

# **Shaanxi Mothers China 2006**



the **Ashden Awards**  
for sustainable energy

## **Fuel, compost and sanitation from biogas in rural China**

### **Summary**

The Shaanxi Mothers' Environmental Protection Volunteer Association (Shaanxi Mothers) is led by its founder Mrs Wang Mingying. It has installed 1,294 biogas plants in rural farming households in the Shaanxi Province of China since 1999. The plants produce biogas from pig and human waste.

The extensive use of wood and coal that has helped to fuel China's rapid economic growth has led to serious environmental damage. In Shaanxi Province (west China), soil erosion on the hillsides is widespread and springtime flow in the rivers has diminished to a fraction of the 'normal' flow. Erosion leads to dust storms and poor outdoor air quality. The use of coal and wood on open fires produces significant pollution. Faced with these problems, the Chinese Government has restricted tree-felling and ordered the re-forestation of the terraced hillsides. Farmers are paid to plant trees and ensure that they survive, and are encouraged to keep pigs. Subsidies are provided to encourage the use of biogas.

Shaanxi Mothers promotes the use of biogas plants connected to the pigsties. These plants provide clean fuel for cooking and lighting, improve sanitation and hygiene and help prevent further environmental degradation. The solid residue from the plants is a valuable fertiliser. Users pay about one third of the cost of the plant which can be covered by the savings they make on fuel and fertiliser within one to two years. Subsidies from the government and Shaanxi Mothers provide the remainder of the cost.

The Ashden Award to the Shaanxi Mothers' Environmental Protection Volunteer Association recognises the tremendous commitment of a small volunteer organisation in bringing the health and environmental benefits of biogas to rural communities in China.

### **The organisation**

Shaanxi Mothers was set up in October 1997 under the control of Shaanxi Women's Federation and is a registered NGO. It has 1,200 association members, a 59-person Board of Directors and a Standing Board of Directors who manage routine matters.

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## Technology and use

In Shaanxi, most pigs are reared in pigsties. Pig waste, combined with human excrement from a toilet can be fed into a biogas plant. Bacteria digest the slurry under anaerobic conditions (without oxygen). The decomposition yields biogas (which typically consists of 60-70% methane and 30-35% carbon dioxide) and a semi-solid residue. The biogas can be burnt to produce heat for cooking or used in lamps. The residue makes excellent fertiliser.

The biogas digester is constructed in a pit which is excavated by a Shaanxi technician with assistance from a member of the household. The body of the digester is an underground cylindrical tank which is built very carefully from bricks and mortar by the technician. The fixed hemispherical dome, which acts as a gasholder, is made from concrete. The pigsty is built over the biogas digester, with the toilet in the house immediately adjacent to it, so that the pig and human waste can be sluiced directly into the plant.

The biogas is piped into the house and connected to a stove for cooking, a lamp for lighting and occasionally a water-heater for showers. Most biogas digesters have a volume of 8m<sup>3</sup> (some are 10-15m<sup>3</sup>) and provide enough gas for a two-ring stove and a light. Biogas appliances are made in several parts of China and can be ordered and delivered to Shaanxi.

Users must stir the slurry frequently, to ensure the bacteria reach all the material and to avoid very high concentrations of digestion products. Water must be added to the pig and human waste so that the slurry can flow easily while maintaining a total solids concentration of 6-8% in summer and 10-12% in winter. The acidity (pH) of the digester is monitored regularly to ensure that the volatile fatty acid concentration does not become too high. For optimum results users must add cow dung periodically as it contains the right anaerobic bacteria. This usually has to be purchased from neighbours or traders.

Annual cleaning and minor repairs are carried out in October and the pigsty is insulated at this time, which helps to keep both the pigs and the biogas digester warm in winter. However the gas production falls off for one or two months during the coldest part of the winter.

This type of biogas digester was developed by Professor Qiu Ling of Northwest Agriculture and Forest University, Yangling, Shaanxi. The project started in May 1999 and by March 2006 it had installed 1,294 biogas plants in 18 counties of Shaanxi Province. The technology has also been adopted in rural areas of Jiangxi, Shandong and Sichuan provinces of China.

## How users pay

At the time of writing (July 2006) 15 Yuan = UK£1 = US\$1.8.

The price of the biogas plant varies from 3,500 to 4,500 Yuan (£220 - £300), depending upon its size and features (such as a shower). The user typically pays one third of the cost of the system in labour and cash. The user contribution depends on the level of support from central and local government which varies from place to place but is typically one third of the cost. The final third is contributed by Shaanxi Mothers which raises funds from NGOs, some overseas government bodies (especially the German Embassy), friends and fund-raising activities.

In Yanan the local government also encourages farmers to rear pigs with a 'buy one, get one free' offer. This enables farmers to continue to earn an income from farming when they are no longer allowed to grow crops in the hills.

The demand for biogas plants is strong and there is currently insufficient money to offer subsidies to every family that applies. The village authorities (generally, the local party secretary and elected village headman) decide who should receive financial support. Selection is based on the number of people who will benefit and whether they have at least four pigs and space to look after them. It is also essential that the user is literate.

## **Training and support**

Experts from the Shaanxi Mothers train local technicians in each village on how to install, service and maintain the plants. The Shaanxi Mothers teach villagers how to use the biogas, maintain the plants and maximise the use of the slurry to increase crop yields. Plants should last for at least 15 years if they are used with care.

## **Benefits of the project**

The disposal of human and animal waste in a biogas plant can have major impacts on human health. Shaanxi Mothers records that the density of flies in houses with biogas is 64% lower than in houses without and even lower in pigsties. The digester prevents effluent from seeping into the groundwater which reduces levels of pathogenic bacteria.

Less fuel wood and coal is needed for cooking and heating (although most people with biogas still prefer to cook bread dumplings in solid fuel ovens). Shaanxi Mothers estimates that a household which replaces fuelwood with biogas saves about 1.5 to 2 tonnes of wood per year, equivalent to three entire trees. The use of biogas greatly improves the quality of air in the home, reducing the concentration of carbon monoxide (CO) by about 74%, sulphur dioxide (SO<sub>2</sub>) by 74% and dust by 77%, according to a survey carried out by the Shaanxi Mothers. Most homes have mains electricity, but appreciate the financial savings from the 'free' biogas light.

The solid residue from the biogas plant makes useful fertiliser which is applied to fruit trees and vegetable plots. Biogas plants (or the pigs which supply manure to them) can also be used to dispose of fruit and vegetable waste from households.

Biogas is available at the point of use and is literally 'on tap'. This saves time collecting wood and in preparing fires for cooking. Users enjoy being able to prepare a meal much more quickly using biogas and not having to endure a smoky kitchen. Women have used the time they save to work in the fields, make clothes for their children or spend time with friends and relatives.

A biogas plant reduces household expenditure on fuel and fertiliser. One 8 to 10m<sup>3</sup> biogas plant can supply a family of 3 to 5 people with enough gas for 90% of their daily fuel needs for 10 to 11 months of the year. This saves 600 Yuan (£40) per year for fuel (coal or wood), 250-400 Yuan (£17 - £27) for fertiliser and 150 Yuan (£10) for electricity (as a result of having biogas lamps). The use of the output residue from the biogas plant as fertiliser can also increase household income by 2,000 Yuan (£135) due to increased food production. Combined, these increase the average disposable income from around 3,000 to 5,000 Yuan (£200 - £340) per year. Thus the total cost of the biogas plant is paid back within one to two years.

## **Management, finance and partnerships**

Mrs Wang Mingying founded the Shaanxi Mothers Association in 1997, initially to raise money for tree planting projects through the collection of rubbish that could be recycled. Shaanxi Mothers has grown rapidly and has links with the semi-official provincial women's federation but is still an independent NGO. Wang Mingying is responsible for managing the biogas projects and technical training. General Secretary, Mrs Li Cuirong, is responsible for financial management, and Mrs Xue Yanmin is responsible for publicity work. The work of Shaanxi Mothers is supported by local and provincial authorities, individuals, NGOs and donors.

Villagers are involved in the whole project process from initial assessment of a new plant to commissioning. They are encouraged to contribute their ideas and participate in decision making.

Shaanxi Mothers also stage huge tree planting campaigns, many involving children and young people. Since 1997 one million people have taken part in the 'Hand in Hand' project run jointly by the Mothers and the Women's Federation

## **Use of the Ashden Award**

The Shaanxi Mothers intend to use the Award to extend the existing biogas programme. They plan to train a further 62 technicians who will work in the 26 villages where Shaanxi Mothers is already operating and add a further five villages. The Shaanxi Mothers will assist 250 households to install biogas systems in these five further villages. A manual on biogas application in rural households will be written with the help of the North West Forestry Technology University and local technicians. This will help users to trouble-shoot common problems.

*This report is based on information from the application submitted to the Ashden Awards by Shaanxi Mothers Association, findings from a visit by one of the judges to see their work in China, discussions between Wang Mingying and the Ashden judges at interview, and a presentation by Wang Mingying and Chen Xiaojiang at an Ashden Awards seminar.*

*Dr Anne Wheldon, Technical Director of the Ashden Awards Jeremy Rawlings, Technical Assistant July 2006.*

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