“Bioslurry always means profit”

Success stories from the Tanzania Domestic Biogas Program

SNV

Netherlands Development Organisation

Contents

Bioslurry as smart investment 2
Dairy 4
Maize and rice 6
Bananas 8
Vegetables 10
Fish breeding 13
Animal feed 15
Cash for bioslurry 17
The future of bioslurry 19

Bioslurry as smart investment

Since its first programme in Nepal in 1989, SNV has built a considerable track record in the field of domestic biogas, with national programmes throughout Asia, Africa and Latin America. Through the SNV supported programmes, more than 663,000 households worldwide have gained access to the biodigester technology, providing them with a clean cooking solution and reducing the environmental pressure related to previous energy practices.

One of the outputs of a biodigester, next to the biogas, is bioslurry. This is the effluent of the organic matter remaining after the anaerobic digestion process. Since pathogens from the cow manure are mostly eliminated and minerals become more readily available for take-up, bioslurry is a very good organic fertilizer. The structure and water retention capacity of the soil are improved, increasing farmers' resilience against the impacts of climate change.

Whereas the biodigester technology is widely valued for its ability to meet the users' energy needs, bioslurry has long been considered a mere co-benefit. However, the value of bioslurry is more and more been recognized and has in some cases become the number one reason to invest in a biodigester.

This trend can also be observed in Tanzania. Bioslurry is used for a wide variety of purposes and in many different ways, ranging from vegetable and banana production to algae growth in fishponds and from the cultivation of larvae for chicken feed to the use of bioslurry as natural insecticide. Farmers using the bioslurry report impressive increases in their agricultural production and a significant decrease in the use of expensive chemical fertilizers. Their income improves and they are able to reinvest in their farms. This report tells some of their stories.

Dairy

The number of cattle smallholders in Tanzania is estimated at 1.2 million, with an estimated 21.3 million cattle. Most of these are found in the highland regions of Mbeya, Kilimanjaro and Arusha. With its steady production and high nutritional value, milk plays an important role for the livelihoods and food security of rural Tanzania. Experience of biodigester users shows that the application of bioslurry on fodder contributes to improved nutrition of the cattle – thereby increasing the milk production.

50% increase of milk production

Bioslurry for fodder production

Maria Laurenti Kaheta owns a 70-acre farm with cattle, pigs, goats and sheep, ducks, chickens, fishponds and a greenhouse for vegetable production. Most of the land is uncultivated. The soil in the area is extremely saline, making it difficult for vegetation to grow.

Maria has seven cattle, which are roaming freely during the day. Two of them produce milk. Because of the poor soil conditions, the grazing ground does not provide them enough feed for optimal milk production. This is why Maria uses part of her bioslurry to improve the soil and grow elephant grass as fodder. Every evening, after returning to their night stables, the cows get this nutritious supplement. Maria has noticed the difference in milk production; whereas each cow used to produce 10 liters per day, production has increased to 14 up to 16 liters. Out of the average 30 daily liters, her husband brings 20 to work to sell to his colleagues. With a price of 1200 Tanzanian shillings per liter, this brings in a monthly 600,000 Tanzanian shillings (280 USD) for the family.

Maize and rice

Maize and rice are important staple crops, ranking number one and two in the top ten of highest daily calorie intake per person in Tanzania. As they can be stored for a relatively long time, both maize and rice provide an important safety net for small-scale family farms.

Staple foods for times of need

Zadoki Kitomari is an organic farmer who continuously seeks innovative ways to improve his farming. He purchased his biodigester in September 2010, after having been selected as demonstration farm by the TDBP. He uses bioslurry or many different purposes, including for the cultivation of maize and rice. Before sowing, he uses composted bioslurry to improve the nutrient content and structure of the soil. Liquid slurry is later applied as top-dressing for the plants. The maize yield went up significantly in the first year; from 1,5 tons when he still used untreated cow dung, to 2,5 tons after the application of the bioslurry. He hopes to have the same yield again this year.

Zadoki experiences only one problem with the biodigester… The bioslurry is not enough for all his needs on the farm. He overfeeds the biodigester in order to have more bioslurry, even though he knows it is not good for the gas production. He owns half an acre of rice, but has only enough bioslurry to fertilize a third of the plot; the other two thirds are left without any fertilizer. The difference is significant; the yield of the plot with the bioslurry is three times as high as the yield without fertilizer.

6 times more rice with bioslurry

The family Kitomari uses rice and maize primarily for own consumption. Both staple foods can be stored for a longer period, and therefore constitutes a good buffer for times of need. In 2014 for example, the family's eldest son had a severe accident in which he broke both his legs. The family then sold ten bags of stored rice, which allowed them to pay for the medical care he needed.

Vitalis Joseph is a farmer and owner of a biodigester construction enterprise. He is an excellent example of "*practice what you preach*"; he has constructed over 60 biodigesters around the Manyara region, including one for himself. He uses bioslurry to fertilize his banana trees, vegetables and maize. The income from his enterprise, the fertilizer savings and increased crop production from the bioslurry have had a big impact on his life. His brother recently passed away, and his sister-in-law moved in with him and his family. He has now been able to construct a new house for himself and his family, giving his own house to his sister-in-law to provide her a comfortable home.

Self-sufficiency and savings through bioslurry

James Felix was Vitalis Joseph's first client in his village. He uses the bioslurry for many different purposes, including on his one acre maize plot. He has kept a diary over the years, keeping track of the yield and his expenses on fertilizers. Before the construction of the biodigester, he used organic fertilizer for sowing and chemical fertilizer for top dressing, costing him 140,000 Tanzanian shillings (65 USD) per year – current prices are even higher. The application of both liquid and composted bioslurry has now entirely replaced these fertilizers. Maize production has increased from 8-10 to 18-22 bags annually. Whereas the family previously had to buy six extra bags per year, they now are now fully self-sufficient – saving an estimated 300,000 Tanzanian shillings (140 USD) per year.

$ 140 saved on fertilizers

Bananas

Tanzania ranks as second largest banana producer in East Africa. With an estimated production of 2,5 megatons per year, bananas find themselves in the top 5 of the country's most important commodities.

Bioslurry has the potential to greatly benefit the banana value chain. Experiences from banana farmers show its application can control weevil infections, shorten the growing cycle and increase the yield with 60-80%.

Banana cultivation as a new business

James Felix is a farmer and local politician who was the first in his village to invest in a biodigester. Although he initially had his doubts, he and his wife decided to give it a try and see what the bioslurry can do for his farm.

Arriving at his house, the first thing that catches the eye is the plot of large banana plants. They have been planted fairly recently; before the installation of the biodigester, James only had a few individual plants, of which one very close to the biodigester; the perfect opportunity to test the bioslurry. The results were incredible; whereas he previously had 100 to 120 bananas on one bunch, the bunches grew to 200 bananas. The family decided to invest in another banana plot, in order to maximize the benefits from their bioslurry. They apply liquid slurry once a month around the foot of the stem. The family currently have 220 plants and a yearly harvest of 300 bunches. They adopted a new marketing strategy; instead of selling the green banana bunches to middlemen, they now sell the ripe bananas individually for 100 Tanzanian shillings each. Their banana plants now provide them an income of 6 million Tanzanian shillings (2800 USD) per year.

70% more bananas

Rhoda Mshomi is a shop owner and farmer in the Kilimanjaro area. She decided to invest in a biodigester, because of her allergy to the smoke from wood fires. Encouraged by the Tanzania Domestic Biogas Program (TDBP), she started applying bioslurry to her crops and bananas. Before, she only had a small banana plot, and only produced for own consumption. Now, using bioslurry and having learnt a different planting method by another project, she has half an acre with 700 plants. The size of the bananas has increased and the time frame shortened. Last year's banana harvest gave her an extra income of 2 million Tanzanian shillings (930 USD). The plants used to suffer from weevil infections; after the use of the bioslurry she never saw it again.

Slurry as pesticide in banana cultivation

Godwin Godfrey has a small banana plantation on the slopes of Mount Meru, near the town of Arusha. In the last years, his production declined due to a weevil infection that affects the overall health of the banana plant and caused a serious drop in production. After attending training on the use of bioslurry, he started to apply 40 litres of bioslurry to each banana plant. After a few months, the weevil infection had disappeared and his banana crop tripled. As an added bonus, the size of his banana has increased tremendously.

Vegetables

The most common use of bioslurry is as fertilizer for vegetables. Vegetable gardening is mostly done close to home, and due to their short cycle, vegetables are ideal cash crops that provide a regular income.

Bioslurry profits for school fees

When **Rhoda Mshomi** decided to invest in a biodigester, she was not even thinking about bioslurry. Because of her allergy to smoke, biogas was her priority. Extension officers from the TDBP convinced her to use the bioslurry for her crops and bananas. She immediately saw a difference in the crop production; the story she had been told about bioslurry, turned out to be true. Her tomatoes, cucumbers, cabbage and spinach grow faster and bigger now, and if she wants, she can sell some every day. Before she used the bioslurry, it was difficult to earn a weekly 15,000 Tanzanian shillings (7 USD) from the vegetables. Now, if she is lucky, she can even earn that in one day. By spraying bioslurry on the tomato plants, she has been able to control fungal pests. Also, in the past she used to apply expensive chemical fertilizers; these are now no longer needed. With these savings and the extra income generated from the vegetables, Rhoda has been able to send her children to university. Rhoda: "the digester has been paid back already 10 times".

$ 7
per day
from cash
crops

Also for **Andrea May**, bioslurry was not the main reason to invest in his biodigester; biogas was. For him and his wife, a biodigester was literally an investment for the future. His children currently still live at home, but it will not take long before they will all move out. Who will then take care of firewood collection? To avoid a heavy burden for his wife, he decided to opt for biogas. Now, three years later, his priorities have changed. Although the biogas is still very important to satisfy the family's cooking needs, the benefits from the farm yield are even more important.

Andrea used to be a local government official, who became unemployed when he did not get re-elected last year. Motivated by the impacts of the bioslurry on his crops, he decided to focus all his time on his farm. He uses the bioslurry for his bananas, as pig feed and as fertilizer for his Irish potatoes, amaranth, tomatoes, carrots, eggplant and different spinach varieties. As soon as the bioslurry comes out of the digester, he brings it directly to his crops, still in liquid form. According to Andrea, his vegetables have improved a lot, both in terms of quantity and quality. The extra income generated from the sales, are used to pay the school fees for their children.

Vegetables for self-sufficiency

On her large farm, **Maria Laurenti Kaheta** uses bioslurry for many different purposes. One of them is vegetables. She applies liquid bioslurry on her crops in a greenhouse. According to Maria, the greenhouse feeds all 10 farm workers for most of the year. The farm is virtually self-sufficient. Maria: "I go to the market to buy rice and cooking oil – that is all. Our food mostly comes from the farm. And the farm is like this because of the bioslurry". She explains that the crops are bigger than before, when they still used untreated cow dung as fertilizer. The bioslurry also keeps insects away, working as a natural repellent.

Innovation in bioslurry application

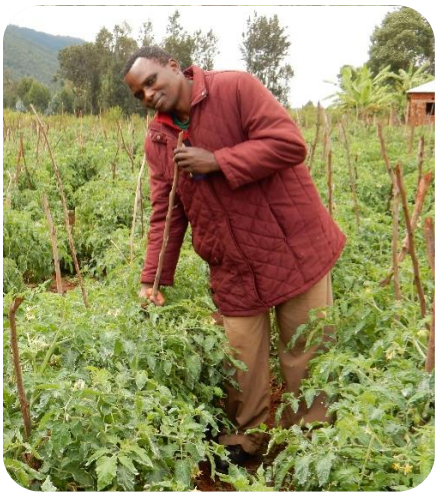
Zadoki Kitomari is a role model for bioslurry use in many different domains – including vegetables. Since his soil is tough, he invented two innovative planting techniques with bioslurry: the *kitchen garden* and *double dig*. The kitchen garden consists of crops planted in an enclosed composted bioslurry heap, which is built above the ground and covered with straw or agricultural residues. The double dig is a vegetable bed in a trench with different layers and different mixes of bioslurry (both liquid and composted) and soil. The double dig beds can be used for three years, only requiring some liquid slurry top dressing. Next to this, liquid bioslurry is used to spray on the vegetable leaves, to keep insects away. The whole Kitomari family is involved in gardening; together they produce lettuce, spinach, parsley, eggplant, maize, tomatoes, sweet pepper, sweet potatoes, leek and a local cabbage variety. Most of the vegetables are used for own consumption, but some lettuce and cabbage is sold at the organic farmers market in Arusha town. Next to farming, he also teaches other biodigester users on bioslurry application techniques.

Off-season vegetables for maximum profits

Ramadan Sungu is a local Islamic leader and an influential person. He was also the first in his village to adopt the biodigester technology, and in order to have a maximum gas and slurry production, he even connected one of the toilets. He uses the bioslurry for his fishponds, fodder production and for the cultivation of carrots, beans, peas, cassava, rice, maize, ground nuts, sunflowers and bananas. With the help of the bioslurry and his irrigation pump, he focuses on off-season production to maximise the profits. According to Ramadan, his vegetables grow faster and his income from vegetables has doubled since the use of bioslurry.

Doubled income from vegetables

Improved harvest through improved soil structure



Like many bioslurry role models, **James Felix** uses his bioslurry for a variety of purposes; bananas, maize, selling of composted slurry, but also for the production of tomatoes and beans. He uses half an acre for the cultivation of high value, first class beans that he fertilizes with composted bioslurry. Last year, he harvested 800 kg; twice as much as when he still used cow manure as fertilizer. For the Felix family, the beans constitute a lucrative cash crop, which they sell on the village market and to middlemen from other districts. The same applies to their tomatoes. Since they cannot be stored for a longer time, "tomatoes are for business". The family cultivates half an acre. Bioslurry is used both before sowing and for top-dressing. For every plant, they dig a hole, fill it with 0.5 litres of liquid slurry, cover it with soil and leave it for two days; the third day, the seedlings are planted. Top-dressing is done after one month. From there, the plant is strong enough to take up itself. In the right season, the harvest is around 10 tons, which can bring in a revenue of 5 million Tanzanian shillings (2300 USD). When James still used chemical fertilizer, this was only half. He explains that many years of cultivation has disrupted the soil structure. With bioslurry, the water retention has been improved, resulting in a better harvest. The family also saved on fertilizer spending; the 280,000 Tanzanian shillings (130 USD) that he would normally spend, is now used to reinvest in the farm and the house.


AMSUNG

Fish breeding

Cultivation of fish such as kingfish and catfish is a lucrative business in Tanzania. After the initial investment of fishpond construction, maintenance costs are relatively low, and the profits are high. Especially with bioslurry.

Bioslurry substituting expensive maize meal fish feed

Raphael Chinolo is an innovative farmer in the Dodoma region. After being told that the slurry from his biodigester could be used for feeding his fishponds he started experimenting. He fed one fishpond with bioslurry, out of the three he has. The other two ponds were fed with chicken manure and maize meal. Raphael's records showed that the increase in the size of the fish fed on bioslurry was comparable with the sole feeding of expensive maize meal.

Bioslurry speeding up the fish' growth

Zadoki Kitomari has been cultivating fish since 2003, in ponds next to his house. He used to feed them kitchen leftovers and agricultural residues, such as the peels from polished maize. Since he has had the biodigester, bioslurry has become their main dish. One time, some clients requested to purchase fish for smoking. Zadoki was not sure if they would be big enough, because he had harvested all mature fish only one month before. He caught a few, and found big fish; in one month time, they had grown to a mature size. He then realized that bioslurry made them grow very quickly.

$ 1400 from fish sales

Nowadays, the Kitomari family keeps the grown-up fish mostly for their own consumption; they sell the fingerlings for others to start up their own fishponds. Last year, he sold more than 6000 for 500 Tanzanian shillings each, providing the family with an extra 1400 USD.

High demand for catfish

Maria Laurenti Kaheta is a farm owner with a true entrepreneurial spirit. After her chicken, pig and duck project, she decided in April 2015 to invest in fish breeding. She currently has three operational ponds, and two are under construction. Bioslurry has been used to get the algae growth going. Production costs are low, and according to Maria, there is a high demand for catfish. As the project is fairly new, she has not sold any fish yet, but the first sales are planned for October this year.

Fish available every day

Ramadan Sungu has purchased his biodigester in 2014, after which he invested in the construction of fishponds. He uses bioslurry to stimulate the growth of algae, which in turn attract insects and worms – a perfect meal for the fish. 400 fingerlings have been introduced this year, and Ramadan expects to have around 1200 by now. The family will sell their fish and keep some for their own consumption. One of the big advantages of the fishpond according to Ramadan: his family can eat fish anytime, whenever they want.

Animal feed

Bioslurry is not only a good fertilizer; it also provides an excellent animal feed – both directly and indirectly. Pigs, chickens, ducks and even cattle benefit from this food supplement.

Bioslurry for soil improvement

Maria Laurenti Kaheta is better known in the village as *Mama Kuku* ("Mama Chicken"). After losing her job in 2009, she decided to switch her career and become a farmer. Her first project consisted of poultry, after which she expanded her business with cattle, goats, sheep, and crop cultivation. She always seeks to innovate and expand, while farming in a sustainable way.

Maria learned about the biodigester technology in 2012, when she met a TDBP officer at a farmer's exhibition. She made a visit to a demonstration farm, and decided to invest in a biodigester. Her main reason: to improve the saline soil. The results are impressive and very well visible. Whereas untreated soil remains poor and bare, soil treated with liquid bioslurry have become suitable for crop and grass production. The grass is used as animal feed.

Larvae and worm breeding

After the construction of the biodigester, Maria started a pig project. She started off with 10 pigs; a recent count indicated a current 300 piglets and mature pigs. Their morning meal consists of a mixture of maize, wheat and sunflower bran, mixed with dried bioslurry and worms. Maria explains that this diet reduces the pigs' fat content, making the meat better. The same mixture is fed to the ducks, another project that she started this year.

Even the larvae and worms for the pigs, ducks and chickens are bred in a mixture of bioslurry, soil, animal (goat or pig) manure and urine. This normally takes three to four weeks, but to get really fat worms, they leave the mixture in a bath tub for three months. Maria has seen a big difference in the weight of her chickens; whereas they used to weigh 1-2 kilograms, they now weigh 5–7 kg. Another difference is the quality and quantity of eggs. Maria used to collect not even one tray of 30 eggs per day; now she has 2-3 trays – bringing in a daily 30,000 Tanzanian shillings (14 USD).

The impact of bioslurry on Maria's farm is enormous. Next to increased crop production as a result of the improved soil, the income from pigs, ducks, poultry and eggs has increased significantly. According to Maria, the income of her farm has even doubled since the construction of the biodigester. She currently employs 10 workers on her farm, and she uses the revenue to pay for the school fees of her children, assisting the community and to expand her business. One disadvantage of the biodigester: "*the bioslurry is never enough!*". As soon as the bioslurry comes out of the digester, they take it out to use on the farm. In order to maximise the benefits more, she intends to construct a second digester and to start composting the bioslurry.

Tripled chicken size and egg production

Cash for bioslurry

Bioslurry has demonstrated to improve the income of farmers through increased agricultural production and savings on fertilizers. This is why people without a biodigester are willing to pay for bioslurry. This provides lucrative opportunities for biodigester owners to gain an additional source of income.

Cash for composted slurry

Zadoki Kitomari does not only use his bioslurry on his organic farm, he also sells it. And it turns out to be a lucrative business. He is a perfect example of a biodigester user who composts the slurry in the right way, using multiple composting pits and protecting the pits against all weather conditions. Fellow farmers come to his house to buy his composted slurry; he already has more than 20 customers who buy in bulk. For one ton of bioslurry, he receives 200,000 Tanzanian shillings (93 USD). Sometimes, he even charges that amount for less than a ton, because he considers the bioslurry too valuable for that price. According to him, "bioslurry always means profit".

$ 93
per ton of composted bioslurry

The composting of bioslurry takes around 6 weeks, and results in 5 tons per cycle. Last year, he sold at least 10 tons to his clients – an extra income of 2 million Tanzanian shillings (930 USD). The remaining 33 tons are used by the family for their vegetables, maize, bananas and fishponds. Zadoki regrets not having installed a bigger biodigester; the bioslurry is never enough. He is no longer interested in using cow dung directly as fertilizer. Instead, he plans to buy a second digester.

Liquid slurry sale for new users

Together with biodigester entrepreneur Vitalis Joseph, **James Felix** promotes the biogas technology in his village. As a promotion strategy, they formed a group of 10 people, who regularly receive some bioslurry for free to try on their farm. Three of the group members already invested in a digester, as they had experienced the benefits themselves. James then sold them more liquid bioslurry, to help the quick startup of the digestion process. In addition, he sells liquid slurry to farmers during sowing season. In one month, he sold 40 drums of liquid slurry, gaining him an extra 200,000 Tanzanian shillings (93 USD) in cash.

The extra income from the bioslurry, both directly and indirectly, has had a great impact on the Felix family. Since the construction of the biodigester, they have been able to purchase an ox wagon to carry the bioslurry to the fields, a new banana plot, a motorbike, the construction of a new house in the family compound, and improvement of the floor and kitchen roof of their house. He already has a new project in mind, feeding chickens with bioslurry-grown worms. He has an entrepreneurial spirit, and is willing to invest. With bioslurry, he says, "I know my money will return".

The future of bioslurry

The Tanzania Domestic Biogas Program (TDBP) puts a strong emphasis on the valorization of bioslurry. Whereas the biodigester technology has traditionally been valued primarily for its gas, slurry is increasingly considered for its economic value as well. An excellent example of this is the sales of composted and liquid bioslurry. Many of the interviewed farmers serve as a role model or even as trainer within their community, teaching others how to maximize the benefits of their biodigester.

Farmers often use bioslurry for many different purposes, applying a variety of methods and techniques for its for handling and storage. In order to prevent nutrient losses, there remains an important role for the TDBP to teach users about the optimal use of bioslurry. Even some of the role models still have room to improve their practices, especially on storage and composting techniques. This indicates that if handling techniques and composting infrastructures are optimized, results could be even more impressive.

The success stories from bioslurry users indicate an enormous potential for this *brown gold* to improve the livelihoods of farmers in Tanzania. Although the evidence is anecdotal and not (yet) representative for the average biodigester owner, it shows how bioslurry, if well used, can help to increase agricultural production in a sustainable way – creating a true impact on the livelihoods of Tanzanian farmers.

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