COWS TO KILOWATTS, Nigeria:
Turning Waste into Energy and Fertiliser (Note a)

Pilot biogas plant

The consequences of abattoir waste pollution are felt by both humans and the environment. Adverse effects on air quality, agriculture, potable water supplies, and aquatic life negatively impact health and well-being. Poor local communities, in particular, have little choice but to consume water polluted with abattoir waste.

This is also true in Nigeria, where standards regulating abattoir water discharge are poorly enforced and water treatment plant capacity is inadequate. Ibadan, the second largest city in Nigeria with a population of over three million, has experienced rapid urbanisation in recent years, coupled with intensified environmental problems. In the city's Bodija Municipal Abattoir, where nearly two-thirds of the animals in Oyo State are slaughtered[26], the wastes from the slaughtering process are currently rinsed into open drains that connect to surface water and percolate into groundwater. Abattoir waste carries high levels of disease-causing microorganisms, such as Salmonella, Escherichia coli bacteria, and Rift Valley fever virus. Hence, the Global Network for Environment and Economic Development Research (GNEEDR) discovered in 2000 that the effluent from the Bodija River downstream from the abattoir had BOD values (biochemical oxygen demand, an indicator of organic pollution) that far exceeded the national threshold for food processing industries. The communities located downstream from the slaughterhouse were particularly affected, as they used the polluted river water for domestic purposes, like washing and sometimes even for consumption.

Building partnerships for sustainable solutions

The Global Network for Environment and Economic Development Research (GNEEDER), an NGO, the Centre for Youth, Family and the Law, a community-based organisation, and the Sustainable Ibadan Project, a quasi-governmental organisation joined forces to find a solution to this problem. The initial idea was to construct an effluent treatment plant, which would treat the abattoir waste, thus preventing it from polluting the surface and groundwater sources. While the partnership was highly innovative and feasible, the critical problem was that, while solving the problem of water pollution, the effluent water treatment plant was creating another. Decomposing organic material releases methane and carbon dioxide (CO^2). While CO^2 is a primary culprit in climate change, methane is 23 times more potent than CO^2.[27]

Therefore, it was decided to consider an alternative solution: employ biogas technology, which converts biological waste into energy and simultaneously helps to improve the quality of life, livelihoods, and health. Biogas technology, which is used worldwide by about 16 million households through small-scale biogas digesters[28], will transform the waste produced by the abattoir into low-cost household cooking gas and organic fertiliser. The local partners, in conjunction with a technology institute in Thailand (the Biogas Technology Research Centre of King Mongkut's University of Technology Thonburi, KMUTT) decided to design, construct, and operate a biogas plant in Ibadan. This plant will be one of the largest biogas installations in Africa, providing gas to 5,400 families a month at around a quarter the cost of liquefied natural gas. The pilot biogas plant which is under construction is scheduled to be in operation in May 2008.

The methane produced by the anaerobic digestion of abattoir waste has several end-use applications. In the form of biogas: it can be used domestically (for cooking, heating, and cooling), to generate electricity, and as biofuel for transport. The partners' initial idea had been to use the biogas to generate electricity. At a rate of 1,000 cows slaughtered per day, the plant would generate approximately 3,600 KWh of electricity per day. Given the high capital costs of a biogas-fired generating plant, it was decided in the end to use the gas for cooking. The option is particularly attractive in Nigeria, where the demand and price for cooking gas has been increasing steadily (Note b).

UN Photo/Fred Noy

The Ibadan system will employ a sophisticated design known as an anaerobic fixed film digester. Properly designed and used, a biogas digester mitigates a wide spectrum of environmental undesirables and it provides a high-quality organic fertiliser. It improves water quality, mitigates greenhouse gas emissions and reduces the demand for wood and charcoal for cooking, therefore helping preserve forested areas and natural vegetation. A well-maintained digester can last over 20 years and will pay for itself in one-fifth that time. But for the developing world, the greatest benefit of biogas may be that it can help alleviate a very serious health hazard: poor indoor air quality.

The estimated capital cost of the project is US$480,000 which includes costs for the construction and design of the plant. The United Nations Development Programme (UNDP) in Nigeria is providing full funding for the biogas plant. The project business plan calculates that the biogas plant, operating as a business enterprise, will achieve a return on investment within approximately two years. It is estimated to have a useful lifetime of fifteen years, but its actual service lifetime may well exceed that.

About 1,000 cows are slaughtered at the Bodija Market abattoir on a daily basis, which would provide 1,500 cubic metres of biogas (900 cubic metres of pure methane) per day. This, in turn, amounts to 5,400 cylinders of cooking gas per month. A sales point could be established at the Bodija Market. Cooking gas could be sold at US$7.50 for a 25-litre cylinder, well below the current market price for cooking gas (Note c). This low price is explained by the fact that the abattoir waste generates "almost free" raw materials for biogas production (Note d). The sludge from the biogas reactor, transformed into organic fertiliser, will be sold to the Oyo State Fertiliser Board, a governmental agency that markets fertiliser. In turn, the fertiliser could be sold to urban low-income farmers at a reduced price of US$1 for 10 litres, about 5 per cent of the standard price of chemical fertiliser in Nigeria.

Producing progress with pilots

Plans are underway to replicate the project in 6 other major Nigerian cities. The funding would be provided by UNDP in partnership with the Nigerian Federal Ministry of Environment based on the successful implementation of the pilot biogas plant. The 'Cows to Kilowatts' team has been contacted by other African countries including Cameroon and Ghana for advice on replication.

The partnership has also received international recognition and several awards. It was a 2005 winner of the Supporting Entrepreneurs for Environment & Development (SEED) Awards (Note e), which honour locally-led, innovative entrepreneurial ideas for sustainable development worldwide. Other awards include the Global Social Benefit Incubator Program (GSBI), Santa Clara University, California, USA (July, 2006); feature of Cows to Kilowatts at AFRICA LEADS (June, 2006); feature of Cows to Kilowatts in World Economic Forum publication (September, 2007).

From abattoir to energy. A biodigester converts slaughterhouse waste into energy and solves two environmental problems—unhealthy waste and a need for clean energy—at once.

Note:

a. The Cows to Kilowatts Case study has been written with guidance from Dr. Joseph Adelegan, the Founder and Executive Director of Global Network for Environment and Economic Development Research. Further input has been gained from Valerie J. Brown's article entitled 'Biogas: a bright idea for Africa' in Environ Health Perspective (May 2006)29 and the case study written by GPPI's Elisabeth Heid for the SEED Initiative Partnership Report 200630.

b. On the other hand there is a risk of competition in the cooking gas sector, as the national government is embarking on a liquefied natural gas project. This may, in time, cause a drop in the unit cost of the cooking gas.

c. The price for cooking gas fluctuates (by season) from US$ 25 to $30.

d. The cost of construction is approximately US$ 60 per cubic metre. The figure of US$ 328,000 is for construction costs only, and does not include maintenance or electricity and water connections and charges.

e. The SEED Initiative assists young and promising initiatives in strengthening and scaling up the impact of their activities. This is not a cash award. Instead, a comprehensive package of tailor-made support services, with a value of US$25,000, will be provided to Winners.