A better life for two million households in Africa through implementation of domestic biogas plants was the ambitious target set at a May 2007 conference in Nairobi, Kenya, organized by the Biogas Africa Initiative. A national programme has already been started in Rwanda, while 10 other countries have started preparations. Wim J. van Nes and Tinashe D. Nhete report.

Biogas for a better life

An African initiative

Unlike Asia, experience with domestic biogas in African countries has been ambiguous. An analysis undertaken by Tinashe Nhete and Christopher Kellner[1] reveals that the exact number of plants installed in Africa is not known but that most units were installed in Tanzania (more than 4000), Kenya and Ethiopia, with hundreds to only a few in other countries. Unfortunately, an estimated 60% of these plants failed to stay in operation. However, other plants succeeded in providing the users with benefits over a number of years and gave evidence on the reliability of the technology if properly deployed.

In most cases, biogas was introduced free of cost through a pilot or demonstration project. Such projects were often implemented through government structures that assumed that the demonstrated benefits of the constructed biogas plants would motivate people to adopt the technology automatically.

However, this approach does not seem to have led to widespread dissemination and market development of the technology. Moreover, most of the plants installed were eventually abandoned. Generally speaking, biogas initiatives in Africa failed to grow from a product-based project approach implemented by a single actor towards a market-oriented programme approach in which various actors co-operate on the basis of institutional arrangements. An exception is, perhaps, Tanzania, where most of the plants in Africa have been built on a semi-commercial basis. But even here, a large-scale dissemination could not be achieved.

TECHNICAL BIOGAS POTENTIAL IN AFRICA

Felix ter Heegde and Kai Sonder made a first assessment on the potential of, and need for, domestic biogas in Africa.[2] The technical potential was defined as the number of households that can meet the two basic requirements – sufficient availability of dung and water to run a biogas installation. Although biogas can be generated from a score of organic materials, in Africa cattle dung from husbandry is best suited to feeding a domestic installation. Biogas can substitute traditional cooking fuels such as wood fuel and charcoal but needs to be produced at a minimum amount of 0.8–1 m^3 daily. To generate this amount of biogas, the household should have 20–30 kg of fresh dung available on a daily basis. For large parts of Africa, zero grazing is not common, and cattle are generally small and undernourished. Therefore most African households would need at least three or four night-stabled heads of cattle to collect sufficient dung. Where cattle urine cannot be collected, the dung has to be mixed with equal amounts of water to enable both the installation's microbiological process as well as the hydraulic functioning. This process water does not have to be of drinking quality but – in view of the significant amount needed on a daily basis – should be available in the vicinity of the household.

Freshwater withdrawal for domestic and agricultural use in Africa ranks among the lowest in the world. In the absence of detailed data on water proximity and availability to

households, 'access to safe water sources' was used as a proxy. Out of a total population of just over 837 million people, Africa has an agricultural population of 455 million. Assuming an average family size of six people, this equals about 76 million agricultural households. Of the total urban population, 85% has access to safe water, but only 50% of the rural population has. Assuming that 80% of the agricultural households are living in rural areas, 43 million agricultural households are expected to have access to safe water.

The total cattle population of Africa amounts to 277 million heads (an FAO figure from 2006), with an estimated 168 million head of domestic cattle. [Note: lacking official data on the share of the total cattle population that is at least night stabled, it was assumed that domestic cattle is equal to all dairy cattle (46 million heads) plus a share of the non-dairy cattle (draft animals, local grazing). For an approximation of the share of non-dairy cattle that is night-stabled, a land-use factor based on the ratio of arable to pastoral land area is proposed. With this land-use factor, 122 million heads of non-dairy cattle (53% of the total non-dairy cattle herd of Africa) are expected to be 'domestic'. Based on these assumptions, Africa is estimated to have some 168 million heads of domestic cattle.]

Taking certain other assumptions into account, the technical potential market for domestic biogas in Africa is estimated at 18.5 million households. In absolute figures, most East African countries, except Somalia and Djibouti, show substantial potential. In southern Africa, Zimbabwe and South Africa stand out, but Lesotho would also have a significant scope. Nigeria and, to a lesser extent, Mali and Burkina Faso seem to qualify for large-scale biogas dissemination programmes. For the continent as a whole, 24% of agricultural households would qualify for biogas.

THE NEED FOR DOMESTIC BIOGAS IN AFRICA

The technical potential of domestic biogas is not the sole indicator for successful large-scale introduction of the technology. As biogas has an impact on aspects of energy, environment, agricultural production, socio-economic development, and health and sanitation, (proxy) indicators of these aspect areas have also been assessed. To be able to compare indicators of such different areas, Felix ter Heegde and Kai Sonder calculated a biogas feasibility index (BFI).[2] This index assesses values within an aspect area relative to each other, not unlike the calculation method of the human development index (HDI). From these BFIs, it can be concluded that the need for biogas in Africa, in terms of its potential contribution to development, energy, health and sanitation, and environment, is very great. Africa's status on these aspects is alarming. In this respect, the BFIs provide an indication of what the 'low hanging fruit' are for starting large-scale biogas programmes.

COST–BENEFIT ANALYSIS

Winrock International conducted a financial and economic cost–benefit analysis of an integrated domestic biogas, latrine and hygiene programme in sub-Saharan Africa.[3] The financial analysis provides insight into customer willingness to invest in combined biogas and sanitation technologies by capturing the potential net returns to the household.

Economic analysis of the costs and benefits at the programmatic level provides donors, policy makers and sector experts with the information needed to compare alternative development investments. For the sub-Saharan Africa programme, the financial rate of return was estimated at 7.5% and the economic internal rate of return dramatically higher, at 178%. The difference between these returns reflects the nature of the intervention. An integrated biogas and latrine programme involves significant capital investment and generates expenditure savings (rather than income) while yielding a wide range of economic (rather than financial) benefits, such as improved health, increased availability of potent organic fertilisers, time savings through the reduced drudgery associated with fuel collection, and environmental benefits. The multifaceted nature of these economic benefits has the potential to make progress simultaneously on a number of Millennium Development Goals, thereby significantly improving the lives of rural African households. Women and children in particular have the potential to be the greatest beneficiaries. They disproportionately endure the drudgery of fuel collection and the negative health effects associated with spending hours breathing highly polluted air just to prepare food for their families.

LAUNCHING OF THE AFRICA BIOGAS INITIATIVE

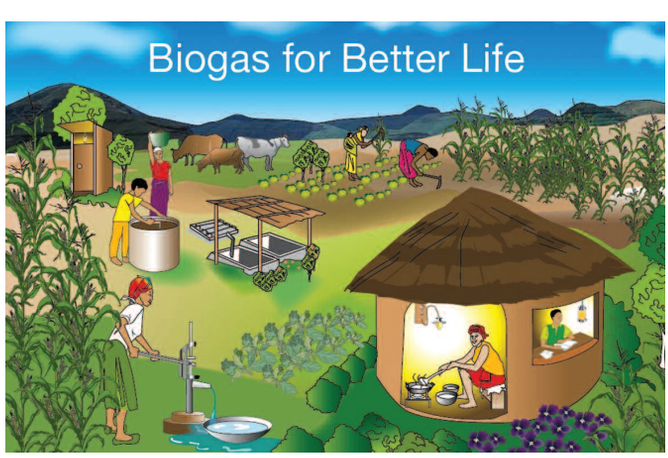
As the various studies turned out to be positive, the partnership decided to take the next step by officially launching the Initiative in Nairobi in May 2007. A total of 135 delegates from 27 African countries attended the conference, while the opening and welcome speeches were delivered by Isaac N. Kiva, on behalf of Kenya's Assistant Minister for Energy Mwangi Kiunjuri, and the Dutch Ambassador in Kenya, Laetitia van den Assum.

The Initiative's business plan was discussed and endorsed at the conference, and two key people were named as Biogas Ambassadors for Africa: Mr Cheikh Modibo Diarra of Mali (Chairman of Microsoft Africa) and Ms Hauwa Ibrahim of Nigeria (a lawyer who successfully defended Amina Lawal from death by stoning).

ENDORSEMENT OF THE BUSINESS PLAN

The conference endorsed the business plan of the Initiative[4] and aims to install two million biogas plants by 2020. The vision

Illustration by the Biogas Africa Initiative



Biogas Ambassadors Cheikh Modibo Diarra (left) and Hauwa Ibrahim (right).

of the Initiative is to succeed in the implementation of biogas technology in African countries as a market-oriented partnership between governments, private sector players, civil society agents and international development partners. The specific targets of the initiative to be achieved by 2020 include:

- two million biogas plants installed (90% operation rate)
- 10 million Africans benefiting in daily life from the plants
- 800 private biogas companies and 200 biogas appliance manufacturing workshops involved or established
- 100,000 new jobs created
- comprehensive quality standards and quality control systems developed and in use
- one million toilets constructed and attached to the biogas plant
- 80% of the bio-slurry used as organic fertilizer
- agricultural production raised by up to 25%
- health and living conditions of women and children improved, and the deaths of women and children reduced by 5000 each year
- drudgery reduced by saving 2–3 hours per household each day in fetching wood, cooking and cleaning the pots
- health costs saved of up to US$80–125 per family, per year
- 3–4 million tonnes of wood saved per year
- greenhouse gas emissions annually reduced by 10 Mtonnes of CO_2 equivalent.

The total financing required is $2 billion, out of which $800 million is to be expected from public funding (national and donors) and the sale of carbon credits. For the latter, the Initiative developed a proposal for a new methodology specifically aiming at the trading of emission reductions from household digesters.[5]

The governing structure of the overall Biogas Initiative is still in progress but should be small, lean and independent. Different staffing scenarios are being looked at before the next conference in West Africa in 2008.

GUIDING PRINCIPLES FOR NATIONAL PROGRAMMES

The Biogas Initiative also developed a number of guidelines that need to be taken into account while preparing and implementing national biogas programmes. Governments are supposed to provide the policy, legal and institutional framework but will not act as implementing agencies. Because it is a programme with many sectoral connections, the government has a specific role in defining the ministerial lines of responsibility and co-ordinating activities related to biogas programmes. The biogas programme should be implemented while taking into consideration business principles: private companies selling biogas installations to households willing to buy.

A clear implementation programme is needed, with well defined roles, responsibilities and decision-making. An implementation agency independent from the government, but with a full mandate to implement the programme, is essential. A sustainable programme should take into consideration all aspects of the introduction of biogas plants: institutional, social, economic, gender, financing, private sector participation, civil society and development agents. Biogas is a service that is broader than just energy supply and a latrine. It uplifts the dignity of women and improves the health and hygienic conditions of families. It will provide trust to the producers and consumers through quality control and guarantees. Biogas needs to be marketed and supported as a symbol and vehicle for socio-economic progression.

The most appropriate biogas technology for the country may be selected. The use of a single design in suitable sizes and the standardization of all products is required. It is paramount to create customer trust in a reliable product. A two-pronged approach may be required: on the one hand, the use of early adopters and influential people in the community and the targeting firstly of those who can pay to develop the market; and on the other hand, the later addressing of those with lower income. The connection of toilets to the digester has multiple sanitation benefits. However, this should not be forced on the users as there can be cultural resistance to cook on gas from human excreta and to apply the bio-slurry that results from it.

The cost of a biogas plant is relatively high for the majority of households in Africa, even for many of those that have cattle. To be able to develop a sustainable market, the national programmes will use a combination of own contribution of the households in cash and labour, credits to households, and subsidy.

The provision of subsidy has many functions. It:

- makes the investment more attractive for households
- gives more confidence at the demand/supply side of the technology
- guarantees quality, the so-called 'carrot and stick'

approach. Companies could be penalized for not complying with quality standards and can even be banned from participating in the programme
- lowers the purchasing price, creates higher demand and helps develop to the market quicker, which – in turn – can lead to a decrease in the price of the biogas installation through competition.

Subsidy will be released to the contractor after the full installation of the plant and acknowledgement of satisfaction by the household. If the subsidy is kept constant, the latecomers – who are mostly poorer – will have to pay less for the installation. The very poor, who can not afford a biogas plant – partly because they do not have any animals – can indirectly benefit as the pressure on dwindling forestry resources is reduced by the biogas programme and because of increasing employment opportunities.

All stakeholders, but especially women, will be involved from the very beginning in the set up of the programme. In most countries, men make decisions about money. However, a biogas plant is a large investment from which women especially benefit. This aspect should be well addressed in the promotion strategy. There should be as much convenience as possible in collecting dung and feeding the digester.

ACTIVITIES IN AFRICA AT COUNTRY LEVEL

Inspired by the Biogas Initiative, many activities are taking place at national level, with Rwanda having already started implementation of the initial phase in May 2007. This consists of the construction of 136 demonstration units in a few potential districts and is financed by the Rwandan Ministry of Infrastructure and the beneficiaries. The Centre for Innovations and Technology Transfer of the Kigali Institute of Science and Technology is implementing this phase with technical support by the Netherlands Development Organisation (SNV) and the Biogas Sector Partnership – Nepal. This phase will be immediately followed by the implementation of the national programme aiming to develop the biogas sector in Rwanda, and to install 14,850 biogas units over a period of four years.[6] The financers of the national programme are the beneficiaries, the Rwandan Ministry of Infrastructure and the Netherlands Ministry of Foreign Affairs (DGIS) through GTZ. The SNV will provide technical assistance.

Apart from Rwanda, identifications and preparations are taking place in Ethiopia (supported by SNV), Senegal (SNV), Uganda (Winrock International), Sudan (Government, ETC/UK, Mr Ahmed Hood), Kenya (ETC/UK), Tanzania (GTZ, Winrock and SNV), Zambia (Practical Action), South Africa (AGAMA), Burkina Faso (GTZ), Mali (ETC) and Ghana (local NGO). DGIS, SNV, Hivos, Shell Foundation and GTZ have so far financed these activities.

THE WAY FORWARD

More than 10 follow-up actions from the conference in Nairobi are to be implemented before the next conference is held in West Africa in May 2008, including: three to five countries will start implementation, a website on the Biogas Africa Initiative (www.biogasafrica.org) will be maintained, and desk and feasibility studies will be conducted in other countries as well.

First biogas plant constructed in Rwanda

Moreover, information will be exchanged between African countries and successful countries in Asia, such as Nepal. A training programme will be started on biogas programme development, the organisational structure of the Initiative will be finalised and external financial resources will be mobilized.

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Useful biogas websites can be found at:
www.biogasafrica.org (Biogas Africa Initiative)
www.bspnepal.org.np (Nepal)
www.biogas.org.vn (Vietnam)
www.idcol.org (Bangladesh)
www.nbp.org.kh (Cambodia)
www.snvworld.org (SNV, click 'practise areas/biogas')

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