Botswana

“Biogas is a Benefit to my Life”

Botswana is a biodiversity hotspot, renowned for its abundance of wildlife. Balancing the needs of local communities with those of migrating animals is essential to ensure this remains the case. Unlocking the country’s biogas potential should contribute to achieving this.

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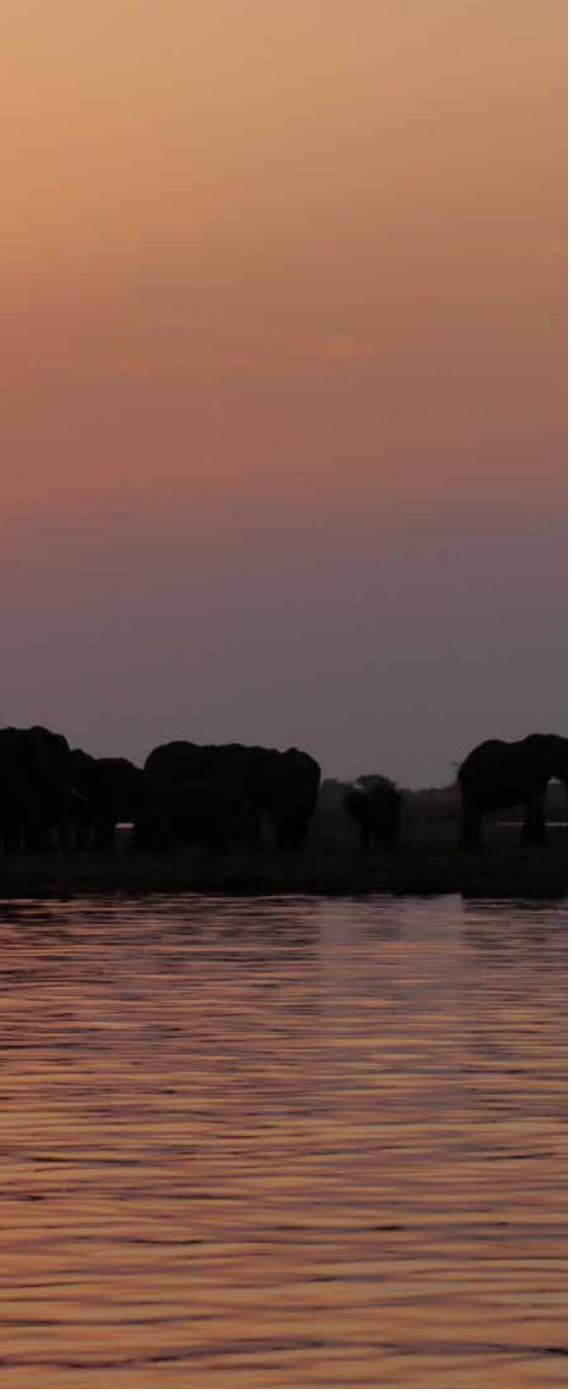


Since Peggy Mogamesa started using biogas, she has cooked exclusively with it. She no longer uses bottled fossil liquefied gas.

Living behind walls, on unused plots of land, herds of cattle on the roads are an everyday sight for drivers in Botswana, even in the bustling capital, Gaborone. Anyone taking a shortcut across unpaved sandy tracks that criss-cross the city should be prepared to encounter these horned animals grazing between bushes and trees. Even where the cattle themselves are out of sight, typical traces of their presence are evident.

Botswana has around 2.4 million inhabitants and – depending on the estimate – between 1.5 and 2 million cattle. Cattle breeding has a long tradition in the land of the Tswana people, who make up the vast majority of the population of this landlocked country in south-western Africa. Owning a herd is a symbol of status and pride. Unsurprisingly, Botswana is a challenging country for vegetarians: Beef – whether grilled, stewed, or dried – is a dietary staple.

The government in Gaborone has realised that cattle, especially in rural areas, also represent a significant opportunity for energy generation. Since 2019, with support from the United Nations Development Programme (UNDP), Botswana has been actively promoting biogas as part of its broader development strategy.

Coal Still Dominates Power Generation

The background to this is that the state wants to focus more strongly on renewable energy sources. At present, electricity is mainly generated by two coal-fired power stations in Morupule, in the central eastern region of the country. There, the state-owned utility Botswana Power Corporation (BPC) operates several units with a total capacity of 712 megawatts (MW) as of 2022. In addition to two diesel-powered power plants, the rest of the electricity required comes from imports from Namibia and South Africa.

Yet the government expects an almost twofold increase in Botswana's electricity demand by 2040 (from the current 4,500 to 8,600 gigawatt hours). According to the National Energy Plan, it therefore intends to expand photovoltaic and wind energy capacity so that renewables will account for 30 percent of Botswana's electricity generation by 2030. At the same time, it aims to reduce CO_2 emissions by 15 percent. Bioenergy is expected to contribute to this effort while also increasing energy independence. An example of this can be found in Lesoma, in the north-east of the country, close ▶

73-year-old Peggy Mogamesa stirs the raw materials for her 5,000-litre biogas plant.

For more biogas in Botswana: The team from the Department of Energy, with James Molenga and Edwin Khethiwe (right).

Cattle everywhere: Cattle graze everywhere, even in the capital city of Gaborone.

to the borders with Zambia, Namibia and Zimbabwe, where the great Zambezi River forms a quadripoint. The famous Victoria Falls are less than a 90-minute drive from here. The small town consists of simple brick-built houses. In addition to the tarmacked main road, sandy tracks criss-cross the area. On the outskirts stands the home of Peggy Mogamesa. The 73-year-old welcomes visitors in colourful traditional clothing. She has another appointment later, but still has a little time to show BIOGAS Journal her new system.

Specially Trained Bricklayers Construct Small-Scale Biogas Plants

At the beginning of the year 2024, she explains, several bricklayers came to excavate the ground behind the house and construct a 6-cubic-metre digester tank including inlet and outlet pipes. Only three steel-covered access points protrude from the sandy soil. She opens the first one and demonstrates how she adds cow dung, which she previously took out of an iron barrel and mixed with water.

The mixture flows into the digester by way of a sloping underground inlet pipe. She prises open the lid above it using a reinforcing bar. All that is visible is the gas tap, which she opens for further demonstration. The brick-built digester beneath is sealed airtight.

The system works on the principle that the gas produced displaces digested substrate into an expansion chamber as it expands. Peggy Mogamesa can extract the digestate through the third access point located there. "I spread it on my maize field as fertiliser," she explains.

Biogas Instead of LPG

She then leads us into her house, in front of which two of her grandchildren are playing. They look up curiously. Behind the front door is a small kitchen with a dual-burner gas stove. She turns the knob and the biogas flows. On the floor stands a bottle of fossil liquefied petroleum gas (LPG). "I don't use that anymore," she says when asked. "Because my biogas flows reliably. There hasn't been a single day when it wasn't there."

With one caveat: "At first I thought it wasn't working, because it took two weeks for the first gas to come." That is how long the digestion process in the anaerobic digester took before the first biogas was produced. Every two to three days she has to feed the system to keep it running. "So, you can't be lazy," she says. But the biogas really saves her money.

The 73-year-old widow is one of the biogas farmers who have received the system free of charge. It is one of 200 pilot projects that mainly focused on training bricklayers. The time for her next appointment has come. She quickly shows us the kraal where her twelve cows and one bull are kept overnight. Now they are out on the pasture, supervised by one of her sons, and have only left behind their "energy raw material." "Biogas is a benefit to my life," she says as she leaves.

Tens of thousands of elephants live in Botswana. What is good for biodiversity must also have advantages for humans.

"Peggy Mogamesa is one of many industrious Botswanan women who manage a household and farm well into old age." Men are often less hands-on, says Lefa Albert, who works for Africa's largest nature conservation park, Kavango Zambezi (KAZA). The wildlife reserve, which has its office in Kasane, Botswana, spans the territories of five African countries. With an area of 520,000 square kilometres, it is slightly larger than Spain. The nearby town of Lesamo and Peggy's farm, just 20 kilometres away, also lie within this area.

Millions for Biodiversity

The aim of KAZA is to protect the region's high biodiversity. Financial support is provided by Germany. The state-owned KfW Development Bank has so far approved around 50 million euros for the preservation of biodiversity in southern Africa. This includes large wildlife such as elephants, giraffes, zebras, and lions, which move freely across the territory.

The Kalahari Desert, the Okavango Delta and Chobe National Park provide three extensive habitats in Botswana alone, and they account for more than half of the country's land area. According to KfW, the elephant population in the KAZA region is the largest continuous elephant population in the world. Around half of Africa's remaining savannah elephants live there. The International Union for Conservation of Nature (IUCN) recently classified the species as endangered, but also praised the fact that populations in the KAZA area are increasing, in contrast to the rest of the continent. A comprehensive count conducted the previous year revealed that around 228,000 elephants live in the area – a success attributable to recent conservation efforts. ▶

The manure mixed with water is being fed into the system here.

Above the digester is the gas tap, which the biogas farmer turns on when needed.

Conservation: Local Communities Must Benefit

To ensure this remains the case, the needs of the local population must also be taken into account. In many communities, roaming animals cause disruption – for example, when elephants trample crops or predators attack cattle. To demonstrate how municipalities can benefit, KAZA representative Albert travelled to Peggy's farm – even though the state-run biogas programme is not directly linked to KAZA. However, Botswana's authorities are striving to work together in support of biodiversity.

This includes the Ministry of Minerals and Energy in the capital. The Department of Energy (DoE) has its headquarters there in a modern office park surrounded by tall trees on the southern edge of Gaborone. A multi-member team of staff is responsible for developing biogas policy.

"There are as many cattle in our country as there are people," says James Molenga, a senior energy engineer at the DoE. This is why using waste from the cattle industry offers the greatest practical potential for bioenergy production. With the support of the UNDP, the country launched its first subsidy programme in 2017. It ran until 2022, financed through the Global Environment Facility (GEF).

"The main objective during this period was to build capacity and competence," explains Molenga's colleague Edwin Khethiwe. As a result, 77 masons were trained, and 231 small-scale plants were constructed –with capacities ranging from 6 to 30 cubic metres (m^3). The owners had to contribute around 50 percent of the total costs themselves, specifically for the construction materials. This amounted to approximately 1,500 euros for a 6 m^3 plant. The expenditure for labour and biogas equipment was covered by GEF funds totalling 2 million dollars.

UNDP Supports Small-Scale Plants

After the first phase was limited to the southern districts, 2023 saw an expansion to the north of the country, where another 200 bricklayers will be trained by 2025. They will implement 120 demonstration projects with plant sizes ranging from 6 to 10 m^3 for households and small businesses – one of which is

that of Peggy Mogamesa from Lesoma. These plants are being constructed free of charge for users with the support of the UNDP. On the basis of this experience, Botswana then intends to further expand its biogas support so that another 630 small plants will be added over the next three years. To support this, the government has launched a budget of 1.5 million euros to provide investment cost subsidies.

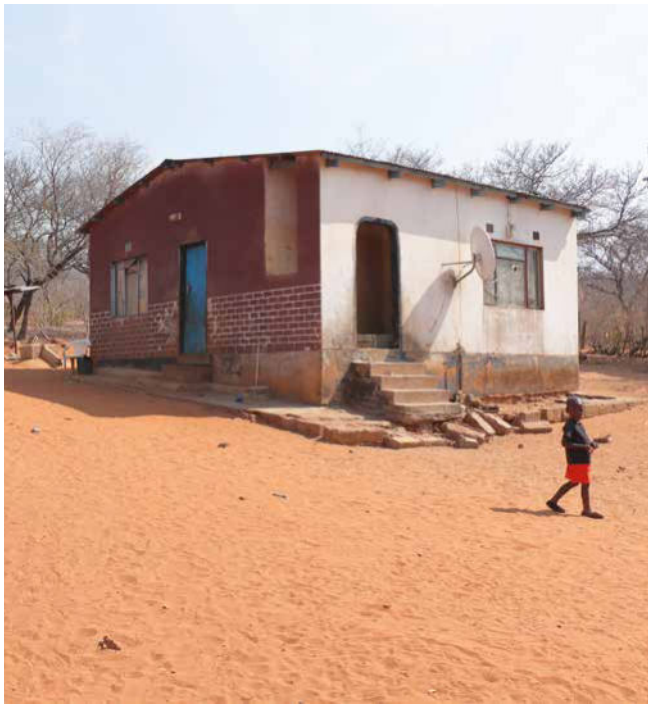
"Our most important goal is to familiarise people with the new technology, which in addition to cooking, is also used for lighting and for heat generation, for example in chicken coops," says Khethiwe. Many households in southern Africa still traditionally rely on firewood for these purposes.

Potential Also for Large-Scale Biogas Plants

However, to further tap into the biomass potential of around 20 million tonnes annually, the DoE is hoping for international cooperation in research and development as well as in large-scale plants. In the future, large biogas digesters could be constructed at sites such as the slaughterhouses of the Botswana Meat Commission. In order to offer investors secure conditions, the government is preparing appropriate regulations. "We are also hoping for financial support from the mining sector," says Khethiwe. Botswana is one of the world's largest producers of diamonds.

Apart from cow dung, with the exception of municipal waste, which Botswana's cities are to use for energy in future, other potential waste materials are not a focus in Botswana. According to the National Energy Plan, "Other agricultural residues offer only limited potential at a rural level".

And according to the DoE employee Molenga, the frequently occurring elephant dung is also not a viable alternative: Too dry and containing too many leaves and branches. "That makes digestion more difficult," he says. The logistics are also demanding, since the animals live predominantly in national parks. And unlike with the cattle, that is how it should stay. ●



Peggy Mogamesa's house was recently equipped with a biogas system.

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