The GWK Limited Irrigation Scheduling Service

The Orange-Vaal Water Users Association's Louis Bosman canal is 24 km long and diverts Orange River water across the divide into the Douglas weir basin in the Vaal River.

It typifies the massive scale and advanced technology of the irrigation area served by GWK Limited (previously Griqualand West Cooperative) with head office in Douglas that now with recent expansions includes some 62 000 highly productive irrigated hectares, two-thirds under centre pivots.

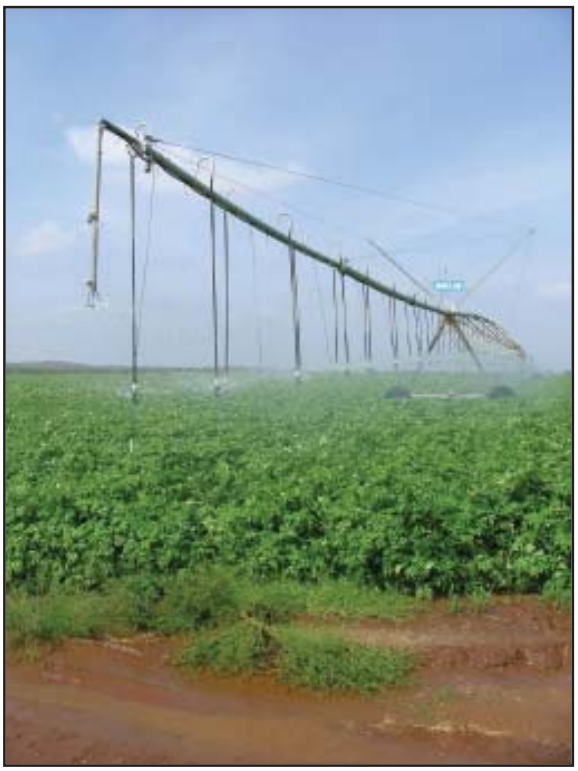
Two of the three Water Affairs and Forestry pilot studies on implementing Water Demand Management that are now approaching successful completion are situated in GWK territory. The studies have been undertaken in conjunction with the Orange-Riet and Orange-Vaal Water User Associations. Possibly a factor that influenced their selection was the well-accepted irrigation-scheduling programme provided by GWK.

There is a perception that all irrigators should "schedule", that is, apply the right amount of irrigation water at the right time based on scientific procedures and that relatively few do! This is not the case where GWK operates and where nearly two-thirds of the area, or about 40 000 ha, is being scheduled. Approximately 55% is being scheduled by the GWK service while consultants cater for a further 12%. Centre pivots predominate in the area and they facilitate scheduling, but this is probably an unequalled record anywhere in the world.

The centre pivots stretch from horizon to horizon and are multi-purpose machines that have revolu-

All concerned with irrigation management are aware of the policy changes brought about by the National Water Act of 1998 and the current emphasis on Demand Management Strategies aimed at making more effective use of existing water sources in preference to creating new ones. Pressure is on for more efficient water use.

tionised irrigation in the region. The spray nozzles are just above the crop reducing wind losses and soil compaction. Fertiliser is applied with the water (fertigation) and there are attachments for applying insecticides and herbicides. They are push-button adjusted or in many cases telemetrically controlled. It is even possible to pre-programme for an extended period.



The significance of the GWK scheduling method lies in its simplicity. To all intents and purposes no additional workload is imposed on the farmer. Once a week he is provided with the level of the soil water in the profile and can then decide if he should step up or reduce the irrigation applications of the pivot during the subsequent week. It is just like pulling up to the garage pump in your car and having the petrol attendant show you the dipstick and ask if you want one or two tins of oil? (It is so similar that if I am sure nobody from GWK is listening I refer to it as the "dipstick scheduling method").

Down the years the Water Research Commission has funded a number of irrigation research projects in the area and there are new projects coming on stream. These projects lead to a number of computer programmes (PUTU, BEWAB, SWB, and SAPWAT) that directly or indirectly could play a role in scheduling. What the Manager Agriservices, Dup Haarhof, achieved, quite apart from his own research contributions, was to weave this data and practical experience into a procedure that was in balance with the climate, crops and soils as well as the irrigation and management practices of the farmers in the area.

What makes the success of the GWK programme all the more remarkable is that while many of the farmers have computers they do not need to use them in the scheduling process unless they prefer to have information e-mailed to them. Irrigation scheduling is so often equated to the farmer use of computer models but here GWK

Andries Wiid, scheduling supervisor Western Region, looks after the computer side of things, organizes and advises. If he sees things going wrong he is quick to warn and recommend. Last winter he had 60 clients with 380 centre pivots and 500 measuring stations.

Sindy de Jager is the scheduling administrator for the GWK Western Region and handled 500 measuring points through last winter and a further 325 this summer. One of the three field units visits each site once a week and Sindy enters the neutron probe readings into the computer that is programmed to do the calculations and produce the output tables and graphs. The results are transmitted, with a minimum of delay, to the farmer by e-mail, fax or SMS.

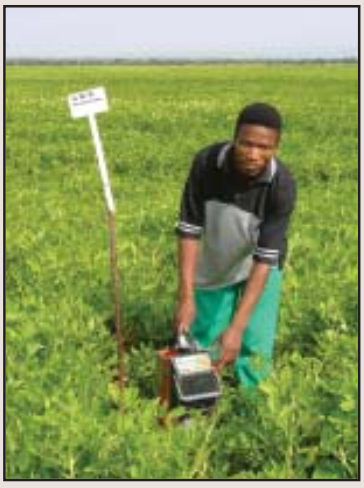
Top right: *This energy and control centre illustrates simplicity in modern technology. No unnecessary buildings or fuss. Just Eskom power, pump house, instrument room and tanks for storing fertiliser and chemicals.*

Bottom right: *Field measurements of profile water content are taken by neutron probe at measurement points where an aluminium pipe is tightly fitted into an augured hole 1.20 m deep. Water content readings are taken at 0.3 m depths over the full 1.20 m depth.*

The first and vital step in the process is to make a small circular dam about 3 m in diameter around the neutron probe pipe and to keep filling the dam up with water until the profile is saturated. The surface is covered with a plastic sheet to prevent evaporation losses and the excess water allowed to drain away. The time this takes, depends on the water holding capacity of the soil but at the end of the process the so-called upper limit or field capacity of each soil layer is known.

The other important point is the refill water content that is the stage when the crop would start to be exposed to stress and the trick of scheduling is to irrigate in such a way that the water content in the root zone remains between the two limits - thus we are back to the dipstick!

Adam Mosebets, scheduling assistant, takes soil water content readings with the neutron probe on his regular weekly visit to the measuring point. On his return to the office Sindy de Jager will download the readings on to the computer and the farmer will soon have the results. Note the extensive area under the pivot. What does this cost? This depends on the the number of measuring stations on a farm and the number of weekly visits during the season. A typical example is 200 ha wheat, 13 weekly visits to 6 measuring points that came to R5 705 or R28.53/ha. On another farm 600 ha of wheat with 17 measuring points and 17 visits this came down to R17.66/ha. According to the GWK Costs Guide *inputs totalled R6 060/ha so that scheduling represented from a quarter to half a per cent.*



specialists handle the computer work in the background.

A crop of maize running at over 13 t/ha under a 50 ha centre pivot represents an expenditure on production inputs of R320 000 and at current prices a gross income of R715 000. This is in the same order as the capital investment in the centre pivot.

Should the maize be double-cropped with wheat the totals for the year would add up to R623 000 and R1 202 500. This is high risk intensive management farming and nothing can be allowed that could have an adverse impact on yield or quality. The position is even more critical in the case of a crop such as onions that is subject to volatile market forces where the corresponding figures are R2 300 000 and R5 500 000.

The GWK scheduling service, in all its simplicity, has been developed to meet the needs of these farmers and has stood the test of time.

Johannes Haas (left), scheduling assistant, is one of two working out of Douglas. Here he sorts out a minor problem with a neutron probe cable under the watchful eye of Andries Wiid and a farm foreman. Absolute reliability is essential and requires discipline, organised training and support at all times.

SCHEDULING WEEKLY DATA

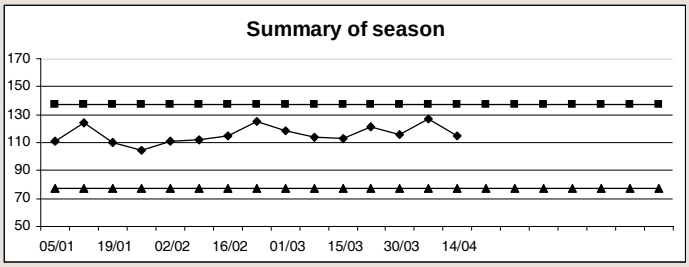
This is the condensed output that the farmer receives weekly for each measuring point.

Pivot # 3			Previous	Current
mm	Upper/ Lim	Low/ Lim	06/04	14/04
0-30	38	23	36	33
31-60	31	16	31	27
61-90	32	17	30	28
91-120	36	21	31	28
0-120	**137**	**77**	**127**	**115**

The water content of the soil in mm is determined for each 30 mm layer plus the total for the root zone as a whole by subtracting the Lower Limit from the Upper Limit in each case. The water holding capacity of the profile is 137-77 = 60 mm. The last two columns give the actual water content at the end of the previous week and of the current week. In this example the profile had dried slightly but at 115 mm was still comfortably in the "safe range". This implies that the water added by irrigation and possibly rain had been adequate.

Surplus/ deficit	Weather station	Rain meter	Recommendation
-22	26	10	25

This table indicates the current state of the profile. The water content has a deficit of 22 mm implying that 22 mm is required to bring it up to the level of the Upper Limit. "Weather station" is the calculated water requirement of the crop based on weather data using a Putu or Sapwat routine based on crop factors or possibly Bewab programme. Rain meter is self-explanatory while the "recommendation" is based on a calculated water balance and provides perspective.



The "summary of season graph" is in practice the crux of the matter from the point of view of the farmer. He knows that if he keeps wobbling along between the limits he will not be going far wrong. It is seldom possible to give the quantity of water planned each week to each pivot. In practice other operations upset the rhythm or things go wrong. Despite this it is quite surprising how effectively farmers keep on track, compensating from week to week.