners of 6m^3 plants have to pay the equivalent of £120 (15,000 NR).

About one third of this is paid in kind, through the family providing labour and materials for the installation of the plant. The remaining £80 is still a significant amount of money in Nepal, but it is an amount that people are willing to pay because they have seen the long-term benefits which the biogas plants bring. Crucially, it is also easy to get finance for biogas plants, because they are regarded as a safe investment in Nepal, and over 80 banks and micro-finance organisations will provide loans for them. Most families pay back their loan within about eighteen months: those who previously purchased fuelwood will have saved more than the cost of the biogas plant within this time.

Training and support

There are many examples of programmes elsewhere where biogas digesters have been installed and later abandoned. The involvement of BSP has enabled the biogas sector in Nepal to function and grow successfully.

On of the main roles of BSP is to provide training and quality control. Since the project started, over 6,000 people have been trained in plant construction, and 120,000 users have been trained in operating biogas plants and minor repairs.

Installations are undertaken by about 61 private construction companies, and BSP provides quality control by monitoring constructions and accrediting and paying a subsidy to companies which perform well. The cost of the biogas plant (above) includes a three-year guarantee period when free maintenance has to be provided by the installation company, which is another incentive to install high-quality plants at the start.

The combination of good installations, affordable finance, support and quality checking have led to very high success rates for biogas plants in Nepal: BSP commissioned independent research which showed that 97% of the plants installed under the BSP programme are still in operation.

Benefits of the project

A major benefit from the programme is the reduction in the consumption of fuelwood. BSP estimate that the average rural household of 7 people uses about 3 tonnes of fuelwood per year for cooking (1.2 kg/day per person), so the plants installed to date save the use of about 375 000 tonnes per year. There is visible evidence of forest regrowth in Nepal, brought about mainly by an active programme of tree planting, and also by the reduction of unsustainable use through the biogas programme.

Fuelwood collection takes considerably more time than collecting and mixing dung. Research commissioned by BSP found that a households with biogas plants save an average of 3 hours per day. This time saving has a huge impact on the lives of women and girls - women use the extra time for income generation like weaving, for farm work and for education. BSP received a letter from one schoolgirl telling them that "I am the first pupil in my region to get 1st division in the national examinations. This is because since we have had a biogas plant I have had the time and the light to study in the evenings."

Fuelwood and, in particular, cattle dung-cakes are very polluting fuels when burned on open fires indoors. Women and children are exposed to high levels of carbon monoxide, particulates and unburned hydrocarbons. Biogas is probably the cleanest cooking fuel available in rural areas, producing even less local pollution than liquefied petroleum gas (LPG), and substantially less than fuelwood and dung. This has enormous benefits to health, and also leaves the kitchen much cleaner. Biogas stoves are very easy to control, and give less risk of burns and accidental fires, because the stove is turned off as soon as cooking has been completed. About 20% of households use some of the biogas for lighting, instead of kerosene lamps. These provide better light, avoid the kerosene fumes, and prevent the risk of fire from lamps which are knocked over.

Linking toilets to the biogas plants gives a minor increase in biogas production, but significant health benefits. Education in hygiene can also be given as part of the general training in the use of the biogas plant.

Each plant produces about 1.75 tonnes of organic compost each year, which owners use to replace the use of chemical fertiliser and improve soil quality. Some of the compost is sold - it can even be bought in a department store in Kathmandu! The compost can also be used for fish-food.

There are substantial savings in emissions of greenhouse gases. The major saving is from preventing the unsustainable use of firewood for cooking, also from the use of kerosene for lighting and for some cooking. There are minor savings in the production of nitrous oxide (N_2O - a very active greenhouse gas), because of the reduced use nitrogen-based fertilizer. However, although methane emission from manure and sewage disposal is avoided, there is overall a small net increase in methane emission, because of unburned methane in cooking and leaks from plants. BSP estimate a net reduction of 4.7 tonnes/year of CO_2 equivalent per plant, or 660 thousand tonnes/year for the plants installed to date.

The technical and management training provided by BSP have led to the development of a real private biogas business sector in Nepal. There are over 55 construction companies, 15 biogas appliance manufacturers and 80 finance institutions involved in the biogas sector, providing over 11,000 long term jobs.

There is huge potential for expansion of the use of domestic biogas, in Nepal and many other countries. BSP have ambitious expansion plans for Nepal. On their estimates, about 2 million households in Nepal could potentially use biogas plants, and about 1 million of these would be economic under the current subsidies. Their present phase of funding which runs to 2009 will covers the installation of an additional 190,000 plants, which will bring the total installed by BSP to over 313,000. A negotiation is being held with World Bank to sell 1 million tones of CO_2 by which BSP will generate about 5 million US$. The fund will be utilised for continuation of the programme beyond 2009.

BSP would like to bring the benefits of biogas to more people. Some families do not have the minimum of two cattle, some places are too cold for the anaerobic digestion to work effectively, and other places do not have a reliable all-year water supply for mixing with the manure. BSP has worked on technical solutions to all these problems.

Management, finance and partnerships

The role of BSP is to coordinate the biogas sector in Nepal, provide training, initiate evaluation studies and manage the subsidy programme. The 'partners' in this work are the many installation companies and microfinance organisations which have the security to operate because of the services provided by BSP. BSP is funded through the governments of Nepal, Germany and the Netherlands.

Use of the Ashden Award

BSP wanted to further increase the use of biogas plants in Nepal, but one of the main barriers to doing this in certain regions is the seasonal availability of water. To solve this problem, BSP developed a rainwater harvesting system that can be built using similar techniques to the biogas plants and can supply water to operate a toilet and also for drinking, using a filter. The waste from the toilet goes directly into the biogas plant, thereby supplying the necessary additional water for correct operation. Water can be drawn from the reservoir for other purposes and can also be added directly to the biogas plant when necessary.

By the summer of 2006, BSP had completed more than 50 biogas plants with the combined rainwater harvesting system, and almost 200 were under construction. This has been achieved despite political unrest in Nepal and the early arrival of the monsoon rains, which limited the availability of labourers and usability of some roads. A key challenge that remains is to reduce the cost of the system, as even with a subsidy the cost is higher than some families can afford. BSP is working intensively to raise awareness of the benefits of biogas plants and the integrated rainwater harvesting systems to ensure potential customers can see that the investment cost is worthwhile. The Ashden Award has helped fund subsidies for customers installing biogas plants with the integrated rainwater harvesting system, and has also been used to provide training and monitoring for the masons who build the plants.

In addition to its work with rainwater harvesting systems, BSP has also facilitated an increase in the number of installed biogas systems from 124,000 to 150,000 since it won the Ashden Award.

This report is based on information provided to the Ashden Awards judges by BSP; on findings from a four-day visit by one of the Ashden judges to see the work of BSP in Nepal; on discussions between BSP and the Ashden judges at interview; and on presentations by BSP at Ashden Awards seminars.

Dr Anne Wheldon, Technical Director of the Ashden Awards, March 2006.