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Photo: M. Egbert

Simple technology with a major impact

Biogas in Vietnam is chiefly the story of the success of small domestic digesters. However, a feed-in tariff for electricity generated by biogas plants could soon lead to larger scale use of the technology, and so provide new sources of income for farmers.

Le Thi Thanh Thuy stands among woks, pots and pans on her tiled kitchen floor and points to the pressure gauge on her little biogas digester. The simplicity of the technology is fascinating. A wooden board, a transparent plastic tube full of water and a few markings. "When the pressure in the digester gets too high I have to cook." If she doesn't use the biogas it can escape from the fermenter via a pressure release valve. "But that almost never happens because we always need it all", adds the farmer, who lives in Khanh An village in An Giang province in the Mekong Delta.

Every day Le Thi Thanh Thuy cooks three meals for the family in the kitchen, which also contains beds for her three children. She often looks after her sister's children as well. Yet she never needs to worry that the biogas

will run out. Behind the family's house are four zebu and twenty pigs, which produce around 75 kilos of dung every day, enough to run a biogas plant of almost ten cubic metres. The plant is connected to a pipe running directly from the small cowshed. The dung flows into a brick-built fermenter set in the ground, rendered with grey cement, and from here a gas pipe runs into the kitchen.

The family has not needed to buy gas for the last three years, so saving the equivalent of 150 euros a year. For this they only have to pay back forty euros a year on the loan that they took out for the four hundred euro plant, and have already paid off a third of it. Le Thi Thanh Thuy's husband takes care of the plant's maintenance, but at the moment he is away selling blocks of ice that he has bought from a factory to shops, homes and restaurants. "The income is crucial to supplement our livestock farming", explains Le Thi Thanh Thuy. A saving of around one hundred euros a year from running the little digester is therefore significant for the family.

■ 145,000 digesters installed with government support

"Even really small-scale farmers with two cows or six pigs have enough manure to run a digester that meets their own energy needs", says Pham Thi Hoa, President of the An Giang Bioenergy and Sustainability Association (ABSA). She receives us in the conference room at the Ministry of Agriculture of the delta province of An Giang, together with Nguyen Minh Trang, General Secretary of ABSA. The domestic digesters are being built as part of a government programme with substantial support from the Dutch development organisation SNV. With the aid of grants and low-interest microloans farmers can buy domestic digesters of between six and almost ten cubic metres. To date the programme has enabled 145,000 digesters to be installed in more than forty provinces. One plant helps to save over six tonnes of CO₂ annually. Less firewood is harvested, and contamination of the environment by untreated dung and the use of artificial fertilisers is reduced. That is because the farmers

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can use the fermentation residues to fertilise their fields and gardens.

ABSA has installed 1,350 of these plants in An Giang province alone. To this end the organisation employs a team of 35 tradesmen. Under the programme only spherical brick fermenters are built, although there are other completely different designs as well. A neighbour of Le Thi Thanh Thuy has one of these. The path to Ha Nguyen Vu's home crosses a rickety bridge over one of the countless canals in the Mekong Delta. The pressure gauge on Ha Nguyen Vu's biogas plant is of even simpler construction: it consists of a plastic bottle filled with water and a short piece of tubing. If the pressure in his biogas tank gets too high the water in the bottle starts to bubble. "Tank" is perhaps something of a misnomer: to be more accurate, it is two clear plastic bags shaped like sausages hanging beneath Ha Nguyen Vu's wooden hut, which is mounted on stilts. The methane in the bags is fed in from a pit, draped with the same plastic sheeting, beside his pigsty. In this way, five cubic metres of dung, all produced by the ten pigs that are dozing in the heat in the shady sty, are fermenting down in the middle of the little garden. A gas pipe runs from the pit through forage grass and sugar cane to the two tanks beneath the house. "The tanks are needed to build up enough pressure", explains the smallholder, who also works as a portrait photographer as well as repairing watches and sunglasses for his neighbours. As someone who enjoys making things, he built the biogas plant himself. "I copied what other people were doing." The materials for the plant cost just the equivalent of forty euros, and in fact the only problems he has are with the plastic covering the pit. "I have to replace it every year; either the mice eat it or a hen pecks a hole in it." Ha Nguyen Vu grins and draws on his cigarette.

■ Securing the substrate

Nguyen Vo Chau Ngan from Can Tho University is familiar with problems of this kind. However, the clear plastic "storage sausage" of his pilot



The students at Can Tho University are carrying out research into suitable substrates.

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plant on the campus at Can Tho, the largest city in the Mekong Delta, just droops limply. Fortunately he has students: they laugh as they compress the methane in the tube, so that Nguyen Vo Chau Ngan can still demonstrate how well the biogas burns in the little stove. Yet the scientist and his team are studying far more than this. After all, biogas has been the subject of research in Vietnam since the 1960s. Although this research was halted after the USA's full-scale intervention in the war in 1965, it resumed in 1975, immediately the war was over.

The scientists at Can Tho University have developed a wide range of different designs for domestic digesters, tested them and evaluated their performance in the field. They are also carrying out research into suitable substrates. As well as animal manure, the intensively farmed delta region can provide many other substrates, most notably rice straw and the water hyacinths that proliferate on almost all water bodies. These have to be removed every year to keep the shipping routes and fishponds clear. "Although a lot of households keep pigs or cattle, many only have very few and these are mostly sold for the New Year celebrations", explains Nguyen Vo Chau Ngan, "but then they have no more dung to run the biogas plant." That is why models that can also run on other substrates are needed. However, water hyacinths have to be turned in the digester more often and more thoroughly than dung, for example. And they require a fermenter with a larger capacity. "On the plus side,

the productivity of plants is higher with mixed substrates." If pig manure is mixed with rice straw or water hyacinths the plant produces almost twice as much methane, plus there is an improvement in the quality of the residues used as fertiliser on the fields or as feed in fish and shrimp farming. "We have to make it clearer to people that a biogas digester won't only save them the money for fuel." With suitable microgenerators at the larger microplants electricity could be generated as well.

■ Planning for tomorrow's energy supply

However, electrical energy could be produced by larger biogas plants in Vietnam as well. It is not only in the Mekong Delta that the farmland of Vietnam offers huge potential for animal waste and residues of sugar cane, rice and starch production. In addition to these there is organic waste from the growing landfill sites in the cities and sewage from water treatment works. Ten billion cubic metres of methane could be captured annually from all these sources combined – and the country needs new sources of energy. Vietnam has demonstrated significant economic growth for a number of years: even immediately after the global economic crisis of 2008 it was running at almost six per cent. However, neither the infrastructure nor the energy supply can keep pace with this growth. By 2020 energy consumption is forecast to rise to 330 billion kilowatt-hours per year, representing a threefold increase within ten years. This is in contrast to an installed capacity of 21,542 megawatts. Hydroelectric power provides forty per cent of this. Electricity shortages and power cuts are everyday occurrences in the dry season, and Vietnam will soon have to import fuel to run its coal-fired power stations.

According to the Vietnamese government's 2011 master plan for the national energy supply, 1,700 megawatts would actually need to be added each year to meet the growing demand. Renewables are to play an increasing part in this. By 2020 they

should generate 5.6 percent of the energy supply, which is almost double the 2010 share. The government aims to expand biogas and biomass to 500 megawatts. Despite this, experts estimate the number of larger-scale biogas plants at fewer than twenty. Of these, only a small minority generate electricity. That includes even the state-owned flagship Go Cat Power Plant with its three 2.4 megawatt generators. Most of the time it stands idle and, moreover, the landfill in Ho Chi Minh City that supplies it is set to close.

Many operators simply burn the methane because it is produced during the mandatory treatment of their waste, while others use it to generate process heat, for example in cassava processing and piglet rearing.

■ Cash for energy

Despite all the potential, what the country has lacked until now have been feed-in regulations with payments that make the operation of a biogas plant economically viable. Recently, however, things have changed. Since the middle of 2014 there has at least been a payment scheme for electricity from landfill gas. Although the 7.28 US cents per kilowatt-hour does not altogether meet expectations in the region for the return on capital, any more than the tariffs for wind power or solid biomass, it is at least a start. A feed-in tariff for electricity from digesters at farms and food processing plants is also due to follow shortly. "These initial steps are right and important. We are convinced that there will now be steady market development", says Tobias Cossen from GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), which was involved in designing the scheme. "There are plenty of examples from other countries where over-promotion has led first to a boom and then to the collapse of the market."

Greco Farm's biogas plant is already generating electrical energy. Do Minh Luan takes a run-up and leaps up onto the fermenter. Although the

black plastic sags as he strides over it, it is bulging with enough methane to bear the farm manager's weight – just like a bouncy castle at a children's party. Do Minh Luan slides back down and grins with pleasure. "The plastic can take that." Quite an achievement, considering that it covers a pit 1,800 square metres in area, six metres deep and containing up to 8,000 cubic metres of pig manure. But the farmer is not only pleased with the construction of his biogas plant. "In only two more years we will have recouped two thirds of our investment."

■ Investment quickly repaid

Greco Farm in An Trach Dong in Bac Lieu province in South Vietnam is a family concern, run by Do Minh Nha, the manager's brother. The family only went into business a few years ago with a small shrimp farm. Three years ago they switched to pig fattening, and now keep 4,500 pigs. Most of these are sold to a dealer who transports them to Ho Chi Minh City, so producing a quick profit for Greco Farm.

That is why the family was able to finance most of the cost of the fermenter, equivalent to around 40,000 euros, itself. Second-hand generators manufactured in Japan and America clatter away in the power plant. "So far they have been reliable – they had only been used for 1,500 hours when we bought them", Do Minh Luan shouts above the noise and wipes the

sweat from his brow. With an electricity output of around 600 kilowatts in total the generators ensure rapid repayment of the investment. They operate for approximately ten hours a day, supplying not only the pig farm but more importantly a twenty-hectare shrimp farm nearby. It needs electricity to drive the propellers that oxygenate the densely stocked breeding ponds. "We don't have power cuts like the public grid", says Do Minh Luan. The environment benefits too: Greco Farm used to just tip their manure into a pit and sterilise it with calcium carbonate. Now they can sell the solid residues from the fermentation process as fertiliser.

Greco Farm is soon to expand its electricity generation from biogas. "We are building two more sheds for 3,000 pigs in all." Do Minh Luan, the manager, points to the unfinished buildings, where sacks of cement render are just being delivered. When they are completed there will be enough methane from the pig manure to run the three generators almost round the clock. Already they could be producing energy for eighteen hours a day, but where would it go? The feed-in system into the public grid is still in its infancy, and would require massive investment in the technology. The Do Minh family has other plans. They want to use the methane to drive ice machines directly without having to generate electricity first. That might be their next success story, because the Vietnamese people's favourite drink is beer with ice.



Ha Nguyen Vu's biogas plant is fed in from a pit beside his pigsty. The plastic covering the pit is often nibbled away by the mice.

Photo: M. Egbert