

Water for food

The art of learning – how science is assisting emerging farmers in Limpopo

The National Research Foundation frequently circulates calls for proposals for collaborative projects involving partners from foreign countries, in line with South Africa's bilateral and multilateral agreements. The extent to which these ultimately benefit 'Joe Public' is sometimes difficult to gauge, but one such project has had a potentially life-changing impact for a group of smallholder farmers in Limpopo.

Sue Matthews reports.



All photographs courtesy EAU4Food

It was a call from the European Union's (EU's) 7th Framework Programme for Research and Technological Development (otherwise known as FP7) in 2010 that spawned the EAU4Food project, coordinated by the Alterra Institute at the Wageningen University and Research Centre in the Netherlands. The project's full name, 'European Union and African Union cooperative research to increase food production in irrigated farming systems in Africa', reflects the fact that it was rolled out in five countries on the African continent – South Africa, Mozambique, Ethiopia, Mali and Tunisia.

The South African partner organisations were Stellenbosch University, represented by Dr Willem de Clercq, and the CSIR, represented by Dr Nebo Jovanovic, also based in Stellenbosch. However, the study site was near Giyani in the Letaba Basin, more than 1 600 km away as the crow flies.

The project's main objectives were to design, test and disseminate effective soil and water management strategies, which would allow African farmers to increase food production and achieve sustainable use of irrigation water, conserve soil

fertility and reduce pollution of freshwater reserves. In doing so, the project would facilitate the development of socially acceptable, environmentally sustainable and economically profitable production systems.

An innovative transdisciplinary research approach was used, actively involving all stakeholders – from farmers and retailers to policy makers, water managers, agricultural officials and NGOs. With assistance from the UK's Overseas Development Institute, learning and practice alliances (LPAs) were set up as stakeholder platforms at national and regional levels, while farmers at local level were invited to community of practice (COPs) groups. A 'photo safari' was arranged to assist farmers in revealing the problems they face.

"While the scientists involved had a clear idea of problems relating to water use and agriculture, we didn't have planned outcomes at the start of the project because we wanted to get buy-in from all the stakeholders in the region, and ensure that the people on the ground had a say in what they wanted us to do," says Dr de Clercq. "So the project was designed in such a way that it focused on solving the farmers' problems."

Four main problem areas were prioritised by the farmers:

- Limited access to markets – lack of information on pricing, lack of packaging materials and facilities, not producing according to market demand and standards
- No equipment – lack of funds to procure irrigation equipment and farm machinery, limited skills and knowledge to operate such equipment
- Heatwaves – no action plan to counter the effect of heatwaves on crops
- Lack of management information – limited knowledge of best cultivars, irrigation volumes, pest control, financial management.

The researchers recognised that some of these problems could be addressed by increasing irrigation efficiency (dubbed 'more crop per drop') as well as economic water productivity ('more cash per splash'). Field trials were therefore initiated at two cooperative farms where the Limpopo Department of Agriculture already had a number of active projects. The trials were conducted over a two-year period by an MSc student from Stellenbosch University's Department of Soil Science, Cou Pienaar, and focused on tomato because this is one of the most important cash crops grown in the area.

Most of the smallholders were using traditional furrow irrigation, so a drip irrigation system was installed, with irrigation scheduled on the basis of soil moisture monitoring, and the results in terms of crop production compared. While the farmers were generally achieving yields of below 5 t/ha, introducing drip irrigation alone increased this to an average 26.5 t/ha. When additional improved management practices were introduced, such as mulching and soil nutrient management, the yield shot up to 120.9 t/ha!

"The farmers receive granular fertiliser from the government, but they didn't know how much to use," says Dr de Clercq. "So we calculated the fertiliser requirement in terms of Coke bottle caps per plant, and showed them a method whereby they use a broomstick to make a hole in the ground close to the tomato

plant, empty one cap in the hole and cover it up again. And the same with pesticides – we trained them on the maximum dilutions they should use."

"The farmers also told us about problems caused by the heatwaves the area experiences. They said it gets too hot to go out into the fields, so all the crops die and they have to start all over again, which is a major stumbling block. But now that we've installed drip irrigation, they don't need to go out into the fields to irrigate, they can just turn on a tap. This has saved their crops and provided a huge amount of security in terms of still being able to deliver to their markets."

"Also, since you don't wet the total surface area with drip irrigation, you get less problems with weeds, so they don't need to be in the field every day like they normally were. We also changed the tomato cultivar to a higher yielding one with a better shelf life."

The manager of two Spar supermarkets in Giyani, Peet Snyman, agreed to buy the farmers' produce, with the result that their net financial income increased from an average of R3 754 to R42 486.

It wasn't only the farmers from the two cooperative farms who benefited from the project, because a number of demonstration days were held, with a good turnout of farmers from the region. And since none of the researchers could speak Tsonga, extension officers from the Limpopo Department of Agriculture were trained in the techniques so they could show the farmers what to do. They have, in turn, shared information with other extension officers working in the region, so the knowledge can be more widely applied.

The success of this project has attracted further funding for a public-private partnership project, called InnoGiyani, to promote agribusiness innovation in the area. The Netherlands' Ministry of Foreign Affairs is contributing half of the €6 million budget via its Facility for Sustainable Entrepreneurship and Food Security (FDOV), while the other half has to be generated by the project. The project aims to develop the Manombe Cooperative Trust in Giyani into a sustainable and profitable institution by facilitating the local production of high-quality maize flour, which will be purchased by the SPAR supermarket.

One of its targets is to rehabilitate Giyani's former irrigation scheme. Dr de Clercq explains that the apartheid government



MSc student, Cou Pienaar, explains his research findings at a Farmers Day held during the project.



The experimental plot for tomato production with fertiliser treatment but no mulch cover.

operated a vast banana production system here as a way of showing that the Gazankulu homeland 'worked', but after financial and technical aid dried up post-1994 it slowly declined until 2006, when most activity came to a halt.

Some 800 ha of the 1 500 ha of land will now be used to cultivate more water-efficient maize, and a defunct maize mill in Giyani will be refurbished to process the crop. Profits will be re-invested to support the cooperative, tailor-made training and capacity-building will be provided, and an innovation hub will be established to help identify new business opportunities.

"Everything is in place for the project, and we are busy repairing some of the water supply lines and so on, but as a result of the drought we decided not to start as yet," says Dr De Clercq. "We don't want to make use of the water that was allocated to us for irrigation while the rest of the community doesn't have water for their livestock."

He explains that water shortages will be alleviated to some extent once the Department of Water and Sanitation's Nandoni Pipeline Project, which will transfer water from the Nandoni Dam on the Luvuvhu River near Thohoyandau to the Nsami Dam just north of Giyani, is completed.

As part of the EAU4Food project, hydrological modelling was conducted to get a better understanding of water availability in the catchment, and how this might be affected if the smallholder farmers increased their crop production. The SWAT (Soil and Water Assessment Tool) model was initially applied for the entire Limpopo catchment to study the effect of irrigation and fertiliser application on crop yields and hydrology. The results indicated that crop yields increase when both irrigation and fertiliser operations are applied, but so does plant transpiration, causing increased evapotranspiration and hence decreased river flows.

Subsequently, SIMGRO (Simulation of Groundwater and surface water levels) was applied at the subcatchment scale, for the Letaba basin. The model simulates regional transient saturated groundwater flow, unsaturated flow, actual evapotranspiration, sprinkler irrigation, stream flow, and groundwater and surface water levels as a response to rainfall, reference evapotranspiration and groundwater abstraction.

Irrigation is known to account for more than 50% of total water demand in the basin, but most of this is by large-scale commercial farms. They use surface water from the major dams – there are 22 in the basin – while smallholder farmers use mainly groundwater, unless they are located next to a stream. The modelling results showed that, as for the SWAT findings, applying more water and/or nutrients on smallholder farms increases water use by crops. However, since the area occupied by smallholder farming makes up only 0.5% of the basin, even increasing the area by 50% or changing to crops with a larger evapotranspiration would have a very small influence on river flows.

"One of the reasons we did these modelling studies was to make sure we understand the system, so that when we start the InnoGiyani project we will not affect the water supply to the

Kruger National Park downstream, nor the water quality," says Dr De Clercq. "And we're now quite certain that we know how to manage irrigation in such a way that we don't negatively influence the water pathways."



Smallholder farmers attend a demonstration day.



The farmers participated in a 'photo safari' to document the challenges they experience.



Mulching did not have a significant effect on yield or water productivity, but resulted in less surface evaporation from the soil, ensuring more sustainable use of water resources when combined with better irrigation management.