WATER AND FOOD

Food security – It takes a village… and a whole lot more

A project funded by the Water Research Commission sought to assess the potential of integrating water, agriculture and biogas to improve food security in a rural area of the Eastern Cape. Article by Sue Matthews

All images courtesy the research project team

In the undulating foothills of the Eastern Cape's Amathole mountains, the village of Krwakrwa lies a little way off the road between Alice and Hogsback. As in many rural villages in South Africa, the residents survive largely on social grants. Most people of working age – particularly men – have gone to urban centres to find employment, so the population is dominated by older women, some of whom tend homestead gardens. Much of the extensive cropland surrounding the village lies fallow today, and livestock farming is now the main agricultural activity, but the communal rangelands are in poor condition due to overgrazing.

Few households have a monthly income exceeding R2 000, so poverty and food insecurity is rife. Electricity is expensive so it is typically only used for lighting, while cooking and heating is done with firewood collected from the veld. This not only results in deforestation, but is a health and safety hazard through exposure to smoke and the risk of accidental burns and house fires.

It was here that a Water Research Commission (WRC) funded project was conducted over the past six years to assess rainwater harvesting and conservation practices for production of food as well as renewable energy in the form of biogas. The village was selected from a shortlist of five that met a set of criteria and were all visited by the project team, made up of staff and students from the Agricultural Research Council (ARC), the provincial Department of Rural Development and Agrarian Reform (DRDAR), the Fort Cox College of Agriculture and Forestry, and the University of Fort Hare. Ultimately, the neighbouring village of Upper Ncera showed so much interest in the project that it was included too.

Within the villages, demonstration plots were established to show how water harvesting, vegetable crops, cow dung and bioenergy can be integrated. Thanks to additional funding from DRDAR, 14 biodigesters – seven in each village – could be installed at households that had their own water storage tanks as well as ready access to cow dung. Fortunately, livestock are kraaled by their owners close to homes overnight, which made dung collection easier, but the selected households needed to be willing and able to carry or transport this somewhat smelly haul back to their biodigesters. The water storage tanks were necessary not only for irrigation, but because the biodigesters need to be 'fed' with both water and dung every five days at least.

Project team members helped the households to construct in-field rainwater harvesting (IRWH) basins in their gardens and provided them with seeds and seedlings. Having learned from previous experience in rolling out the IRWH technique within communities, the team tried to avoid promoting 'dependency syndrome' by informing the households that they should not expect ongoing handouts. As a result, some started buying their own inputs from an early stage, and there was a marked improvement in food supply.

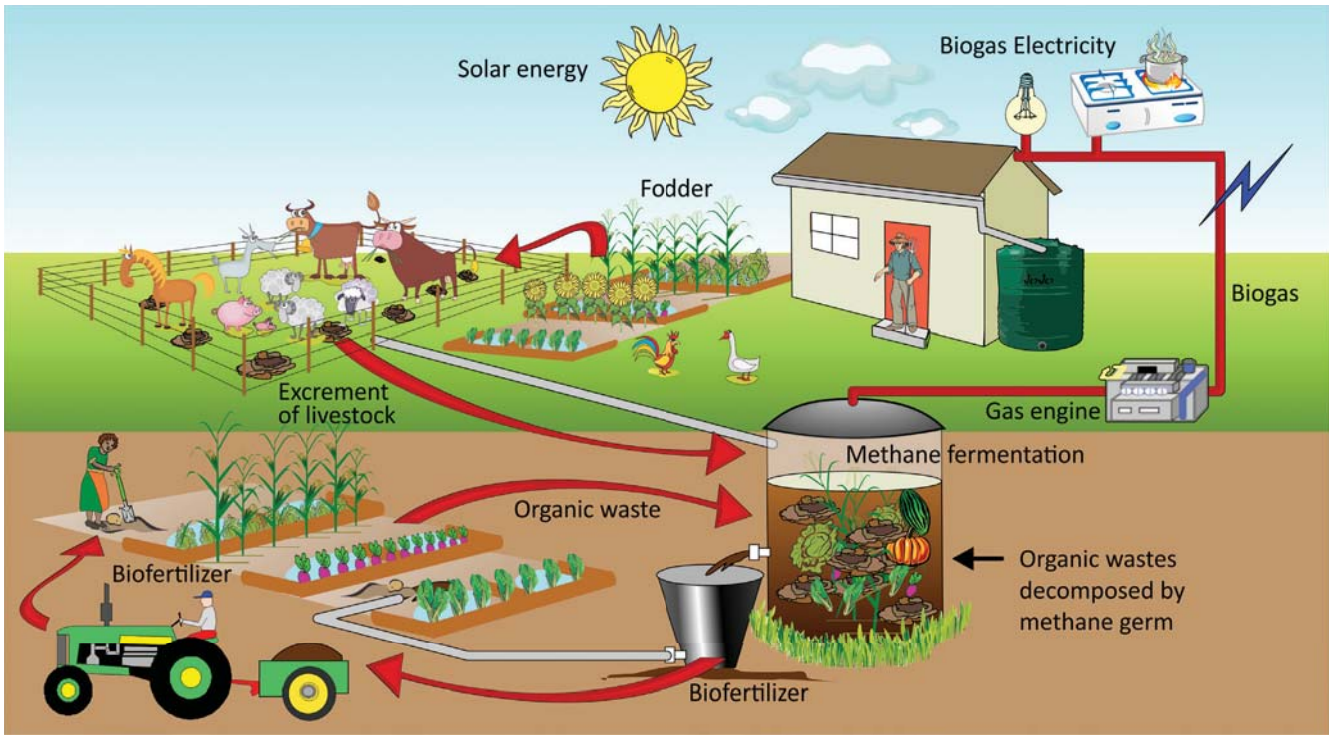
"Previously, most of the backyard gardens were either not utilised or only used to produce one or two crops, mostly just a small patch of maize and perhaps some spinach," explains Dr Kobus Anderson, who took over as project leader after Dr Cobus Botha resigned from the ARC. "With the IRWH technique they were able to produce a variety of vegetable crops throughout the year, because they could now use water from the tanks for supplemental irrigation during the dry season."

The project team wanted to assess whether tank water emanating from roof runoff was sufficient to meet the requirements for irrigation, biodigester operation and domestic use, and asked householders to keep detailed records, even supplying them with rain gauges. Most neglected to do so, and the data was also compromised by the fact that tanks were filled from the municipal water supply whenever it was available – taps in the area remain dry for long periods because municipal services have collapsed in the area.

Bioslurry effluent from the biodigesters was used as a fertilizer source, and the improved soil water and nutrients in the gardens meant that they quickly became infested with weeds. "The majority of beneficiaries were elderly, and sometimes the situation got too much for them to keep up with effective weed control," says Anderson. "Weeds were then competing with the main crop for available water and nutrients."

In a few cases, weeding and basin maintenance was done by grandchildren, who had been exposed to the technologies at school as part of the project team's capacity-building and knowledge dissemination efforts. Teachers arranged for the school gardens to be ploughed by local tractor owners, some of whom were parents of learners at the schools, before IRWH basins were constructed by members of the project team and the learners themselves. The learners were asked to bring spades and rakes from home on the designated day, and were shown how to reshape the ground and plant various crops. Over the following months they maintained the gardens and recorded data on crop production, rainfall, water storage and water usage, before presenting the results at a mini-conference and receiving a cash prize for the school, enabling them to buy more seedlings for the school garden.

The school and homestead gardens were only one aspect of the project though, because the research sought to upscale the techniques to croplands and rangelands. Viewing the villages on



A diagrammatic representation of the aim of the project.

In-field rainwater harvesting (IRWH) basins have proven potential to increase maize yields, particularly when used in conjunction with supplemental irrigation and fertilizer application.

Google Earth reveals rows of fallow fields that were intensively cultivated in the past. During the apartheid era, when the area formed part of the Ciskei homelands, villagers were given government assistance in the form of extension services, access to tractors and other farming implements, and the ability to sell their produce through the Ciskei Marketing Board.

When that support fell away in the new dispensation, most crop-growers struggled on for a while, until drought put paid to any hope of getting back on their feet. Even when good rains returned, they could not afford to have the land ploughed, or to buy seeds and fertilizer. Nowadays, only the chief, who has a tractor, and a few villagers cultivate their croplands, growing mainly maize and beans. Yields are generally low, though, so the project team wanted to assess how well rainwater harvesting and conservation practices, together with bioslurry application, could boost production.

Unfortunately, the croplands are mostly unfenced, and livestock owners would allow their animals to graze in the fields, destroying the crops and the IRWH basins. The project team therefore opted to conduct experiments under controlled conditions at Fort Cox College, 10–12 km away from the villages as the crow flies. The IRWH basins constructed there were managed in three different ways before maize was planted: left bare, planted with a cover crop of buckwheat, or covered with mulch in the form of maize leaves and stalks. Bioslurry was applied as a liquid fertilizer at three different doses, but another treatment used manure instead. Contrary to expectations, the manure treatment resulted in the lowest yields. The cow dung simply dried out and caked on the surface because there was too little rain to moisten it and leach nutrients.

The bioslurry also tended to form a cake as it dried out, acting as a mulch that helped reduce evaporation from the soil surface. Its nutrients improved maize biomass and grain yield slightly, but even at the highest application of seven tonnes per hectare the increase was not significant. The normal maize-based mulch also didn't perform as anticipated, because it soaked up the sporadic, light rainfall and allowed very little water to infiltrate the soil. It did at least create a cooler soil microclimate, and was found to have a greater impact on grain yield than bioslurry application, followed by the cover crop management option. Although bioslurry might be more effective at much higher application rates, the project team concluded that its use isn't very practical beyond the homestead gardens, given the effort required to get it from the biodigesters to the croplands.

For the rangelands component of the research, the project team constructed IRWH basins in the abandoned croplands and established experimental plots within them in which four leguminous (and hence nitrogen-fixing) pasture species were intercropped with one grass species. The aim was to improve grazing quality for the villagers' livestock, not only by growing palatable fodder but also by increasing soil water and nutrients. However, neither intervention had a significant effect on forage dry matter yield, partly because the trial period coincided with a drought, so survival of the legumes was rather poor.

The project team also placed GPS collars on a number of cattle from different herds, and tracked the animals' movements during the wet and dry seasons. This revealed that the cattle spent most of their time grazing close to homesteads, water points and riparian vegetation, where more palatable grass species were available compared to those in the veld further afield. Since the cattle were left to wander freely in the veld and overgrazing was evident, the team fenced off a number of 2x2 m exclosures at various positions to protect them from grazing, and recorded production and species composition within and outside them. The highest production values were from inside the exclosures during the summer and autumn months, which indicates that implementing a rotational grazing strategy in the area would be beneficial. Although it would be ideal if the livestock owners could establish larger grazing camps or exclosures themselves, the project team note that this may not be feasible in the area as fencing is often stolen. A better option might be to employ herders to move livestock into lightly grazed areas, ensuring more even grazing distribution, although this too is costly.

Alternatively, the villagers could elect a committee to oversee the rangeland use. Over the six years of the study, the project team engaged extensively with the community through meetings

The villagers were shown how to construct IRWH basins and were initially given seeds and seedlings, but needed to take responsibility for maintaining the basins, irrigating the plants using water from their storage tanks, applying fertilizer in the form of biodigester effluent, and ensuring weeds were removed.

and discussions, and repeatedly emphasised the importance of institutional arrangements in the form of rules, regulations and organisational structures. Ultimately, committees were formed to help implement the project, assist with monitoring and evaluation, and issue fines to those who failed to comply with the rules – for example, letting their cattle graze in the maize crops. Nevertheless, adherence to institutional arrangements remained a challenge, largely because of the poor health status of the area's chief and the fact that some villagers no longer acknowledge the authority of the traditional leadership, due to political interference.

Now that the project has been completed, one wonders whether the interventions will be sustained, but Thabiso Koatla, the ARC's team member tasked with the socio-economic aspects of the project, says that the extension officer in the area has been asked to continually follow up with the households to check on their progress.

"What the ARC normally does when we conclude a project is draw up an exit strategy, whereby we plan – together with all the stakeholders that were involved in the project – what to do to make sure that whatever we achieved doesn't die off when the ARC team leaves," he explains. "We have already compiled the exit strategy, but the implementation has not been done due to Covid. Our meeting with stakeholders had to be postponed but should take place before the end of the year."

"The villagers are very keen on the biodigesters though. The beneficiaries are using the biogas piped into their kitchens now, but they need regular training. We've been told some of the biodigesters are blocked, and although we provided training on how to unblock them, some people have forgotten how to do it, so we need to give refresher courses."

As for the broader food production issues, Anderson feels that community members need to be further empowered with the necessary knowledge and skills to implement rainwater harvesting and conservation systems, and supported with effective extension services, but without contributing to dependency syndrome.

Biodigesters were installed at 14 households that already had water storage tanks and access to cattle nearby, since the biodigesters needed to be 'fed' with water and cow dung at least every five days. Two control digesters with full-gas profiling and meteorological measurement capability were installed at SolarWatt Park on the Alice Campus of the University of Fort Hare.

The project team conducted cropland experiments at Fort Cox College in nearby Middledrift, and provided training to the second-year students studying crop sciences and agri-business for three years, reaching some 300 students. The experimental plot was also visited by project beneficiaries and stakeholders during annual 'information days'.

Farmers' days were held to allow the selected beneficiaries to display the fruits of their labour and share their knowledge and challenges with stakeholders and other villagers.

"In an ideal world you want to teach people how to fish, but initially you will need to give them a kickstart by supplying them with the fishing rods and hooks," he says. "It needs to be made clear that if inputs are given, it's a once-off – in other words, we will teach you how to catch fish, but we will not be here forever. At some point, you'll need to stand on your own two feet."