

Executive Summary

1. Introduction

The Water Research Commission of South Africa initiated a research project in 2000 in order to review the current situation and needs in the field of irrigation water measurement in South Africa. It commenced in 2001 and was undertaken by the Department of Civil and Biosystems Engineering of the University of Pretoria together with the Agricultural Research Council's Institute for Agricultural Engineering and NB Systems. The initial project proposal provided for a three year project period but during the second year the project steering committee recommended that the project be extended with an additional year, and the extension was approved by the WRC. **The main objective of the project was to develop guidelines for the correct choice, installation and management of water measuring devices by Water User Associations for canal, pipeline and river distribution systems.**

The main objective was achieved through the four project aims as included in the original project proposal, and listed below:

- **Aim 1:** To identify the methods and technologies for water flow measurement (hydraulic, mechanical, electrical) used in different water distribution systems (canals, pipelines, rivers) on irrigation systems under South African conditions, and
- **Aim 2:** To investigate the effectiveness of the various flow measurement methods and technologies through laboratory and field evaluations.
- **Aim 3:** To determine the reasons for not measuring water use in practice by means of a field survey amongst farmers
- **Aim 4:** To Compile guidelines for the correct choice and management of water measuring devices for irrigation systems under different conditions

2. Project activities

A series of field visits to prominent irrigation areas in South Africa as well as visits to a number of measurement equipment manufacturers and the relevant government departments were undertaken to address Aim 1. A comprehensive literature study of flow measurement in irrigation was also conducted.

A considerable amount of time was spent on the activities required to reach Aim 2, which was addressed through the installation of various flow measurement devices at irrigation schemes. Different types of flow meters as well as water level sensors were installed at a number of WUAs, and monitored for extended periods of time. Shorter evaluations were conducted under laboratory conditions.

Surveys were conducted amongst water users from 6 different water user associations with different water distribution systems, irrigation systems and farming conditions as part of Aim 3. The areas covered were the Lower Riet River, Umlaas River, Loskop, Vaalharts, Hartbeespoort and Dendron. In addition to the farmer survey, a discussion forum on reliable measuring methods was held in Bloemfontein in April 2004. The purpose of the discussion forum was to provide an opportunity for stakeholders in irrigation water use and management to provide inputs into the final phases of the research project against the backdrop of the legal requirements according to the National Water Act, current water management practices, and available measuring methods. The Forum took place on 29 April 2004 in Bloemfontein, and although initially only about 25 people were invited, a total of 58 attended in the end.

As part of Aim 4, the water measuring guidelines included in this report were compiled and a computer based database of commercially available measuring devices for irrigation water (KBS) was developed.

3. Project results

The process of planning and installing measurement devices in the field exposed the project team to some of the constraints that WUAs has to face when implementing water measurement as required by legislation. The contact with specific WUAs helped to create a better understanding of the day-to-day activities on the schemes, and assisted in developing practical guidelines for water measurement, which was the main objective of this project.

A good practical working knowledge of measuring devices was established and information on different devices that are available both locally and internationally was gathered. The first hand experiences of the project team have definitely led to the development of new skills that will hopefully be put to good use in future.

The contact with water management staff and users showed that irrigation water measuring cannot be considered in isolation but is rather one of the tools that can be used by WUAs and of which greater awareness is necessary, especially as far as new technological development is concerned. This, together with the interest that was shown in the Discussion Forum, definitely points to a need for the transfer of information to WUAs and water users.

Conversations between project team members and participants during and after the forum indicated that there is a need for information to be made available to stakeholders at grassroots level. It was clear the participants were looking for information and clarity on how measurement should be implemented, and therefore they were also the ones that had to be consulted on the needs to be addressed by this report.

It was found that suitable measuring devices are available, but in order for them to be used successfully, they need be installed correctly, well maintained, and read accurately. In other words, a WUA's water measuring system has to be managed. This approach of managed implementation consists of at least the following components:

- A reason for measuring ("trigger"),
- Acceptance and support by the water users,
- Assessment of the current situation and planning the system,
- Choosing appropriate technologies,
- Correct installation by skilled technicians,
- Sound operation and maintenance policies,
- A system for data retrieval and management,
- Comprehensive financial planning, and
- Procedures for handling disputes and tampering

The guidelines that were compiled it aimed at implementing this approach successfully in practice, and give a detail description of the actions that need to be taken under each component listed above. The guidelines include a chapter on the approach that is recommended for implementing irrigation water measurement successfully in South Africa. There is currently no policy to guide WUAs in this and it is hoped that this chapter will provide some guidance to policy makers with regard to the issues that have to be addressed.

4. Research Products

Except for the knowledge and skills that were collected and developed by the project team members, the most important products were two publications:

- the Guidelines for the selection, installation and management of devices for irrigation water measurement, which forms part of the final project report, and
- the KBS (Knowledge Base System), a computer based database of irrigation measuring devices and their characteristics with extensive search and sort functions.

5. Conclusions and recommendations

The following conclusions could be drawn at the end of the project:

- The project team obtained valuable insight into irrigation water measuring practices and problems.
- A wide network of useful contact was established during the initial field visits and maintained through the field and laboratory evaluations that took place over three years.
- A good practical working knowledge of measuring devices was established and information on different devices that are available both locally and internationally was gathered.
- Each WUA's situation is unique, in order to identify the relevant measuring requirements, needs to be evaluated as such. No two WUAs can blindly use or apply the same devices or methods.
- Suitable technologies are definitely available, and their failure is more often than not linked to incorrect application (unsuitable for specific conditions), installation practices or lack of maintenance.
- Greater awareness of the availability of suitable devices amongst WUAs is necessary, especially as far as new technological development is concerned.
- There is an urgent need for water measuring policy to guide WUAs in selecting appropriate measuring devices and systems.

The following recommendations are made:

- A water measuring policy should be drawn up as a matter of urgency to provide a reference for implementation procedures.
- A special technical committee should be set up (by SANCID) to look after the interest of the irrigation sector in terms of measuring water including policy and institutional issues.
- A knowledge center should be created at the Department of Civil and Biosystems Engineering at the University of Pretoria, to continue research, prepare and distribute information, train students and provide a field service to WUAs in assisting them with measuring implementation, evaluating devices and trouble-shooting.
- A training manual and other training material based on the Guidelines and the KBS should be developed and this information transferred to interested parties through short courses or seminars.
- For the KBS to stay relevant, it will have to be maintained and updated regularly, and it is recommended that a way be found to do this on a website

6. Capacity building

6.1 Individuals

The following students from the Department of Civil and Biosystems Engineering completed projects based on specific components of the project activities as part of their studies and graduated in the course of the project, arranged according to completion date of studies:

- Ms TA Khumalo (M Inst Agrar): Allocation and Management of Water on Small-Scale Irrigation Schemes in South Africa
- Mr SB Ghezehei (MSc Applied Sciences): Comparison and performance testing of selected flow meters in-field and at a hydraulic laboratory
- Mr FH Hidad (MEng Agric) : Measurement of irrigation water losses from Canal D of the Gamtoos Irrigation Scheme
- Mr AJ Komakech (MEng Agric): Categorization and quantification of water losses in a lined canal and balancing dam at the Gamtoos Irrigation Scheme
- Mr YA Tsehaye (MSc Applied Sciences): Comparison of irrigation water measuring methods at the Umlaas Irrigation Board
- Ms I van der Stoep (MEng Agric): Evaluation of an indirect method for measuring irrigation water abstracted from rivers with centrifugal pumps

6.2 Communities

The farmers from the Kama Furrow community on the Zanyokwe Irrigation Scheme were involved with the installation of meters at their farms.

6.3 Organisations

The staff of the Orange-Riet Water User Association benefited from the project activities, but largely through their own initiative supported by the project team. In their search for measuring solutions, they have explored various options and set an example to other WUAs in this regard. The project team members have assisted them with the calibration of the prototype power-based meters purchased by the WUA, and learnt valuable lessons themselves in the process.

Through the field work conducted at this scheme, the water management staff was exposed to various measuring methods and devices. They supported the project team through assistance with data collection and maintenance to equipment. Mr Xolisa Ngwadla of MBB Consulting Engineers in the Eastern Cape has also benefited from the project through his involvement with the Gamtoos field tests. Mr Ngwadla is an agronomist by training, and although he has had no technical background, he successfully assisted the project team in managing the equipment at the scheme. He has obtained experience in telemetry systems, datalogger programming and operation, and been involved with measurements done by the DWAF Hydrometry staff.

The water bailiff from this Irrigation Board, Mr Owen Odell, was also actively involved with the field evaluations that took place at a river pump station. As a result of the evaluations, the Irrigation Board became aware that their method of measuring is in need of serious attention and that large errors are being made during measurement.