Farmers along the lower Orange River are dependent on releases from Vanderkloof Dam, more than 1 000 km upstream.

Drinie van Rensburg

South Africa and Namibia ensuring enough irrigation water together

A demonstration project on water management was recently conducted at the Noordoewer-Vioolsdrift Joint Irrigation Authority under the auspices of the Orange-Senqu Strategic Action Programme. Sue Matthews reports.

The four-year UNDP-GEF Orange-Senqu Strategic Action Programme has recently come to an end, but has provided a solid foundation for sustainable development and environmentally sound water resource management in the Orange-Senqu basin. The programme was established to provide support to the Orange-Senqu River Commission (ORASECOM) in promoting integrated water resource management in the basin and its four member countries – South Africa, Lesotho, Botswana and Namibia. It included the finalisation of the Transboundary Diagnostic Analysis to close knowledge gaps and identify problems, causes and effects in the basin, and the

development of National Action Plans and an overarching Strategic Action Programme to address them. At the same time, a number of projects were implemented, two of which were on the final stretch of the Orange River's 2 200 km journey from source to sea.

A two-year demonstration project on water management in the irrigation sector was conducted at the Noordoewer-Vioolsdrift Joint Irrigation Authority with the aim of encouraging more efficient use of water and better pollution control. Many people might recognise these place names as the Namibian and South African border posts at the international boundary along the Orange River, but back in 1933 – when the then South West Africa was under South African control – the government constructed an irrigation scheme on both sides of the river to stimulate agricultural development and job creation. Namibian independence in 1990 meant that the scheme could no longer remain under South African jurisdiction, so in 1993 the Joint Irrigation Authority was established, with a Board made up of representatives of the two farming communities, the South African Department of Water Affairs (now the Department of Water and Sanitation) and the Namibian Department of Agriculture.

Today the irrigation scheme delivers about 15 million m^3 of water per year to almost 884 ha of farmland, 600 ha of it on the South African side of the river. Water is diverted at a weir 13 km upstream of the border post into an open canal that runs alternately along each bank, criss-crossing the border five times via inverted siphons under the Orange River to supply farmlands spread along a 28 km stretch of river. In a few places water is pumped from the river to augment the flow in the canals, while some farmers pump their own irrigation water directly from the river. Sub-canals carry the scheme's water to the various agricultural fields, where farmers each withdraw their allocation – 0.042 $m^3/s/ha$ for a period of six hours per week – by opening sluice gates.

The system relies on honesty and peer pressure – water usage is not measured, although as part of the demonstration project a number of measuring devices were temporarily installed. These included an ultrasonic flow measuring device in the the canal upstream of the first off-take, multiple submersible pressure probes and V-notches to measure the water usage of flood irrigation, as well as water- and electricity meters on pumps supplying water into the canals and at the farmers' own pump stations.

In addition, an automated weather station was erected and 28 soil moisture probes installed in pairs to provide data at 15 minute intervals for use in irrigation scheduling. These were left *in situ* after the completion of the demonstration project, but most of the soil probes were removed when fields were prepared for a new planting of cash crops.

Project Leader, Francois du Plessis of MBB Consulting Engineers, is not concerned by this. "The demonstration project was to show the farmers what can be done, and it will take a little effort for them to start to apply what they learned," he says. "Plus they may have to contract a service provider to give advice on soil moisture status and to maintain the equipment."

Other components of the project were training sessions on irrigation scheduling, crop cooling and frost protection, and field trips to visit other irrigation schemes in the Northern Cape and Namibia so that best practices being applied there could be observed.

"The field trips were especially valuable for them," says Du Plessis. "They could go and see what other people are doing, opening their eyes to new possibilities. For example, laser-level flooding is really catching on, and more and more of them are doing that now."

Prior to the 1970s, earth canals and flood irrigation were the norm in irrigation systems, especially along the Lower Orange River. While many of the canals have since been lined, flood irrigation – a particularly inefficient form of irrigation – is still widely used. In fact, it is experiencing a resurgence in popularity in the face of rising energy prices, since it is a gravity-fed irrigation system.

Lucerne is the dominant crop in the Noordoewer-Vioolsdrift irrigation scheme, making up 22% of the

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The Orange River sustains Namibian and South African crops in the Noordoewer-Vioolsdrift Joint Irrigation Authority.

***Right:** Soil moisture probes provide data for irrigation scheduling.*

***Below:** The main canal supplies a number of sub-canals along its route on either side of the border.*

François du Plessis

total hectares planted, and almost all of it is flood-irrigated. Other major crops – in descending order of importance – are grapes, tomato, butternut, baby marrow, mango, green beans and pumpkin, while 19 others make a smaller contribution. Most of these crops are flood-irrigated somewhere in the scheme, so this method accounts for 41% of the total hectares planted.

By laser-levelling their land, farmers can improve the distribution uniformity of flood irrigation, and hence make it more efficient. To date, laser-levelling only makes up 4% of the scheme's total hectares, but the number of farmers adopting this technology for a variety of crops is growing steadily. Drip irrigation contributes 31% of the total, being used for green bean crops, the majority of the tomatoes and many of the other crops too. Most vineyards depend on micro-irrigation, which is also used for some mango crops, bringing the contribution of this method to 17%. Pivot and sprinkler irrigation make up the remaining 7%.

Du Plessis predicts that drip and micro irrigation will become increasingly important in the scheme.

"These methods allow for much more effective control," he says. "The traditional flood-irrigation systems are only about 60% efficient, so much of the water that they apply goes back into the river, taking nutrients with it. This is the main reason the farmers are interested in laser-levelling – the saving in fertilizers – and it also requires less labour."

Of course, irrigation return flows may also increase the nutrient loads and salinity of the river, which is why the demonstration project included a pollution control component. A handheld meter was used for monthly water quality measurements in the river and canal system, and samples collected for laboratory analyses, but no deterioration in water quality could be detected from one end of the scheme to the other. The instrument was donated to the Joint Irrigation Authority at the end of the project, with the hope that this monitoring would be continued.

Using all the information collated during the demonstration project, a Water Management Plan was developed for the scheme, which the Joint Irrigation Authority will update annually in accordance with the requirements of Water User Associations outlined in the National Water Act. The process involves analysing current water use, setting targets for improved efficiency, and planning a realistic means of reaching those targets. The aim is to improve water conservation and water demand management in the agricultural sector, which is the biggest user of water in South Africa, and considered the most wasteful.

At present, the farmers have little incentive to save water as the scheme delivers enough to meet their combined quota. However, the water supply is dependent on releases from Vanderkloof Dam, more than 1 000 km upstream, and it is not a constant volume as releases are subject to the dam's complex operating rule. Since the water takes about a month to reach the irrigation scheme and there are a number of other users upstream, temporary shortages do occasionally occur, especially during heat waves. High flows come down the river periodically too

François du Plessis

because ESKOM, which uses the releases for hydropower generation, is permitted to release additional water once the dam level is above a certain limit. This water may arrive at times when the farmers cannot make optimal use of it.

Construction of either a small balancing dam or a large storage dam just above Vioolsdrift was recommended a decade ago as an outcome of the joint South African and Namibian Lower Orange River Management Study, better known as LORMS. A pre-feasibility design and costing was subsequently carried out for a small balancing dam, which could be used to re-regulate flows.

At that stage, significant 'operational losses' estimated at 270 million m^3 per year were occurring due to inefficient management of the Orange River system. The operating rules for hydropower releases were amended in 2008 to improve efficiency, but still did not take into account any inflow from the Vaal River, which enters the Orange River more than 180 km below the Vanderkloof Dam. This inflow varies from almost zero flow to extremely high flow when the major dams are spilling, and was estimated to average 1 680 million m^3 per year at the 2005 development level. There are also sporadic local inflows from the catchment downstream of the Orange-Vaal confluence. A dam close to Vioolsdrift could 'catch' these flows and provide more water to downstream users, which may well be necessary given that Namibia is planning new irrigation schemes along the Lower Orange River.

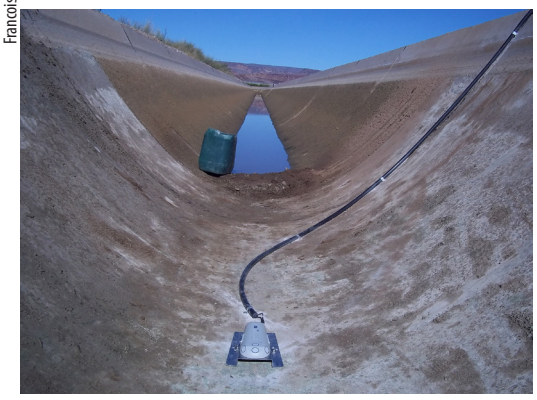
Furthermore, the launch of Phase II of the Lesotho Highlands Water Project in March has highlighted another motivation for building the dam. Phase II includes the construction of the 2 200 million m^3 capacity Polihali Dam, expected to be completed in about 2022. Water will be transferred via a tunnel from the Polihali Dam to the Katse Dam – built during Phase I – and then delivered to the Vaal River basin to meet demand in Gauteng. This will divert flows that currently enter the Orange River, reducing the yield of the Gariep and Vanderkloof dams to such an extent that shortages will be experienced downstream. The Vioolsdrift Dam would provide a means to offset this reduction and correct the yield versus demand balance in the Orange River system.

A reconciliation strategy for the Orange River Water Supply System is currently underway, the aim being to ensure that sufficient water can be made available to supply the current and future water needs of all users to the year 2040. The study will entail analyses of various scenarios, including different projections of future water requirements, revised operating rules and options for infrastructure developments – among them the dam at Vioolsdrift, and whether this should be a small balancing dam or large storage dam.

Of course, the environmental impact of dams is always a concern, but in this case aquatic ecologists recognise the advantages of a small balancing dam at Vioolsdrift. The dampening of floods by Vanderkloof Dam, together with its year-round release of water, mean that flows reaching the Orange River estuary are much more constant than would have occurred under natural conditions. This has had a range of negative consequences, mainly because the mouth now stays open almost permanently and the supratidal saltmarsh rarely gets inundated. Being able to manipulate flows reaching the estuary by controlling releases from Vioolsdrift Dam – 350 km upstream – would allow for mouth closure and back-flooding of the supratidal saltmarsh.

In order to improve understanding of the effects of this and other dams being constructed or considered, the Orange-Senqu Strategic Action Programme included a research project on the environmental flow requirements of the Lower Orange River, focussing on the river reach below the Fish River confluence. More on that in the next issue of *The Water Wheel.* ❑

Francois du Plessis



***Top left:** Site visits to other irrigation schemes allowe farmers from the Noordoewer-Vioolsdrift Joint Irrigation Authority to share experiences and discuss best practices.*

***Bottom left:** An ultrasonic flow-measuring device was used during the demonstration project.*