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**SUPPORT TO PHASE 2 OF THE ORASECOM BASIN-WIDE  
INTEGRATED WATER RESOURCES MANAGEMENT PLAN**

**Work Package 6:**

**Water Conservation and Water Demand in the Irrigation Sector**

**The Promotion of Water Conservation and  
Water Demand Management in the Irrigation Sector**



**February 2011**

**ORASECOM**



The *Support to Phase 2 of the ORASECOM Basin-wide Integrated Water Resources Management Plan* Study was commissioned by the Secretariat of the Orange-Senqu River Basin Commission (ORASECOM) with technical and financial support from the German Federal Ministry for Economic Cooperation and Development (BMZ) in delegated cooperation with the UK Department for International Development (DFID) and the Australian Agency for International Development (AusAID). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) implemented the study.



## Prepared by







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# 1 INTRODUCTION

## 1.1 General Context

The Orange - Senqu River originates in the highlands of Lesotho some 3 300m above mean sea level, and it runs for over 2300km to its mouth on the Atlantic Ocean. The river system is one of the largest river basins in southern Africa with a total catchment area of more than 850,000km<sup>2</sup> and includes the whole of Lesotho as well as portions of Botswana, Namibia and South Africa. The natural mean annual runoff at the mouth is estimated to be in the order of

11 500 million m<sup>3</sup>, but this has been significantly reduced by extensive water utilization for domestic, industrial and agricultural purposes to such an extent that the current flow reaching the river mouth is now in the order of half the natural flow. The basin is shown in **Figure 1-1**. The Orange-Senqu system is regulated by more than thirty-one major dams and is a highly complex and integrated water resource systems with numerous large inter and intra basin transfers.



**Figure 1-1: Orange – Senqu River Basin**

## 1.2 Management and Environmental Context

### 1.2.1 General

Management issues, including environmental protection, conservation and sustainable development have to deal with problems relating to, both, water quantity and quality, potential conflicts between users, pollution sources from industry, mining, agriculture, watershed management practices and the need to protect ecologically fragile areas. The riparian countries have for some time recognized that a basin-wide integrated approach has to be applied in order to find sustainable solutions to these problems and that this approach must be anchored through strong political will. The development of this strong political will is one of the key initiatives of SADC, in particular the Revised Protocol on Shared Watercourses and the establishment of the Orange-Senqu River Basin Commission

(ORASECOM). These initiatives are intended to facilitate the implementation of the complicated principles of equitable and beneficial uses of a shared watercourse system. It is accepted by all countries that the management of water resources should be carried out on a basin-wide scale with the full participation of all affected parties within the river basin.

Water supply in terms both of quantity and quality for basic human needs is being outstripped by the demands within and outside of the basin. Meeting the water supply needs of rapidly growing towns and cities at the same time having sufficient water of an acceptable quality to meet existing and proposed irrigation and other demands (including environmental) further downstream is a challenge for planners and decision makers and stakeholders in the Orange-Senqu river basin.

### **1.2.2 ORASECOM**

Southern Africa has fifteen trans-boundary watercourse systems including the Orange–Senqu system. The Southern African Development Community (SADC) has adopted the principle of basin–wide management of the water resources for sustainable and integrated water resources development. In this regard, the region recognizes the United Nations Convention on the Law of Non-navigational Uses of International Watercourses, and has adopted the “Revised Protocol on Shared Watercourse Systems in the SADC Region”. Under this Revised Protocol, a further positive step has been the initiatives towards the establishment of river basin commissions in order to enhance the objectives of integrated water resources development and management in the region, while also strengthening the bilateral and multilateral arrangements that have been in existence for some time. The Orange–Senqu River Basin Commission (ORASECOM) which was established on 3 November, 2000 in Windhoek, Namibia. is a legal entity in its own right.

The highest body of the ORASECOM is the Council consisting of three permanent members, including one leader, for each delegation from the four riparian states. Support from advisors and ad hoc working groups can be established by the council. The main task of the Council is to “serve as technical advisor to the Parties on matters relating to the development, utilization and conservation of the water resources in the River System”, but the council can also perform such other functions pertaining to the development and utilization of water resources as the parties may agree.

## **1.3 Context of the Study and this Working Paper**

### **1.3.1 GIZ Support to SADC and ORASECOM**

The overall goal of the GIZ-supported ‘Transboundary Water Management in SADC’ programme is to strengthen the human, institutional, and organisational capacities for sustainable management of shared water resources in accordance with SADC’s Regional Strategic Action Plan (RSAP). The programme, which GIZ implements on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), and in



delegated cooperation with the UK Department for International Development (DFID) and the Australian Agency for International Development (AusAID), consists of the following components:

- Capacity development of the SADC Water Division
- Capacity development of the river basin organisations (RBO) and
- Capacity development of local water governance and transboundary infrastructure.

The activities of this Consultancy, “Support to Phase II of the ORASECOM Basin-wide Integrated Water Resources Management Plan”, being undertaken by WRP (Pty) Ltd and Associates, contributes to Component 2 above. The work of Phase 2 comprises six work packages as briefly outlined in Section 1.3.2.2 below

### **1.3.2 Support to Phase 2 of the ORASECOM Basin-wide Integrated Water Resources Management Plan**

#### **1.3.2.1 Objectives of the Overall Consultancy**

The main objectives of this consultancy are to enlarge and improve the existing models for the Orange-Senqu Basin, so that they incorporate all of the essential components in the four Basin States and are accepted by each Basin State. These models must be capable of being used to meet the current and likely future information needs of ORASECOM. These needs will likely encompass additional options to achieve water security in each Basin State – including changing configurations for water supply and storage infrastructure - and ensure that ORASECOM is able to demonstrate that its operations are aligned with the principles embodied in the SADC Water Protocol.

#### **1.3.2.2 The Six Work Packages**

In order to contribute to the realisation of the above-mentioned objectives, the project includes six work packages as outlined in **Table 1-1**. The first of these work packages is central to Phase 2 of the IWRM Plan and will also be at the core of the final plan to be developed in Phase 3. In work package 1 the WRYM water resources simulation model is being updated and expanded to cover the entire basin.

**Table 1-1** Summary of Work Package Objectives and Main Activities

<b>Work Package</b>	<b>Main Objectives</b>	<b>Main Activities</b>
WP 1: Development of Integrated Orange-Senqu River Basin Model	To enlarge and improve existing models so that they incorporate all essential components in all four States and are accepted by each State	<ul style="list-style-type: none"> <li>• Extension and expansion of existing models</li> <li>• Capacity building for experts and decision-makers</li> <li>• Review of water balance and yields</li> <li>• Design/initiation of continuous review process</li> </ul>
WP 2: Updating and Extension of Orange-Senqu	Updating of hydrological data, hands-on capacity building in each basin state for generation	<ul style="list-style-type: none"> <li>• Assessment of Required Improvements to the Existing Gauging Networks.</li> <li>• Capacity Development</li> </ul>

Work Package	Main Objectives	Main Activities
Hydrology	of reliable hydrological data including the evaluation of national databases,	<ul style="list-style-type: none"> <li>• Extension of Naturalized Flow Data</li> <li>• Review of Existing Data Acquisition Systems, proposals on basin-wide data acquisition and display system.</li> </ul>
WP 3: Preparation and development of integrated water resources quality management plan	Build on Phase 1 initial assessment to propose water quality management plan, based on monitoring of agreed water quality variables at selected key points	<ul style="list-style-type: none"> <li>• Establishment of protocols, institutional requirements for a water quality monitoring programme, data management and reporting.</li> <li>• Development of specifications for a water quality model that interfaces with the systems models.</li> <li>• Capacity building to operate the water quality monitoring system and implement the water quality management plan.</li> </ul>
WP 4: Assessment of global climate change	Several objectives leading to assessment of adaptation needs	<ul style="list-style-type: none"> <li>• Identification of all possible sources of reliable climate data and Global Climate Model downscaling for the Orange-Senqu Basin</li> <li>• Scenario assessment of impacts on soil erosion, evapotranspiration, soil erosion, and livelihoods</li> <li>• Identification of water management adaptation requirements with respect to observed and expected impacts on water resources</li> <li>• Assessment of major vulnerabilities and identification of measures for enhancing adaptive capacities</li> </ul>
WP 5: Assessment of Environmental Requirements	Several objectives leading to management and monitoring system responsive to environmental flow allocations	<ul style="list-style-type: none"> <li>• A scoping level assessment of ecological and socio-cultural condition and importance</li> <li>• Delineation into Management Resource Units and selection of EFR sites.</li> <li>• One biophysical survey to collate the relevant data at each EFR site and two measurements at low and high flows for calibration.</li> <li>• Assessment of the Present Ecological State and other scenarios</li> <li>• Assessment of flow requirements, Goods and Services, and monitoring aspects.</li> </ul>
WP 6: Water Demand management in irrigation sector	To arrive at recommendations on best management practices in irrigation sector and enhanced productive use of water	<ul style="list-style-type: none"> <li>• Establish a standard methodology for collecting data on irrigation water applied to crops, water use by crops and crop yields;</li> <li>• Document best management practices for irrigation in the basin and finalise representative, best-practice demonstration sites through stakeholder consultation</li> <li>• Consider and assess various instruments that support water conservation/water demand management.</li> </ul>

The other work packages are both self-standing and intended to provide inputs to an improved and more complete water resources simulation model for the whole basin. The model will be enhanced by a more complete hydrology (WP2), better and more complete water quality information (WP3), allowance for climate change impacts and adaptation (WP4), inclusion of environmental flow requirements at key points (WP5) and modelling of scenarios with improved water demand management in the key irrigation sector (WP6).

### **1.3.3 Background to Work Package 6 and this Working Paper**

#### **1.3.3.1 Work Package Objectives**

The overall objective of the work package is to attain an overall understanding of how better management practices could reduce water demand in the irrigation sector in the Orange-Senqu River Basin, and to make recommendations on improved water demand management in this sector in the future. In order to reach this goal a number of sub-objectives were identified in the terms of reference:

- Developing a GIS Database irrigation inventory through the collection and collation of reliable and detailed information about the use of irrigation water by crops and crop yields
- Assessment of various instruments for enhancing productive use of water, e.g. water markets and their operation in a local as well as trans-boundary context
- Detailing the best management practices for irrigation in the basin;
- Selection and evaluation of demonstration projects of best practices at suitable sites;

#### **1.3.3.2 Work Package Activities**

- Collect and collate previous studies on water conservation and demand management in the in the Orange-Senqu River basin;
- Identify caveats/pitfalls related to the practical implementation of results of these previous studies in the basin;
- Establish a standard methodology for collecting data on irrigation water applied to crops, water use by crops and crop yields;
- Developing a GIS Database irrigation inventory through the collection and collation of reliable and detailed information about the use of irrigation water by crops and crop yields
- Document best management practices for irrigation in the basin;
- Consider and assess various instruments that support water conservation and demand management, also in a transboundary context.
- Hold stakeholder workshops
- Finalise and evaluate representative, best-practice demonstration sites; and make recommendations on how the generalisation of best management practices could improve water conservation and water demand management in the sector

### 1.3.3.3 This Working Paper

This working paper reports back on activities a, b, d, e, f, g and h. **Section 2** provides a brief overview of the approach and methodology. **Section 3** effectively covers a and b, providing a detailed overview of water conservation and water demand management in the irrigation sector in each of the basin states. Regulatory, institutional, technological and agronomic aspects are covered. It should be noted that there is very little irrigation in Botswana and none within the area of the basin. For this reason only a background to the sector and a review of the general regulatory and institutional frameworks are provided for this country. For both Lesotho and Namibia some detail on the irrigation sector as a whole is provided. The focus is not only on water demand management and water conservation. Less of this background has been provided for South Africa in **Section 3**, since much of it is provided in later sections of the report when several of the major schemes in South Africa are described in some detail.

The analysis of best management practices (e, h above) was carried out initially through a combination of site visits and stakeholder workshops covered in **Sections 4 and 5**. During this process a great deal was learnt about the caveats and realities (see b above) of many theoretical best practices when tested on the ground. During the stakeholder workshops, a number of best management practice sites were identified and then visited and evaluated (see h above) by the team. The results of these visits are described in **Section 6**.

Finally all the knowledge gleaned during the whole process was used to prepare the conclusions and recommendations that are presented in **Section 7**. These conclusions and recommendations are of both a general and specific nature. The team feels that there are fundamental general aspects and issues on which general recommendations have been based and made, and which ORASECOM will be encouraged to support. At the same time some recommendations of a more specific nature have been made. These are often technical or semi-technical measures which could be implemented relatively immediately and for which ORASECOM could perhaps secure donor funding either as part of Phase 3 of GiZ support or from other sources.

## 2 APPROACH AND METHODOLOGY

### 2.1 Introduction

The methodology utilized to identify implementable Water Conservation and Water Demand Management (WC/ WDM) approaches comprised a desk study to review water conservation and water demand management in the irrigation sector followed by the analysis and evaluation of best management practices currently in operation. The distribution of water to irrigators and the use of the water require very different management practices. It was therefore decided to evaluate BMPs at two levels;

- Distributor level i.e. Water User Associations (*water user associations*), Irrigation Boards (IBs), Departments of Water Affairs; and
- Irrigator level

### 2.2 Review of WC/WDM in the Irrigation Sector

This review was largely carried out during the Inception Phase and during the early part of the project. It was largely a desk-top review supplemented by discussions with key players in the irrigation sector. The objective of the review was to obtain a clear picture of existing and potential *water conservation and water demand management* measures and initiatives both in general and internationally and more specifically as appeared relevant to irrigation within the basin. The review provided the basis for the detailed stakeholder consultation which then followed. One key aim of the stakeholder consultation was to investigate the caveats that may exist and which make the implementation of *water conservation and water demand management measures difficult*.

### 2.3 Distributor Level Consultation

#### 2.3.1 Introduction

*Best management practices* at distributor level were evaluated by means of a four-step process. The first step was to visit the larger *water user associations* and, through the use of a questionnaire/discussion document, to document what was currently being done by each in terms of *water conservation and water demand management*. The second step was to hold a workshop for *water user associations* and their leading farmers where the initial findings of the visits to *water user associations* were presented and discussed. One or more *water user associations* which were the most advanced in terms of WC /WDM were then identified for further in-depth investigation. The third step was to visit the identified *water user associations* and do an in-depth investigation of their *water conservation and water demand management* practices, which were then documented. The fourth step was to draw conclusions and make recommendations on key *best management practices* and how their implementation could be more generalized.



### **2.3.2 South Africa**

The International trend in *water conservation* and *water demand management* is for water distributors to draft a water management plan (WMP) in which the distributor sets itself certain goals for improvements in *water conservation* and *water demand management*.

In terms of the South African Water Act a Water Management Plan (WMP) is mandatory for all *water user associations* established in terms of the Act. The Department of Water Affairs (DWA) has prepared guidelines for use by *water user associations* in drafting their WMPs. The guidelines are based on international best practice and set initial BMPs for distributors which can be continuously improved and evolved over time. DWA are currently appointing service providers to assist *water user associations* to draft their first WMP.

In order to not create confusion amongst *water user associations* it was logical to not draft a new set of questions but to rather build on what has already been achieved by DWA. A questionnaire/discussion document based on DWA's WMP guidelines was drafted and used as a basis for discussions with *water user associations* during site visits. Appendix 1 is the questionnaire/discussion document that was used.

Nine of the larger *water user associations* and IBs in RSA, representing approximately 85 000 ha, were visited and the questionnaire/discussion document completed.

### **2.3.3 Namibia**

All of the large irrigation water distributors within the basin in Namibia were visited. These distributors are either a government department or an informal organization. The questionnaire used in RSA was not suited to these types of distributors and a less formal approach was used to determine current practices.

### **2.3.4 Lesotho**

The Lesotho Department of Agriculture was visited to determine the current state of irrigation Lesotho and a review of available literature on irrigation in the country was undertaken.

## **2.4 Irrigator level**

The evaluation of BMPs at irrigator level was undertaken by way of a three step process. The workshops with *water user associations* and their farmers were used to identify the leading irrigators using different (representative) irrigation systems. The second step was to visit selected farmers from this group of leading irrigators and observe and document their systems, approaches and efficiencies. The third step was to use their best practices to set initial benchmarks to encourage other farmers to gradually improve and evolve their irrigation practices over time.

### **3 REVIEW OF THE IRRIGATION SECTOR**

#### **3.1 Introduction**

The Orange-Senqu is the only river in southern Africa that rises in cool temperate and alpine regions, but which flows through progressively more arid terrain and ultimately through hyper-arid desert. This extreme range of climatic conditions has resulted in a wide variety of crop types being grown throughout the catchment under irrigation. In the more temperate north-eastern sections of the catchment rain-fed crop production occurs widely and is interspersed with irrigated cropping. Moving westwards, crop production becomes more dependent on irrigation to the point where rainfall is too low or too unreliable and only irrigated crop production takes place. In the more temperate north-western sectors, mixed cropping with field crops and fodder crops predominates. The main field crops are maize, wheat, potato, groundnut, cotton, soybean and dry-bean while the main fodder crops are lucerne, maize-silage and pastures. Limited areas of orchard crops such as cherry, apple and peaches are grown in the high altitude areas with adequate winter chill. In the dryer western areas permanent orchard and vine crops like table grapes, raisin grapes, wine grapes, citrus and dates predominate. Lucerne is also a common crop in the dryer western areas.

The great majority of irrigation in the basin takes place in South Africa. However, in recent years there has been a rapid growth in irrigation on the Namibian side of the river, especially in the growing of high value crops such as table grapes. There have been a number of irrigation initiatives in Lesotho and these continue with a view to increasing food security in the mountain kingdom. There is no significant irrigation in the Botswana portion of the basin and for this reason only some background to the sector country-wide is provided in the following sub-sections.

In the remainder of this section, a brief analysis is provided of regulatory, institutional and technical aspects of the irrigation sector as it is practised in each of the basin states. This sets the context for the more detailed analysis of irrigation practices on the ground presented in **Sections 4, 5 and 6**. The situation in South Africa is not described in as much length as for Namibia and Lesotho because much of the detail is provided in these later sections of the report.

#### **3.2 South Africa**

##### **3.2.1 Overview**

Water use for irrigation in the South African section of the Orange River catchment occurs in two main areas, the Vaal River catchment and the remainder of the Orange River catchment.

The Vaal River catchment, which covers three water management areas namely 8 (Upper Vaal), 9 (Middle Vaal) and 10 (Lower Vaal) under the National Water Act of 1998 extends into five Provinces, namely Free State, Gauteng, Mpumalanga, North West and Northern Cape. With respect to irrigation, the catchment has been divided into 10 irrigation zones each

consisting on a group of quaternary catchments and containing irrigation schemes and river reaches. The irrigation schemes fall under Government Water Schemes (GWS), Irrigation Boards (IB) or *Water User Associations*.

Licensed irrigation water use in the Vaal River catchment is in the order of 1 200 Mm<sup>3</sup>/annum on 150 000ha of which about 10 000ha falls outside controlled irrigation areas.

The main crops grown in the Vaal River catchment are annual field crops such as maize, wheat, potato, soybean, dry bean and groundnuts (80%), fodder crops such as lucerne, pastures and maize silage (17%) and orchard/vine crops (3%).

The remainder of the South African portion of the Orange River Catchment covers two water management areas under the National Water Act namely 13 (Upper Orange) and 14 (Lower Orange) and extends into three provinces namely Free State, Eastern Cape and Northern Cape.

The Orange River Replanning study of 1998 divided the Orange River into 22 River Reaches from the border of Lesotho to the Orange River mouth. These reaches only considered irrigation from canal infrastructure along the river or from direct river abstraction. These reaches have been referred to in various development initiatives particularly with respect to the involvement of emerging (resource poor) farmers.

Most of this irrigation occurs on commercial farms with freehold tenure. The average size of irrigated areas per farming unit is about 50ha. However, there are many farms with larger irrigated areas where consolidation of irrigation units under one owner has taken place in order to maintain or improve financial viability of irrigated farming. A programme to introduce and develop resource poor farmers on smallholder irrigation schemes is intensifying in the South African portion of the catchment but these areas make up only about 10% of total irrigation.

### **3.2.2 Regulatory and Institutional Aspects**

#### **3.2.2.1 Introduction**

South Africa's new National Water Act (Act 36 of 1998) provides for a fundamental reform of water resources law, for the conservation of a scarce resource, and for the equitable allocation of water for beneficial use.

Some of the key elements which guide water management in South Africa are that:

- The status of the nation's water resources as an indivisible national asset was confirmed and formalised.
- National government acts as the custodian of the nation's water resources and its powers in this regard is exercised as a public trust.
- Only water required to meet basic human needs and maintain environmental sustainability will be guaranteed as a right. This will be known as the Reserve.

- In shared river basins, Government is empowered to give priority over other uses to ensure that the legitimate requirements of neighbouring countries can be met.
- The new system of allocation will be implemented in a phased manner, beginning in water management areas which are already under stress. This system of allocation will use water pricing, limited term allocations and other administrative mechanisms to bring supply and demand into balance in a manner which is beneficial in the public interest.
- The riparian system of allocation, in which the right to use water is tied to the ownership of land along rivers, was effectively abolished. Transitional arrangements will over time, ensure an orderly, efficient and gradual shift in water use allocations as and when necessary.
- Water use allocations will no longer be permanent, but will be given for a reasonable period, and provision will be made to enable the transfer or trade of these rights between users, with Ministerial consent.
- To promote the efficient use of water, the policy will be to charge users for the full financial costs of providing access to water, including infrastructure development and catchment management activities. This will be done on an equitable basis and according to the realistic reasonable programme which has already been begun.
- All water use, wherever in the water cycle it occurs, will be subject to a catchment management charge which will cover actual costs incurred.
- To promote equitable access to water for disadvantaged groups for productive purposes such as agriculture, some or all of these charges may be waived for a determined period where this is necessary for them to be able to begin to use the resource.
- All major water use sectors must develop a water use, conservation and protection policy, and regulations will be introduced to ensure compliance with the policy in key areas.
- Provision will be made for the phased establishment of catchment management agencies, subject to national authority, to undertake water resource management in these water management areas

### **3.2.2.2 Catchment Management Agencies (CMAs)**

*Catchment management agencies* are statutory bodies established under the Act. A *catchment management agency* manages water resources within its Water Management Area. South Africa has been divided into 19 Water Management Areas as part of the progressive development of the National Water Resource Strategy.

*Catchment management agencies* must develop and implement a catchment management strategy for the water resources within their Water Management Area. Catchment management strategies must be in harmony with the National Water Resource Strategy.

### 3.2.2.3 Water User Associations

A *water user association* is a statutory body established by the Minister under Section 92 of the Act. *Water user associations* are, in effect, cooperative associations of water users who wish to undertake water-related activities for their mutual benefit. A water user association must accommodate all water sectors within their area of jurisdiction.

The broad role of a *water user association* is to enable people within a community to pool their resources (money, human resources and expertise) to more effectively carry out water-related activities. Members will thus benefit from addressing local needs and priorities.

The Act provides adequately for the implementation of *water conservation and water demand management* in the irrigation sector and the Department of Water Affairs (DWA) has developed (WC/WDM) strategies and guideline documents for agriculture. The Act requires that *water conservation and water demand management* be driven primarily by *water user associations*. *Water user associations* are, in turn, required to submit annual business plans, to a *catchment management agency*, or the DWA in the absence of a *catchment management agency*. The business plans are to include a Water Management Plan (WMP).

The development of a *water management plan* by a *water user association* is central to implementing *water conservation and water demand management* in the agricultural sector. The *water management plan* sets out benchmarks and best management practices for *water conservation and water demand management* and a manageable and affordable programme for their implementation by both the *water user association* and their irrigators over time. The *water management plan* is therefore the primary tool with which the agricultural sector is expected to implement the National Water Conservation and Demand Management Strategy (NWCDMS).

In terms of this strategy, the vision of all *water conservation and water demand management* endeavours is the efficient use of water by water institutions and consumers in South Africa.

Efficiency is understood as the ratio between inputs and outputs: the bigger the output for a given input, the higher the level of efficiency. The NWCDMS defines “output” in terms of:

- economic output;
- social development;
- social equity;
- environmental protection;
- sustainability of water supplies and services; and
- political acceptability,

The input is simply water and its associated management. These principles arise out of the fact that the water systems of South Africa are developed and owned by the public sector and paid for with taxpayers’ funds, but are used by the private sector. There is therefore an



expectation that they should deliver public goods to the population at large as well as private goods to the direct consumers of the water.

These considerations require that a *water management plan* should be efficiency and output driven, it must operate within accepted national principles, and it must be linked back through the Agricultural WCDM strategy and National WCDM strategy to the provisions of the National Water Act.

This approach places the responsibility of water conservation squarely in the hands of the water distributors and their water users.

South Africa's approach to water conservation and water demand management is also aligned to three important global trends in water resource management:

- integrated water resource management within catchment boundaries;
- decentralised management, operation and maintenance of water delivery; and
- improved management of existing water resources to promote water use efficiency and water conservation.

All of these trends are given effect through the National Water Act.

### **3.2.3 Technological Aspects**

#### **3.2.3.1 Conveyance and Distribution Systems**

The South African portion of the basin is characterised by a highly sophisticated network of water storage and conveyance infrastructure serving a large number of formal irrigation schemes.

In the case of the Vaal River portion of the catchment water is allocated to these schemes from 22 government controlled dams (including major dams such as the Vaal dam and Bloemhof dam through to minor dams and weirs) and is distributed to irrigators via canals, pipelines, balancing dams and pumping systems. There is a significant amount of uncontrolled (diffuse) irrigation from the Vaal River and its tributaries and from private farm-dams. In the Orange River portion of the catchment, irrigation water distribution is controlled from the Gariep Dam and the Vanderkloof Dam and a number of weir and canal systems along the Orange River. The Vanderkloof canal which runs for over 100 km from Vanderkloof dam is a major artery of high-quality Orange River water to the water stressed central region of the catchment near Kimberly, feeding the Riet/Modder irrigation areas.

Distribution to farmers within schemes is mainly by means of, calibrated sluice gates while in-line flow meters with telemetry are used in some schemes in the central region of the basin.

The irrigation distribution infrastructure and particularly the lined open canals are aging and the rehabilitation requirement is widespread. There are a few exceptions such as *Kakamas water user association* where a comprehensive upgrade of bulk infrastructure has taken place.

The infrastructure and operating systems within the catchment are covered in more detail in **Section 4**.

### **3.2.3.2 On-farm Technologies**

Centre pivot irrigation now makes up about 80% of all irrigation systems in the catchment and micro-jet and drip irrigation systems are dominant in the orchard and vine crops. Flood irrigation is still practiced widely in the basin particularly on the Lower Orange areas like Boegoeberg, Upington and Kakamas.

The majority of farmers irrigate on the basis of an allocation of irrigation water per ha and technical irrigation scheduling is the exception rather than the rule. These are both aspects which are of critical relevance to water conservation and water demand management in the irrigation sector and will be re-visited several times in this report.

### **3.2.4 Agronomic Aspects**

Relatively low-value field crops such as maize and wheat and fodder crops like lucerne make up over 85% of irrigated crops in the South African portion of the catchment. Higher value field crops like potato, vegetables and certain annual fruit crops such as sweet melon, make up only about 5%. The move to higher value orchard and vine crops, which tend to be more water efficient and provide a significantly higher net financial return per unit of irrigation water, make up about 10% of irrigated crops. This present situation is determined by a number of key factors:

- Assurance of irrigation water supply: Without a high assurance of supply (in irrigation terms) farmers are hesitant to convert to capital-intensive permanent crops which do not allow any form of flexibility in times when water allocation cuts may be necessary. Farmers therefore usually prefer to stick with annual crops which reduces risk in times of reduced allocation.
- Cost of water: The present cost of water usually allows farmers to farm profitably using annual field crops, provided they maintain a reasonably high standard of management and intensive rotation of summer and winter crops. However, their concern is that in the event of a significant increase in the cost of irrigation water (including the cost of pumping where required) profitability is likely to become marginal.
- High capital cost of establishing orchard and vine crops: Capital costs of establishing orchards and vines is extremely high (see **Table 3-1**). This remains one of the main disincentives for a change to export orientated, high-value crops particularly in the present depressed economy.
- The high-value orchard and vine crops have to be export-orientated for financial viability. This is often a deterrent to farmers because in a climate of fluctuating exchange rates, export of expensive and management-intensive crops can add to their financial risk .

- Management intensity: Successful production of permanent orchard crops has become a complex multifaceted agribusiness requiring good management skills, substantial financial resources and technical skills.
- Climatic risk: Add to the intensive agribusiness the potential climatic misfortunes such as hail and unseasonal frosts, it is understandable that the pace of change to such enterprises in the Basin has been relatively slow.
- Water quality issues: Deteriorating water quality has become a major concern particularly in the Vaal River system. The rate of change to orchard/vine crops is being affected by water quality because of their generally higher sensitivity to water quality. International marketing standards are putting pressure on fruit exporters to ensure that irrigation water quality meets minimum quality standards. In addition certain crops such as citrus are highly sensitive to water quality – particularly chloride levels.

There are, however, areas where rapid evolution to intensive and water-efficient irrigation is taking place in the Basin. The factors influencing this trend are consistent with the constraining factors discussed above. Taking the Lower Orange irrigation area from Boegoeberg Dam to Vioolsdrift as an example, the world-renowned table-grape and raisin industry has blossomed on the basis of favourable climatic conditions, relatively high assurance of supply of irrigation water and the development of sophisticated agri-business operators. In addition, as the industry expands onto the higher-lying ground away from the River, pumping costs (coupled with ever-increasing electricity costs) have become a significant component of crop production costs. This has led to an ever-increasing irrigation efficiency through sophisticated irrigation scheduling.

**Table 4.2** shows crop gross margins for the main crops grown in three broad regions of the Orange River.

This economic analysis of crops grown in the catchment was undertaken as part of this study and is reported on in more detail in another report from this work package “Irrigation GIS database; Interactive Database and **Irrigation Scenarios Tools**”. The analysis applies to three agro-economic regions which are broadly described as the Eastern, Central and Western regions. Their specific locality is described in the above-mentioned report

Gross margins represent income from the sale of the produce, less all direct costs that can be allocated to the production of the specific crop. The gross margins for each enterprise have been estimated using data from primary as well as secondary sources and are based on the following assumptions:

- The gross margins are based on an average of top producing farmers in the area in an attempt to be representative of a typical best practice farming operations in the region. In reality, the management practices among farmers, differ substantially which results in a wide variation in actual income and production cost of enterprises;

- Gross income is based on representative yields and current prices for the enterprise. Where the gross margin applies over a number of years (e.g. citrus) the values are given in constant 2010 prices;
- The gross margin costs include:
  - input costs such as seed, chemicals and fertilizer,
  - mechanical operations such as ploughing and spraying,
  - water charges and pumping costs,
  - all directly allocated labour costs (overhead labour costs such as the farm manager's salary are not included)
  - packaging and transport costs to the market.

The gross margin analysis shows that as one moves from the Eastern to the Western agro-economic regions the greater the production of high value, intensive crops such as table grapes, melons and raisins. Crops with the highest net returns per hectare are table grapes, melons and raisins.

**Table 3-1 Gross margin analysis of the main crops grown in three broad agro-economic regions of the Orange River catchment in South Africa**

Crop	Yield (t/ha)	Price (R/t)	Revenue (R/ha)	Total variable costs (R/ha)	Gross margin (R/ha)	Establis h-ment costs (R/ha)	Crop life cycle (yrs)	Amortization of establishment costs over crop cycle (R/yr)	Gross margin including amortized establish- ment costs (R/ha)
<b>Eastern Zone</b>									
Lucerne	19.0	917	17,426	10,524	6,902	13,933	7	2,787	4,115
Maize	14.0	1,300	18,200	14,608	3,592	-	1	-	3,592
Wheat	6.0	2,280	13,680	11,329	2,351	-	1	-	2,351
Dry beans	2.5	5,000	12,500	10,389	2,111	-	1	-	2,111
Cherries	3.0	50,000	150,000	70,000	80,000	240,000	20	12,000	68,000
<b>Central Zone</b>									
Lucerne	20.0	917	18,343	10,884	7,459	13,933	7	1,990	5,469
Early Maize	16.0	1,300	20,800	14,608	6,192	-	1	-	6,192
Late Maize	14.0	1,300	18,200	14,403	3,797	-	-	-	3,797
Wheat	7.0	2,280	14,820	11,447	3,373	-	1	-	3,373
Potatoes	40.0	3,250	130,000	83,831	46,169	-	1	-	46,169
Dry beans	2.5	5,000	12,500	10,389	2,111	-	1	-	2,111
Table grapes	18.0	16,667	300,000	168,186	131,814	321,812	20	16,091	115,723
<b>Western Zone</b>									
Lucerne	21.0	917	19,260	11,243	8,017	13,933	7	1,990	6,026
Melons	12.0	16,250	195 000	98,969	128,531	-	1	-	96 031
Table grapes	18.0	16,667	300,000	168,186	131,814	321,812	20	16,091	115,723
Dates	5.0	20,000	100,000	34,743	65,257	-	50	-	65,257
Raisins	10.0	8,675	85,883	56,889	34,754	36,059	20	1,803	32,951

### **3.3 Namibia**

#### **3.3.1 Overview**

The total agricultural area under irrigation in Namibia consists of about 9,000 hectares. Considering existing national water and land resources, the arable development potential through irrigation in Namibia is estimated at 43,500 hectares. This area leaves sufficient development potential not only to cover the substitution of existing food imports, which in terms of cereals, crops and horticulture products amounts to an annual amount in excess of N\$ 450 million, but also to enhance the exports of high value horticulture products such as grapes, dates, mangoes and some vegetable produce.

Irrigation in Namibia is mainly vested in either commercial enterprises, or in state owned projects. Very little informal irrigation takes place, mainly because of scarce water resources, combined with either very sandy soils or often high pumping heads. However, state owned projects are designed in such a way that  $\pm 50\%$  of each project is allocated to smallholder farmers, while the remaining 50% of the area is cultivated by commercial entities.

The part of the Orange River Basin which falls within Namibia consists of four catchment areas. The four catchment areas are again grouped into two main areas, namely the Orange-Fish River Catchment and the Nossob-Auob River Catchment:

Present irrigation from the two catchment areas comprises about 5500 ha, while the potential irrigable area is about 8750 ha.

- the Orange- Fish River Catchments (4 465ha)
- the Nossob – Auob Catchments (1 036ha)

#### **3.3.2 Regulatory Aspects**

The Water Act 54 of 1956 has a colonial origin and applies to Namibia the riparian principles of well-watered European countries. It is not only outdated but also, and above all, inconsistent with the country's hydrologic reality. It predicates the right to water through ownership of riparian land and thus effectively excludes non-landowners, particularly in the rural areas, from having adequate access to water.

The Government of Namibia is currently in the process of drafting the blueprint for a new Water Act for Namibia to replace the Water Act 54 of 1956. The Bill of the new legislation includes:

- The establishment of a Water Advisory Council as the nation's supreme advisory authority in water resources matters;
- The establishment of a Water Regulator and a Water Pricing Policy
- The establishment of a Water Resources Management Agency

- The establishment of Basin Management Committees to deal with matters relating to the use, protection, development, conservation, management or control of a water resource in a basin or part of a basin, including irrigation activities.
- The establishment of an International Water Management Institution to be responsible for implementing the international agreement.
- The establishment of Water Point Committees for the management of rural water supply services;
- The formation and periodic review of a National Water Master Plan.

Legislation on irrigation in Namibia has been in draft form since 1993. Two main constraints are impeding progress. On the one hand, the legislation should be in line with existing national and neighbouring country legislation, and this was impossible because the Water Act was not finalized. On the other hand, massive investment is needed to upgrade existing irrigation scheme infrastructure to levels that users could be expected to assume responsibility for it.

The National Agricultural Policy and the Green Scheme Policy are the only two pieces of legislation which currently directs irrigation development to a certain extent. The National Agricultural Policy of 1995 has the following guidelines relating to irrigation:

- To improve regional irrigation performance through improved economic efficiency.
- To ensure that future irrigation development should be socially and economically viable.
- To minimize direct government intervention and investment in present and future irrigation development, thereby reducing the government's financial burden within the sector. This should however not exclude the government from providing major, general infrastructural investment.
- To create an enabling atmosphere, whereby the non-government sector is encouraged to invest in irrigation development and manage their own operations.
- To establish the principle that the water user, rather than the government, pays for irrigation operation and maintenance.
- To encourage and support development of the informal irrigation sector, bearing in mind the need to limit direct government financial intervention.
- The government to provide sound national planning, monitoring and evaluation of irrigation development.
- To provide sound extension to irrigators, especially smallholders.
- To encourage the participation of women at all levels of the irrigation sector.
- To ensure that future irrigation development is environmentally sustainable.
- To ensure adequate health standards on irrigation schemes.
- To ensure close regional cooperation in future irrigation development.

There are elements of the policy which clearly encourage water conservation and water demand management, especially the principle that the water user should pay for irrigation operation and maintenance. In addition, a positive aspect is that commercial irrigation from boreholes is currently regulated by a permit system. Certain areas are declared as “Water Control Areas” and a permit is required from the Department of Water Affairs if the irrigated area exceeds one hectare. Since abstraction normally takes place on individual farms, no irrigation boards or authorities are involved. However, very little control is currently exercised by the Department of Water Affairs.

In the absence of adequate legislation to support irrigation sector development, a key policy development is the Green Scheme Policy (Cabinet Decision No. 18th/06.08.02/004). This approved a program of investment and promotion of increased food production through irrigation. Through irrigation development, Government aims to bring the private sector to remote and underdeveloped areas, thereby building local capacity in terms of production, marketing management and general development.

The Green Scheme is designed to maximise irrigation opportunities and aims at harnessing the resources of Government and other stakeholders in order to increase agriculture productivity and social development as envisaged in the NDP III and Vision 2030 strategy.

The Green Scheme is designed to achieve the following objectives:

- To increase agriculture production and sector contribution to GDP.;
- To promote investment in food production and agro industry;
- To mobilize private and public capital for investment in agriculture;
- To promote food security at national and household levels;
- To diversify agricultural production and products for the domestic and export markets;
- To promote research and adaptation of technology to increase productivity;
- To promote value addition and job creation; and
- To promote skills development and transfer of technology.

More importantly a number of strategies were identified to achieve the objectives of the policy:

- Increasing the existing irrigated agricultural areas to full potential;
- Identification of potential areas for agricultural irrigation;
- Development of agro-projects at identified areas for irrigation;
- Development of storage facilities and marketing infrastructure;
- Mobilization of public and private capital;
- Capacity building to ensure productivity and competitiveness;
- Research and development, technology transfer and adaptation;
- Implementation of Good Agricultural Practices;
- Promotion of the efficient utilisation of agricultural land and water resources; and



- Diversification of agricultural crops and export promotion

While elements of these strategies could be aimed at *water conservation and water demand management*, such as capacity building and research and development, nothing is explicitly stated.

### 3.3.3 Institutional Aspects

The Ministry of Agriculture, Water and Forestry (MAWF) is the custodian of the Green Scheme and as the implementing agent, will be responsible for the organization and coordination of the work of the Inter-Ministerial Committee. For the purpose of consultation and coordination, the Inter-Ministerial Committee consisting of MAWF, National Planning Commission, Ministry of Lands and Resettlement, Ministry of Finance, Ministry of Trade and Industry, Office of the Attorney-General and the Ministry of Education will be established and will meet twice a year.

As said earlier, irrigation in Namibia is mainly vested in either commercial enterprises, or in state owned projects. Very little informal irrigation takes place. However, state owned projects are designed in such a way that  $\pm 50\%$  of each project is allocated to smallholder farmers, while the remaining 50% of the area is cultivated by commercial entities.

Commercial farmers on the Hardap Irrigation Scheme have their own Irrigation Committee. The committee is however of an informal nature, since it not appointed by Government. The committee works in very close collaboration with NamWater, which is a parastatal and which is responsible for the operation and maintenance of the dam and the bulk water reticulation system. A private company does the day-to-day operation and maintenance for NamWater.

The Noordoewer/Vioolsdrift Joint Irrigation Scheme is managed by the Noordoewer/Vioolsdrift Joint Irrigation Authority (JIA) which was established through a bilateral agreement between Namibia and South Africa in 1992. Farmers from both sides of the border serve on the board and oversee the allocation of water to individual farmers as well the payment of levies. The funds are administered by the JIA and are used for the maintenance and operation of the scheme.

State owned irrigation projects are normally developed under the **Green Scheme Concept** as described above. The institutional establishment is as follows:

- MAWF will establish an agro-production unit within the Department of Agriculture, which will be charged with the responsibility of the day-to-day management of the Green Scheme.
- The Unit will be staffed with professionals specialized in the relevant fields for the implementation of the policy and who are civil servants. Professional services outside the public service will be procured within the Government procurement laws and regulations.

- MAWF will engage the Namibia Development Corporation (NDC) and other Government Agencies for the physical implementation, infrastructure development and management of the Green Scheme.
- The Unit will prepare an implementation manual, and will amend and update the manual as required with the approval of the Minister responsible for agriculture.

The Orange River Irrigation Project (ORIP) on the farm Aussenkehr falls under category 4.5 of the policy and a Service Provider renders services to the small scale irrigation farmers. The bulk water supply is automated and farmers irrigate under gravity from a balancing dam. The micro and drip irrigation systems are efficient, but proper scheduling does not take place. All plots and irrigation blocks have water meters, but they are not used to control the water applied to the fields and the farmers may not really know how much water they use.

### **3.3.4 Technological Aspects**

#### **3.3.4.1 Conveyance and Distribution Systems**

Gravity fed conveyance systems are only found below the large state owned dams such as Hardap and Naute and at the Noordoewer/Vioolsdrift Joint Irrigation Scheme. The bulk water distribution networks are generally in a fair to good condition, since they belong to Government and it is normally also maintained by Government, whether directly or indirectly. The Noordoewer/Vioolsdrift Scheme is an exception, because it is maintained by the farmers, but Government has made substantial contributions towards upgrading and repair of the infrastructure.

All other projects or schemes have to pump the water either from boreholes or from the Orange River.

Farmers who use boreholes generally do not irrigate on a very large scale. Since many of the boreholes are of artesian nature, pumping heads are not very high. Distribution is normally done via pipelines and efficient irrigation systems are used.

Farmers who pump directly from the Orange River are more conscious of losses, since they normally pump against high heads and high energy costs force them to have more efficient distribution systems. Balancing dams are used in certain cases, but most of them are bitumen lined and losses are curtailed.

#### **3.3.4.2 On-farm Technologies**

A wide variety of irrigation systems are found in Namibia. Many farmers at the Hardap Irrigation Scheme and the Noordoewer/Vioolsdrift Joint Irrigation Scheme still use flood irrigation and do not practice proper irrigation scheduling, which leads to poor water use efficiency. Labour issues (mainly the cost) as well as the introduction of high value crops such as grapes, dates and vegetables have however encouraged some farmers to switch to more efficient irrigation systems like centre pivots, micro and drip irrigation.

In many cases, a switch from flood irrigation to more capital intensive systems is hindered by risk of flood damage. At the Hardap Irrigation Scheme where salinity problems are severe, flood irrigation is often maintained since it is effective for leaching out of salts. Centre pivots can be used, but then it must be designed for the purpose which is expensive, while drip and micro systems only push the salts out from the immediate vicinity of the pipe. When water application is stopped, salts quickly accumulate in the root zone again. Unfortunately, sub-surface drainage is a huge problem and high water tables aggravate the problem.

Farmers who have to pump their water are generally much more mindful of efficiency and more efficient irrigation systems are normally installed. The adoption of efficient distribution and irrigation systems is currently driven by high energy costs and not by the appreciation of the value of water. Water for irrigation is rarely charged for on a volumetric basis and farmers do not feel the pinch if excessive volumes of water are used. In many cases nutrients are leached out by applying too much water. Many irrigation farmers do not fully comprehend the concept of scheduling. .

### **3.3.5 Agronomic Aspects**

From a theoretical point it can be argued that the most efficient use of water is to maximize the income per cubic meter water used. This is however not always practical, since climatic conditions, soils and markets or the lack thereof) (more relevant for a small economy like Namibia than South Africa) sometimes preclude the production of certain high value crops. Government policies, such as an emphasis on food self-sufficiency and food security, also play an important role. In the Namibian context, the production of Lucerne is a good example of a highly variable possible income per cubic meter. Lucerne has a very high irrigation demand, but it can be a lucrative crop during periods of drought when demand is high. However, during good rainy seasons there is little demand for Lucerne and prices fall drastically, resulting in a very low income (or a loss) per cubic metre.

The very harsh climatic conditions, combined with relatively poor soils, limit the production opportunities for Namibian farmers on the northern banks of the Orange River. Temperatures regularly exceed 40°C, the humidity is extremely low, rainfall is negligible and strong winds batter the crops. Soils away from the narrow stretches of alluvial soils next to the river generally have very high pH values (8+) and the texture is coarse with low water retaining capacities. Ironically, these conditions favour the production of table grapes, dates, prickly pears and some vegetables; all which can be described as high value crops. Experiments were carried out at Aussenkehr with aromatic plants for the production of essential oils but although the results were very promising no project has come into fruition. .

A major problem for Namibian growers is the dominance of South African marketing infrastructure and logistics.

The demand for horticulture produce exceeds the local production in Namibia by far. It is estimated that local Namibian producers supply only 10% (now 28%) of the demand. Importation of fresh produce from South Africa is the order of the day, while local producers

are battling to increase their market share. This anomaly or contradiction can be ascribed to the fact that South African wholesalers, because of inadequate local marketing infrastructure and marketing strategies, positioned themselves in such a way that it is difficult for local producers to compete effectively. To penetrate the local market, some producers are sending their produce to the Cape Town Fresh Produce Market as the case is with onion and potato producers in the Hochfeld Area and tomato producers along the Orange River. Eventually some of these products find their way back to Namibia via the South African Wholesalers.

The above paragraphs highlight the fact that farmers cannot always maximize the ratio between water consumption and income by choosing the most profitable crop, because other factors play a role too. It is however important that the water usage vs. income ratio should be optimized for a particular crop by applying the correct principles of irrigation as well as water demand management. As said earlier, a mind shift is necessary to regard water as a scarce and precious (and expensive) commodity. The only way to achieve this is to meter the use of water and to charge per cubic meter. Efficient use of water should be rewarded, while wastage should be penalized.

### **3.4 Lesotho**

#### **3.4.1 Overview**

There are several contrasting estimates of the irrigation potential of Lesotho. At the most optimistic end, the long-term irrigation potential has been estimated at 12 500 ha. The other extreme, taking into account reduced water availability as a result of the Lesotho Highlands Water Project, the high cost of irrigation development and the limited market for high value crops, estimates potential for new irrigation at no more than 1 000 ha (Aquastat Lesotho 2009).

All potential irrigation development in Lesotho falls within the Orange- Senqu River basin.

Irrigation is only responsible for 1% (0,6 Mm<sup>3</sup>) of water use each year. Over the last 40 years numerous large-scale top-down irrigation development projects have been initiated, but very few still function today. A survey in 1999 found that of the 2 637 ha equipped for sprinkler and surface irrigation in Lesotho only 67 ha were still operational and largely relied on donor aid. Current estimates are higher, ranging from 200ha to as much as 2000ha. Successful projects include small-scale irrigation and water harvesting initiatives based on an individual approach to communally-owned irrigation schemes. Private irrigation has also been successful, and is used to improve household food security and (at times) provide enough excess for sale at rural markets

Vegetables are produced in fairly large quantities under irrigation but production remains very seasonal. The main crop is cabbage, but carrots, spinach and a variety of other crops are also grown. There are both large-scale farmers (often using rented land) and smaller farmers working under irrigation programs.

Home gardens are an important source of horticultural produce in Lesotho, where an estimated 70 percent of rural households produce some vegetables. Most home gardens are rainfed, supplemented with irrigation from household and/or community domestic water supplies, although some families have invested in small pumps supplied by streams and ponds. The produce from home gardens is mainly for self-consumption, with limited quantities appearing on the local village market.

Lesotho Government policy documents identify the total potential area for irrigation as 30 000 ha and their 20 year vision is to develop it all.

### **3.4.2 Regulatory Aspects**

The National Irrigation Policy of the Government is arguably in disarray to some degree. The Government and its donors recognize that previous policies have failed, but at this stage no comprehensive alternative has been developed. However certain government strategies can be identified, including efforts to wean farmers away from growing traditional cereals and move towards high value crops.

A proposed mission statement for Lesotho's irrigation policy is: "To manage and develop water and land resources for diversified economically sound and sustainable irrigation and drainage systems under organized smallholders and private commercial farmer management and to maintain an effective advisory service."

In Lesotho, all land is owned by the people and allocated by and through the traditional structure of chieftainship. Until very recently, when new forms of land holding were introduced, there was little legal (as opposed to customary) security for the tenants. For irrigation projects this has had major consequences, as the high fixed costs of providing the systems are only justifiable when the benefits can be shared between many recipients.

The National Environmental Policy of Lesotho recognized that the sustainable development of small-scale irrigation schemes, based on surface water resources via the construction of small dams and diversion of rivers, is totally dependent on the improvement and stabilization of soil conservation and afforestation measures in the catchment areas serving these schemes and adopted this as a guiding principle for water resources management. Furthermore, regular audits of, among others, irrigation schemes shall be undertaken with the aim of ensuring that they comply with this environmental policy.

The main legislation in the water sector is the 1978 Water Resources Act, which provides for use, control and conservation of water resources. However, legislation relevant to water resources is scattered over several orders and acts administered by different departments without adequate consistency or overall guidelines. Another piece of legislation dealing with water resources is the LHWP Treaty entered into by Lesotho and South Africa. The treaty provides for the protection of the quality and quantity of water in the LHWP area, but does not consider other relevant components of the utilization of shared water courses between the two countries.

### **3.4.3 Institutional Aspects**

The institutions involved in the irrigation sub-sector are:

- The Irrigation Section in the Engineering Division of the Crops Department of the Ministry of Agriculture and Food Security (MAFS) is involved in the investigation of new irrigation technologies.
- The Engineering Division of the Crops Department of MAFS provides planning, design and implementation support for, amongst many others, irrigation.
- The Agronomy and Horticulture Divisions of the Crops Department of MAFS also have potential links to irrigation development.
- The Soil and Water Conservation Division of the Department of Conservation, Forestry and Land Use Planning of MAFS is involved in irrigation development as far as dam planning, design and construction is concerned.
- The Extension Division of the Department of Field Services of MAFS is involved in irrigation through its decentralized District Agricultural Offices (DAOs) in the 10 districts. However these offices do not have designated posts for irrigation and thus extension service in irrigation is not available.
- The Agricultural Research Division of the Department of Field Services of MAFS has an Irrigation Unit in its Engineering Section. One of its aims is to provide smallholder farmers with appropriate irrigation technologies and services to improve irrigation systems and, by doing so, productivity.

It would appear that Irrigation services are available from a number of departments and units in MAFS but all are unfortunately, poorly resourced.

At the farmer level there are organizational and/or administrative problems because farmers are not organized into formal structures, let alone legal entities, and therefore there are no regulations. This should be of primary importance however, as the farmers share water storage and conveyance facilities and some form of regulatory framework is needed to manage these facilities.

There would seem to be a strong argument for the restructuring of the institutional framework for irrigation in Lesotho into a more self-sufficient and streamlined agency.

### **3.4.4 Technological Aspects**

#### **3.4.4.1 Conveyance and Distribution Systems**

Almost all irrigation water is supplied through pumping or via short temporary diversion works. There are no large-scale distribution systems.

#### **3.4.4.2 On-farm Technologies**

Although the areas are not actively being used around 2 600ha of irrigation has been equipped in Lesotho. Of the total equipped area, 175 ha were small schemes (< 100 ha) and 2,462 ha were large schemes (> 100 ha). In small schemes mostly vegetables are grown and

surface and sprinkler systems are used. Large schemes were equipped for sprinkler irrigation. The two types of irrigation systems commonly used are sprinkler and flood irrigation. Sprinkler irrigation is the most common, while flood irrigation is not so widely used because of the topography of Lesotho.

Depending on pressure, three categories of irrigation can be distinguished:

- Pressure < 5 m; taps with buckets or surface irrigation;
- Pressure from 5 m to 20 m; low pressure system;
- Pressure > 25 m; high pressure system.

Irrigation development in Lesotho is expensive. Studies point to the conclusion that probably only gravity-fed systems produce an adequate, commercial rate of return. Investments in pump-based irrigation in Lesotho should rather be considered primarily as (an albeit potentially important) social investment.

### **3.5 Botswana**

#### **3.5.1 Overview**

The agricultural sector is composed of two distinct farming systems, the commercial and the traditional systems which both engage in crop and livestock production. The difference between commercial and traditional farming is based on land tenure, use of technology and marketing as opposed to consumption of production:

- Commercial farms tend to specialize in cattle production. They cover 8 percent of the total land area and represent less than 1 percent of all farms. They hold more than 15% of all cattle and account for around 40% of the total production of cereals and pulses. The small amount of irrigation is restricted to commercial farms along the Limpopo River which does not form part of the Orange River catchment. ;
- Two-thirds of traditional farmers practise mixed farming, with cropping on individually-managed holdings and livestock grazing on communal land. As the incidence of drought is high, small farmers are highly vulnerable to crop failure because they are totally reliant on rainfed crop production and do not make adequate use of drought-resistant varieties.

#### **3.5.2 Institutional Aspects**

The main institutions involved in the water management are:

The Ministry of Minerals, Energy and Water Affairs (MMEWA) is responsible for national water policy. There are two water supply units under the Ministry, the Department of Water Affairs (DWA) and the Water Utilities Corporation (WUC), which are responsible for managing the country's water supply systems. The WUC is responsible for supplying water to all urban and mining centres. The DWA is the lead agency in water resources and

provides support to the National Conservation Strategy Agency in the implementation of the National Conservation Strategy, and is responsible for supplying water to the 17 major villages;

In some situations, such as in the livestock and agricultural sector, water provision is the responsibility of the Ministry of Agriculture and its Irrigation Section (IS), established in 1982 under the Department of Crop Production and Forestry within the Land Utilization Division. The MoA constructs small dams in farming areas used for livestock and assists syndicates (user groups);

In the rural areas, the District Councils under the Ministry of Local Government, Lands and Housing (MLGLH), oversee the water supply to rural villages.

Until 1993 the Ministry of Agriculture supplied water to farmers at no charge. Farmers were responsible for operating and maintaining the dams, which mainly involved building and maintaining fencing around the dams and keeping the spillways in good repair. In 1993 the ministry changed its policy and asked farmers to contribute 15 percent of dam construction costs. The ministry also gives grants to syndicates to finance a portion of the costs of sinking boreholes for livestock watering. Syndicates operate and maintain the boreholes, but pay nothing for the water. They are required to obtain water rights from the Water Apportionment Board, which are free of charge.

The National Development Plan 8 (NDP 8) consists of the construction of 30 small agricultural dams, maintenance and rehabilitation of existing dams, assisting farmers in establishing small-scale irrigation schemes and promoting the utilization of treated effluent for irrigated crop production. In order to implement NPD 8, the government earmarked the sum of US\$3.1 million for the period 1997/98 - 2002/03.



## 4 SITE VISITS

### 4.1 Introduction

In line with methodology, a number of site visits were carried out, in particular in Namibia and South Africa, where the majority of irrigation within the basin is taking place. The sites visited are indicated on **Figure 4-1**.

### 4.2 Lesotho

#### 4.2.1 Introduction

A meeting was held with the Chief Engineer of the Lesotho Department of Agriculture in Maseru to determine what the current situation is in Lesotho with regard to irrigation. A literature review was also carried out.

#### 4.2.2 Description

Farmers growing crops in Lesotho can be categorized as in **Table 4-1**.

**Table 4-1 Categories of Farmers in Lesotho**

Farmer Type	Farm Size (ha)	Crops	Irrigation System
Subsistence Farmer	0.1 – 0.2	Maize, sorghum, beans	None
	>0.2 - 1	Cereals, maize, sorghum, legumes, potatoes	None
Micro-irrigating farmer	0.025 (home garden)	Vegetables, fruit trees	Watering can, hose pipe / low pressure sprinklers
	0.1 – 0.5	Vegetables, fruit trees	Gravity-fed irrigation
Small-scale semi-commercial farmer	1 - 4	Vegetables, fodder	High-pressure irrigation system
Medium-scale commercial farmer	10 - 20	Vegetables	High pressure system with travelling guns



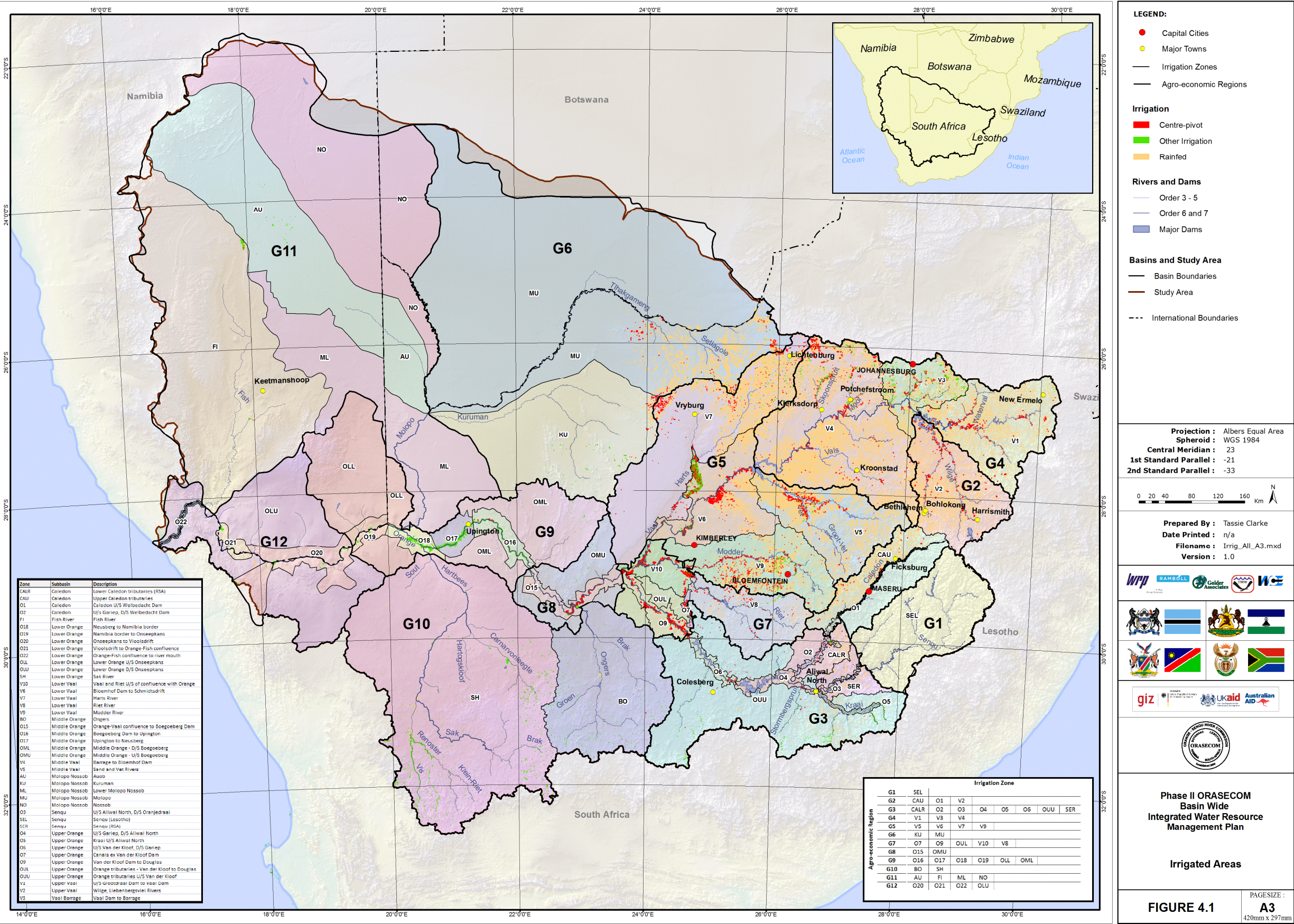


Figure 4-1: Irrigation Schemes visited and discussed with Stakeholders





Approximately 2 600ha has at some stage been developed for irrigation in Lesotho but very little of this is apparently still operational. Estimates of irrigation potential vary enormously probably because of differing criteria used. According to **Table 4-2**, the potential, as given by district is only around 2 500ha. It seems likely that these areas in fact correspond to those which at some time in the past, have been developed.

**Table 4-2 Irrigation Development in Lesotho**

District	Irrigation Potential (ha)
Hololo	30
Hlotse	500
Phutiatsana	950
Mpetsana	40
Makhalend	1000
	2 520

The failure of the irrigation policy of the past was recognized by the Government, which is now focusing on farmer- and market-led irrigation development based on small-scale schemes provided for and managed by the farmers themselves. In all parts of Lesotho farmers are anxious to expand irrigation schemes, provided the schemes complement existing farming practice including land-holding, crop-selection and marketing and the control over decisions remains with the farmers.

#### 4.2.3 Findings

- Irrigation is in the hands of individual small farmers.
- The predominant irrigation type is/has been pressurized irrigation using sprinklers, micro jets and drippers.
- The Lesotho Government policy documents identify the total potential area for irrigation as 30 000 ha and their 20 year vision is to develop it all. Taking into account the reduced availability due to the LHWP, it is reckoned that a minimum of 3,500 ha and up to 7,000 ha could be brought under irrigation if the Senqu River potential is fully exploited..
- Successful projects include small-scale irrigation and water harvesting initiatives based on an individual approach to communally-owned irrigation schemes. Private irrigation has also been successful, and is used to improve household food security and (at times) provide enough excess for sale at rural markets.

To implement successful schemes, the concerned developing authority will have to keep in mind the following:

- The agricultural sector in Lesotho exists within a very complex set of family, community, and national relationships. Irrigation development, i.e. the introduction of a major technical change, has to be seamlessly inserted into this complex socio-

economic culture in order to ensure the success of the project in the long-term, when the sponsor has withdrawn.

- The irrigation sub-sector is currently not represented in the extension services of the District Agricultural Offices; this will have to be addressed to ensure appropriate on-site farmer support.
- The level of training (irrigation knowledge) in the country is insufficient, and any irrigation initiative taken will have to provide extensive training at all levels, including academic.

Because of the high cost of development, irrigation potential will be limited by the market for high value crops, rather than by the available land and water resources.

### **4.3 Namibia**

#### **4.3.1 Introduction**

Namibia has an estimated potential of approximately 43 500 ha that is suitable for irrigation of which  $\pm$  9 000 ha is currently developed. The four river catchments that drain into the Orange-Senqu River have a potential for approximately 8 750 ha that is suitable for irrigation. Currently 5500 ha has been developed. There are therefore approximately 3 250 ha which can still be developed. However this could change with the addition of the Neckertal Dam on the Fish River which could add up to 5 000 ha of irrigation land.

Irrigation in Namibia is mainly vested in either commercial enterprises, or in state owned projects.

The following schemes were visited and assessed:

- Hardap Irrigation Scheme
- Stampriet farmers
- Orange River (Vioolsdrift/Noordoewer)
- Naute Dam

The location of these schemes is shown on **Figure 4-1**.

#### **4.3.2 Description of Schemes**

##### **4.3.2.1 Hardap Irrigation Scheme**

The Hardap Dam in the Fish River basin is the water source for the Hardap Irrigation Scheme which comprises of about 2 200 ha under irrigation. The dam and bulk water distribution infrastructure belongs to the state and was constructed in 1963. The gravity fed distribution system consists of concrete canals and pipelines, which are in a fair condition and which is now operated and maintained by NamWater; a state owned parastatal. The Government replaced several pipelines over the last few years and also affected repairs after the major flood of 2006. Farmland is privately owned and there are currently about 26 farmers, producing grapes, dates, maize, wheat, vegetables and lucerne. Flood irrigation is still used extensively, although some farmers have changed to centre pivot irrigation for

maize and wheat production. Dates, grapes and vegetables are irrigated with either micro or drip irrigation technology. It should be recognised that almost all farmers who practice flood irrigation, have laser levelled their fields. which undoubtedly enhances the application and distribution efficiency.

Water is however not always used efficiently, as is evident from the fact that about 45 million cubic meters are used annually to irrigate 2200 ha, which culminates in a figure of  $\pm 20,500$  m<sup>3</sup>/ha/annum. This is excessive and it is also evident from the return flows into the river. The nutrient rich return flow contributes towards excessive reed growth in the Fish River. The reeds are a serious problem for the Government of Namibia, because it has been proven that the thick reed coverage hampers the free flow of water in the river and it aggravated the flooding of the farmland as well as the town during the recent floods of 2002 and 2006.

Poor soils are the single biggest limiting factor on the scheme. Severe salinity problems are visible all over the scheme and farmers battle to achieve high yields. Soil types also vary tremendously with more sandy soils closer to the river and more clayey soil types further away.

Sub-surface drainage systems were installed at some areas on the scheme, but other areas suffer because of poor drainage. Surface drainage channels are not well maintained and are overgrown with reeds.

Farmers have to leach out salts, but this result in drainage problems for lower lying areas and it also results in high water tables, because all the water cannot drain back to the river. Water which does drain back to the river contains high concentrations of salt and nutrients and it enhances reed growth in the river. Reeds in the river obstruct the flow of water during flood situations and serious erosion takes place when the river breaks its banks and water enters the flood plains which are also the irrigation fields

The maintenance and operation of the bulk water reticulation system was handed over to NamWater in 2009. NamWater again contracts a private company to do the day to day maintenance and operation. A tender is currently out for the installation of electromagnetic water meters at each plot. The objective is to charge farmers on a per cubic meter basis and thereby force them to use water more efficiently.

**Figure 4-2: Photographs from Hardap irrigation Scheme**

Lazer levelling at the Hardap irrigation Scheme



Salinity problems at Hardap Irrigation Scheme



Nutrient-driven reed growth reduces the carrying capacity of the Fish River causing increased flooding

#### **4.3.2.2 Stampriet farmers**

The Stampriet irrigation area falls within in the Nossob and Auob catchments and is not adjacent to a river, but farmers irrigate from boreholes. Many of the boreholes are of artesian nature and are generally very deep, but pumping heads are not very high. Farmers who use boreholes generally do not irrigate on a very large scale. Distribution is normally via pipelines and efficient irrigation systems like centre pivot, micro and drip are used.

**Figure 4-3: Irrigation in the Stampriet Area**

Vegetables under micro-irrigation using groundwater near Stampriet

Operation and maintenance thereof, however, leave a lot to be desired. Very few farmers implement proper irrigation scheduling and a lack of regular maintenance of irrigation systems to maintain efficient water distribution and application leads to unnecessary losses.

#### **4.3.2.3 Orange River (Vioolsdrift/Noordoewer)**

The Noordoewer/Vioolsdrift Joint Irrigation Scheme was built in 1934 and is managed by the Noordoewer/Vioolsdrift Joint Irrigation Authority (JIA) which was established through a bilateral agreement between Namibia and South Africa in 1992. Farmland is privately owned and the operation and maintenance of the canal and inverted siphon distribution system is done by the JIA with own funds. The reticulation system is in a fair state and the Namibian Government as well as the South African Government contributed towards the upgrading of two of the canals and the installation of a new siphon through the Orange River. Many farmers still use flood irrigation, but several are beginning to switch over to centre pivot, micro and drip irrigation. Water usage is not measured and there is little incentive for farmers to switch to more efficient irrigation technologies.

Several privately owned farms on the northern bank of the Orange River irrigate by pumping directly from the Orange River. Farmers are responsible for their own pumping, distribution and irrigation systems and they produce table grapes, dates, vegetables and lucerne, mainly under micro, drip or centre pivot irrigation. Despite the generally high pumping heads, farmers give little attention to scheduling and it is suspected that efficiencies are much lower than it should be. This can clearly be seen at some of the projects on the Farm Aussenkehr where excessive return flows can be observed (It has improved lately). One should however take into account that a certain amount of leaching is required, because the pH of the soils is very high and the soils contain high amounts of salts.



#### 4.3.2.4 State Owned Irrigation Projects

There are currently only two state owned projects in the Orange River Basin, namely the Naute Irrigation Project and the Orange River Irrigation Project (ORIP).

The Naute Irrigation Project is below the Naute Dam near Keetmanshoop and it is currently 145 ha in size. It is operated by the Namibia Development Corporation (NDC) and produces grapes, dates, pomegranates and prickly pears under micro irrigation; all under gravity. The infrastructure is well maintained. An agreement between the NDC and the United Arab Emirates (UAE) is currently negotiated to develop a further 200 ha, mainly for the production of dates. Water distribution from the dam is via two pipelines; one on each side of the Löwen River. The pressure head varies with the water level in the dam, but when full, the static pressure is approximately 60m. The infrastructure is in a good condition and no losses occur. Although irrigation scheduling could be improved, water usage is considered to be acceptable. Since the NDC is currently the sole user of the water, there is no need for a regulating body. This could, however, change when the UAE develop their part of the project.

The Orange River Irrigation Project is situated on the farm Aussenkehr and approximately 165 ha are irrigated. There are 20 Small Scale Farmers with 4 ha each and the commercial section is leased to a private company. The main products are dates, table grapes and vegetables and micro and drip irrigation is used. Water is pumped from the Orange River against a height of  $\pm 75$ m. Infrastructure is generally in a good condition and is well maintained. Irrigation scheduling can definitely be improved.

All other projects or schemes have to pump the water either from boreholes or from the Orange River.

#### 4.3.3 Findings

Metering of water consumption, coupled to the cost to the farmer, will inevitably compel farmers towards optimizing the ratio between consumption and yield/income. Farmers should however not be penalized for irrigating a particular crop (like Lucerne), but only for usage above acceptable limits.

Achieving the objectives of Water Demand Management will therefore revolve around education and training and a mind shift to regard water as a scarce and precious (and expensive) commodity. The only way to achieve this is to meter the use of water and to charge per cubic meter. Efficient use of water should be rewarded, while wastage should be penalized. More specifically:

##### At Hardap

- There is room for improvement in water use efficiency. At present application is about 20,500 m<sup>3</sup>/ha/annum whereas the target for the area is about 18,000 m<sup>3</sup>/ha per annum or lower, depending on the crops which are cultivated. No irrigation scheduling is practised.

- Nutrient-rich return flow is causing excessive reed growth in the Fish River which aggravates flooding and has necessitated the Department of Agriculture embarking on periodic aerial spraying to eradicate reeds.
- A farmer-conceived and driven Irrigation Committee is responsible for water allocation, collection of levies and general administration. Farmers are currently billed on a per hectare per annum basis.
- Electromagnetic water meters will be installed in 2011 to enable billing on a volumetric basis.
- A very large percentage of the scheme is subject to flood risk. The 1:20 year flood line already affects a substantial part of the irrigated land, while the 1:100 year flood affects almost all of it. This discourages investment in new technologies.

#### **At Naute Dam**

- Grapes, dates, pomegranates and prickly pears are irrigated using micro-irrigation.
- Although irrigation scheduling could be improved, water usage is considered to be acceptable.

#### **At Noordoewer/Vioolsdrift Joint Irrigation Scheme**

- Parts of the scheme are prone to periodic flooding and major damage occurs to infrastructure, farmland and irrigation systems.
- Border control procedures complicate the efficient management and maintenance of the Scheme, because it restricts movement of officials and technical personnel.

#### **From the Orange River**

- Irrigation direct from the Orange River is regulated by a permit system. Little control is exercised and water usage is not measured.
- Irrigation efficiencies are probably much lower than it should be as evidenced by excessive return flows that are observed at Aussenkehr. (The situation has improved)
- A certain amount of irrigation for leaching is required as pH and salinity levels of soils are high.

#### **In summary**

- Water is not charged per unit volume
- No action is taken if excessive volumes are used.
- Very few farmers practice irrigation scheduling.
- The adoption of more efficient systems is driven by high energy costs and labour issues and not the appreciation of the value of water.
- The risk of flood damage restrains the installation of more efficient (but expensive) irrigation systems
- Problematic soils (saline and high pH) necessitate leaching, which is most effectively done with flood irrigation systems, but sacrificing efficiency.

- A dedicated effort is required to educate and train farmers in irrigation technology and management thereof and to make them aware of the advantages of water demand management.
- No specialized extension services are readily available to farmers

## 4.4 South Africa

### 4.4.1 Introduction

Nine of the larger *water user associations* and IBs were visited.

- Sand Vet *water user association*
- Vaalharts *water user association*
- Orange Vaal *water user association*
- Kalkfontein *water user association*
- Orange Riet *water user association*
- Lower Modder River *water user association*
- Boegoeberg *water user association*
- Upington IB
- Kakamas *water user association*

Together these schemes represent approximately 85 000 ha of irrigation. Their locations are shown on **Figure 4-1**

### 4.4.2 Description of Schemes

#### 4.4.2.1 Sand Vet Water User Association

The Sand Vet *water user association* came into being in 2007 and is an amalgamation of two Government Water Schemes (GWS); the Sand Vet GWS which is fed from the Allemanskraal Dam on the Sand River and the Vet River GWS which is fed from the Erfenis Dam on the Vet River. The total area under irrigation is 12 317ha made up of 7162ha on the Vet River and 5155ha on the Sand River. Both schemes consist of a lined canal on one or both sides of the river which track the river course. While some farmers pump directly from the rivers the majority are supplied from these canals. The Vet scheme supplies 301 irrigators and the Sand scheme 234 to give a total of 535 irrigators.

Originally designed as flood irrigation schemes, only about 1% of the scheme is still flood irrigated. 90% is irrigated by centre pivot with the remaining 9% being other systems such as micro and drip irrigation. Canal users are supplied with irrigation water by means of calibrated sluices while river users are supplied by means of in-line water meters.

The main crops grown are maize and wheat with some potatoes and groundnuts.

The scheme suffers from regular water shortages and users seldom receive their full annual allocation.

Users are charged on a cubic meter per hectare basis using calibrated sluice gates..

#### **4.4.2.2 Vaalharts Water User Association**

The Vaalharts *water user association* came into being in 2001 and is an amalgamation of the Vaalharts GWS, the Harts GWS, the area served by the KB canals, and the Taung Irrigation Scheme. The main source of supply is the Bloemhof Dam on the Vaal River and the Spitskop Dam on the Harts River. Water released from the Bloemhof Dam is collected in the Vaalharts Weir and then distributed via lined canals to the Vaalharts, Taung and KB canal areas. Water from the Spitskop Dam is distributed via a canal to users downstream of the dam. Certain users also pump directly from the Vaal and Harts rivers. The Vaalharts *water user association* serves 900 users on a total area of 35 700 ha.

Originally designed as flood irrigation schemes, approximately 40% of the scheme is still flood irrigated, 40% is irrigated by centre pivot and the remaining 20% using other systems such as micro and drip irrigation. Releases to irrigators are measured using calibrated sluices except for Taung which is not measured at all.

A variety of crops are grown including maize, wheat, pecans, vegetables, lucern, groundnuts, cotton, citrus, olives and grapes.

Irrigators are charged on a cubic meter per hectare basis.

The Vaalharts and KB canals areas receive 9140 m<sup>3</sup>/ha/a Taung 8470 m<sup>3</sup>/ha/a and the Harts area 7700 m<sup>3</sup>/ha/a.

The first elements of the scheme were constructed 80 years ago and most of the infrastructure is of an advanced age requiring major investment for rehabilitation.

The water quality from the Vaal River is rapidly deteriorating as a result of acid drainage from the Gauteng area. High nutrients in the Vaal River cause excess algae and water hyacinth growth which block canals and measuring structures. The Vaalharts scheme also has significant salinity problems. Consequently sub-surface drainage has been installed on large portions of the scheme. Nutrient rich sub-surface drainage water from Vaalharts is collected in the Spitskop Dam which in turn causes water quality problems for users from this dam.

#### **4.4.2.3 Orange Vaal Water User Association**

The Orange Vaal *water user association* came into being in 2007 As a result of the Orange Vaal IB's conversion to a *water user association*.

The original total area under irrigation was 8 113 ha. This has increased to 11 058 ha as a result of purchases of water allocations from outside the scheme.

The scheme is located at the confluence of the Vaal and Orange Rivers. Originally its water was obtained from the Douglas Weir located on the Vaal River. An increase in water use upstream in the Vaal River catchment necessitated the construction of a transfer scheme from the Orange River to the Douglas Weir. The transfer scheme, known as the Orange Vaal Transfer Scheme, consists of a pumping installation to lift the water over the divide and deposit it into the Bosman Canal which flows into the Douglas Weir. The entire scheme's water allocation comes from the Vanderkloof Dam via the Orange Vaal Transfer Scheme. 90% of the area is irrigated by pumping directly from the Bosman Canal, the Douglas Weir or the Orange River downstream of the Douglas Weir. 10% of the area is supplied by two canals, the Buckland Canal and the Atherton Canal. These canals were originally designed to provide flood irrigation. However only 3% of the entire scheme is still flood irrigated, 90% is irrigated using centre pivots and 7% by other systems. The Orange Vaal *water user association* supplies 180 irrigators.

Canal users are measured using calibrated sluices. All other irrigators are not physically measured. Water use is determined pre season. 90% is irrigated by centre pivots which have known application rates and known areas. The irrigator informs the *water user association* of the crops and the areas of each crop he intends to plant. The *water user association* then uses the average weekly evaporation figures over the last five years multiplied by a crop factor to determine the amount of water required for the crop and the area. In consultation with the irrigator the areas are then adjusted until the annual requirement is equal to the irrigator's allocation and both parties are in agreement. The irrigator is then limited to planting the agreed areas. Post planting water control officers then validate the areas planted. Approximately 5000 ha (45%) are planted to maize in rotation with wheat and three crops are grown every two years. 2000 ha (18%) is planted to lucerne and 2000 ha (18%) to cotton. The balance (19%) is planted to a variety of other crops.

Users are charged on a m<sup>3</sup> per hectare per year basis. The original allocations are 9140 m<sup>3</sup>/ha/yr and the purchased allocations 10 000 m<sup>3</sup>/ha/yr.

The Orange Vaal *water user association* has major water quality problems as a result of poor quality water from the Vaal River. Acid mine drainage and industrial pollution from the Vaal River catchment, and nutrient rich sub-surface drainage water from the upstream Vaalharts scheme often produce TDS as high as 861, while drainage water from the Orange Riet and Kalkfontein schemes upstream on the Riet River produce TDS as high as 1500. In contrast the water from the Orange River has a TDS of only 145. Water emanating from all three sources is deposited in the Douglas Weir. Research has shown that as a result of different densities the poor and good quality water do not mix but remain in envelopes which cause problems for irrigators when the envelope of poor quality water pass the extraction points.

#### **4.4.2.4 Kalkfontein Water User Association**

The Kalkfontein scheme originated as a GWS and become an IB in 1994. In 1998 it was the first IB to transform to a *water user association* in terms of the new Water Act. The scheme is

served by the Kalkfontein Dam on the Riet River. The bulk of the scheme consists of lined canals on both sides of the Riet River which more or less track the river course from which water is supplied to irrigators. Some irrigators pump directly from the Riet River. At inception the area under irrigation was 3526 ha, with 3046 ha supplied from canals and 480 ha pumping direct from the river. The area served from the river has reduced to 456.9 ha reducing the total area to 3502.9 ha. The canals were originally designed to provide water for flood irrigation. Only 10% of the entire scheme is still flood irrigated. 90% is irrigated using centre pivots. The Kalkfontein *water user association* supplies 120 irrigators.

All use is measured, some of it using telemetry, and water is available on demand. Canal users are measured using calibrated sluices. Irrigators who extract direct from the river are measured using in line water meters. Approximately 60% of the area is planted to maize in rotation with wheat and three crops are grown every two years. 20% is planted to lucern and 20% to a variety of other crops.

Allocations are 11 000 m<sup>3</sup>/ha/yr. However users are billed on actual use on a per m<sup>3</sup> basis.

Water shortages are the norm and most years farmers receive just a portion of their allocation depending on the state of the Kalkfontein Dam, some years receiving as little as 15% of their allocation. As a result the Riet River seldom flows and water quality deteriorates significantly. The regular shortages of water have resulted in a mind shift in farmers and they are very conscious of WC/WDM.

#### **4.4.2.5 Orange Riet Water User Association**

The Orange Riet *water user association* is possibly the most complicated of all of the schemes. When it was formed in 2000 it incorporated the Riet River GWS, which included the Riet River Settlement, Scholzberg Irrigation Area and the Ritchie Irrigation Area, and the Lower Riet IB. The scheme is served by a number of lined canals and some irrigators pump direct from the Riet River. Due to the shortage of water in the Riet River the Orange Riet Transfer Scheme was constructed to bring water from the Vanderkloof Dam, on the Orange River, to serve these areas. Water is pumped from the Orange River to a point high enough for water to gravitate via a canal to the serviced area. Irrigators along this transfer canal extract direct from the canal. At inception the area under irrigation was 16 903 ha. Additional allocations have been purchased from the Eastern Cape bringing the current total to 17 050 ha. The canals were originally designed to provide water for flood irrigation. Only 9% of the scheme is still flood irrigated while 90% of the area is now irrigated using centre pivots with the balance of 1% using other systems. The Orange Riet *water user association* supplies 190 irrigators.

The majority of use is measured with 175 of the 190 users measured by either calibrated sluice or in-line water meters. Plans to measure the remaining unmeasured users are well advanced and by early 2011 all users will be measured. All measuring stations are fitted with telemetry which feed back to a central 24 hour control station which monitors all use in real

time. The telemetry system allows for water to be available on demand. The Orange Riet *water user association* is arguably setting the bench mark for water measurement and use in South Africa.

The main crops are wheat and lucerne. 37% of the area is planted to wheat, 26% is planted to lucerne and 37% to potato, groundnut, maize, oats, barley, grapes and other crops. Allocations are 11 000 m<sup>3</sup>/ha/yr. However users are billed on actual use on a per m<sup>3</sup> basis. As is the case with the Kalkfontein *water user association*, the Riet River seldom flows and water quality deteriorates significantly in the lower reaches of the river.

The Orange Riet *water user association* operates a water bank. Irrigators who do not use their full allocation can either sell their water to a willing buyer or hand the water back to the *water user association* who then sells the water at a premium to willing buyers.

#### **4.4.2.6 Lower Modder River Water User Association**

The Lower Modder River *water user association* came into being in 2010 and incorporates the former Modder River GWS. Being adjacent to the well run Orange Riet *water user association*, the Lower Modder River Board elected to “piggyback” on the expertise of the Orange Riet *water user association* and have engaged them to also operate the Lower Modder River *water user association*. The two *water user association* share a common CEO. The *water user association* is supplied by the Krugersdrift Dam on the Modder River and irrigators extract directly from the Modder River to irrigate 3 526 ha. 90% of the irrigators are measured using in-line water meters fitted with telemetry, and plans to measure the remaining 10% are well advanced for installation early in 2011.

The crop mix and annual allocations is similar to that of Orange Riet *water user association*.

The *water user association* is run in the same way as the Orange Riet *water user association* using the same personnel and operating procedures.

#### **4.4.2.7 Boegoeberg Water User Association**

The Boegoeberg *water user association* was established in 2003 and is an amalgamation of the Boegoeberg GWS, the Northern Orange IB, the Gariep IB, a portion of the Middle Orange Irrigation Area, and the Karos Geelkoppan Water Board. The total area under irrigation is 9198.. The Boegoeberg GWS has been in existence since 1931. The scheme consists of a lined canal on one or both sides of the Orange River which more or less track the river course. While some farmers pump directly from the rivers the majority are supplied from these canals. The Boegoeberg *water user association* supplies 306 irrigators. Nine livestock farmers are also supplied with water for for domestic and animal use. The total area of livestock farming is 60 000 ha.

Originally designed as a flood irrigation scheme 90% of the area is still irrigated by flood irrigation and the remaining 10% being irrigated with micro and drip irrigation. 30% of the flood irrigated area has been laser levelled. Canal users are measured using calibrated

sluices. 297 of the 306 irrigators are measured. 9 river users are not measured. The main crops grown are grapes (80%), lucern and maize (10%), with other crops such as cotton, wheat, peas and pecan making up the balance (10%).

Water shortages are rare and users are billed on a m<sup>3</sup>/ha/yr with the allocation being 15 000 m<sup>3</sup>/ha/yr for users on the Boegoeberg, Northern Orange and Gariep portions and 10 000 m<sup>3</sup>/ha/yr on the Middle Orange portion. The infrastructure is very old and the entire scheme is in need of rehabilitation. Consequently losses are high.

The operating philosophy is that the *water user association* has created just another channel of the river and water flows through the canals with similar or less losses as would be the case if the water had stayed in the river.

#### 4.4.2.8 Upington Islands Main IB

The Upington Islands Main Irrigation Board is still in the process of transforming to a *water user association*. At present it consists of seven individual Irrigation Boards operating under an umbrella Main Board. The total irrigated area is 7363.6 ha. The first IB was established 1912 and the umbrella Main Board in 1993. The seven irrigation boards are; Straussburg, Olyvenhoutdrif, Louisvale, Swartkop, Blaauwsekop, Steynsvoor and Kanoneiland Bo. Each Board has its own river diversions and canals which generally follow the course of the Orange River supplying water to farms situated on the river banks and on the many islands that exist in the river course.

Originally designed as a flood irrigation scheme 90% of the area is still irrigated by laser levelled flood irrigation and the remaining 10% being irrigated with micro and drip irrigation. Canal users are measured using calibrated sluices. At the time of the site visit the number of users could not be determined as this information resides with each individual IB. The main crops grown are grapes (70%), lucern, maize, cotton and wheat (20%), with other perennial crops such as citrus, olives and pecan making up the balance (5%).

Water shortages are rare and users are billed on a m<sup>3</sup>/ha/yr with the allocation being 15 000.

Much of the infrastructure is old and requires rehabilitation.

The operating philosophy is that the *water user association* has created just another channel of the river and water flows through the canals with similar or less losses as would be the case if the water had stayed in the river.

#### 4.4.2.9 Kakamas Water User Association

The Kakamas *water user association* which was established in 2003 was started in 1890 by the Dutch Reformed Church and became a GWS in 1983. The total area under irrigation is 10 485 ha made up of 5196 ha of the original GWS and 5289 ha of allocations purchased and existing water rights taken up under the new Water Act. The scheme consists of lined canals on one or both sides of the Orange River which more or less track the river course.



While some farmers pump directly from the rivers the majority are supplied from these canals. The Kakamas *water user association* supplies 580 irrigators.

Originally designed as a flood irrigation scheme 70% of the area is still irrigated by flood irrigation and the remaining 30% being irrigated with micro and drip irrigation. A large portion of the flood irrigated area has been laser-levelled. Canal users are measured using calibrated sluices. River users are not measured. The main crops grown are grapes (90%), with other crops accounting for just a small portion (10%).

Water shortages are rare and users are billed on a m<sup>3</sup>/ha/yr with the allocation being 15 000 m<sup>3</sup>/ha/yr.

The entire Kakamas GWS infrastructure was rehabilitated between 1983 and 1998 and this scheme is in the best condition of all the schemes visited.

The operating philosophy is that the *water user association* has created just another channel of the river and water flows through the canals with similar or less losses as would be the case if the water had stayed in the river.

#### **4.4.3 Findings**

##### **4.4.3.1 Introduction**

The findings have been grouped into the following main headings:

- Differences between *water user association*/IBs
- Common issues
- Water Management Plans
- Water markets

##### **4.4.3.2 Differences between water user association/IBs**

The main differences between the *water user association*/IBs were found to be:

- Every *water user association* is unique in their layout, operating philosophy and requirements, and challenges
- *Best management practices* that work in one *water user association* may not work in another *water user association*. Some *best management practices*, such as good measurement are universal. However some *best management practices* will have to be developed per *water user association* as they will be unique to the *water user association*.
- The *water user associations* have widely differing operational philosophies. Orange Riet *water user association* measure everything and in detail. The schemes in the lower Orange River like Boegoeberg, Upington and Kakamas have a philosophy that the *water user association* has created just another channel of the river and water flows through the canal with similar or less losses as would be the case if the water had stayed in the river.

- There is a greater awareness of *water conservation and water demand management* amongst farmers and their *water user association* management where regular shortages are experienced like Kalkfontein and Sand Vet *water user associations* and where the bulk of irrigation water has to be pumped such as the Orange Riet and Orange Vaal *water user associations*.
- The new South African Labour Act has greatly influenced operations of flood schemes like Boegoeberg, Upington and Kakamas. The *water user association* can no longer operate for 168 hours a week but only 120 hours. This requires that more water be supplied per hour and often the existing infrastructure does not have the capacity to do so as it was designed to operate on a 24 hour basis. The reduction in the maximum hours that labour can work, the shortage of labour and the spiralling cost of labour has driven the need for laser levelling of flood irrigation beds which results in reduced irrigation time.
- There are widely differing views on the effectiveness and accuracy of in-line water meters. Orange Riet believe they have found a reasonably tamper -proof meter and use them extensively. Orange Vaal does not believe that a tamper-proof meter exists and has developed a system to calculate water use pre season as most of their irrigation is pumped. There are also widely differing views on who should own the water meters. Orange Riet and Kalkfontein insist that the farmer own and maintain the meter, while Sand Vet and Vaalharts insist that the *water user association* should own the meters. Both camps put forward convincing arguments to justify their view.

#### 4.4.3.3 Common Issues between Water User Association/IBs

Common issues for *water user associations* are as follows:

- Although some *water user associations* have been established for some time most are still young. Most *water user associations* are also an amalgamation of one or more organisation. Consequently *water user associations* are still finding their feet.
- The majority of *water user associations* are well managed and well run from an operational perspective.
- A recurring theme with most *water user associations* was aging infrastructure. With the exception of Kakamas and possibly Orange Riet, most schemes have been in existence for a very long time and require major rehabilitation work and capital investment to get them back to peak operating condition.
- The situation with aging infrastructure is exacerbated in that for a long time prior to *water user associations* taking over from Government water schemes there was a general lack of maintenance of Government water scheme infrastructure.
- Although *water user associations* are responsible for maintaining infrastructure, ownership of infrastructures vests in the Department of Water Affairs and not the *water user associations*. Any capital works such as rehabilitation therefore requires their consent and agreement to fund the works. This is further subject to the availability of funds from Government coffers and must compete for funds with pressing demands from other social and development programmes. This makes it difficult to plan ahead.

- Most *water user associations* have insufficient and/or inaccurate measuring equipment on their main water conveyance systems making it difficult to measure losses. The ownership issue complicates this. Generally most users in areas served by canals are well measured. The calibrated sluice at farm turnout is ubiquitous.
- Generally most users pumping direct from source are not well measured with the exception of Orange Riet who use water meters and Orange Vaal who calculate water use.
- All allocations are in m<sup>3</sup>/ha/yr.
- There are no incentives for farmers to save water. There is a perception amongst farmers that if he uses less water than his allocation then in terms of the new Water Act, which no longer recognises a “right” to water, he runs the risk of losing a portion of his allocation. The water allocation is attached to the property and determines the value of the property. Any reduction in allocation would devalue the property. On flood irrigation schemes most plots of land are bordered by other plots and the farmer has no access to more land which he could irrigate should he save on his allocation.
- There are no incentives for *water user associations* to save water. *Water user associations* operational budgets are based on selling a certain volume of water. If water is saved the *water user association* will have less revenue and with *water user associations* just recovering their costs, the *water user association* could find itself in financial difficulties.
- The *water user association* responsibility stops at the farm turn out. All of the *water user associations* were adamant that water delivered to and paid for by the farmer becomes his property to use as he sees fit, including to waste it if he so wishes.
- All *water user associations*, even the best measured, agree that better measurement of water use by farmers and *water user associations* is required.

#### 4.4.3.4 Water Management Plans

The DWA guidelines for drafting Water Management Plans broadly looks at:

- Operating rules & regulations/policies
- Benchmarks
- Water Auditing: Accounting & Disposal Reporting
- Best management practices for *water user associations*
  - Primary BMPs
  - Secondary BMPs

*water user associations* were assessed on the above criteria whether they had a WMP in place or not. Three of the *water user associations* visited had a WMP in place. The WMP appear not to be used as a management tool but were in place because it was a legal requirement.

#### Operating rules & regulations

The following findings were made with regard to operating rules & regulations :

- Written rules and regulations. All except one have them in place.
- Scheduling of water. Most require that water be ordered weekly in advance.
- Policy on return flows & drainage. None have a formal policy. Vaalharts has a *de facto* system in place in that drainage water flows into the Spitskop Dam and is utilized again.
- Transfer of water allocations. The *water user associations* perceive DWA to have placed a moratorium on permanent transfer of allocations. All *water user associations* would like to see permanent transfers. In the mean time all allow temporary transfers (annually) subject to system capacity.
- Water allocation in times of shortage. All apply a % cut across the board
- Policy on wasteful use. No *water user association* has a policy on wasteful use (as opposed to unlawful use). Once the farmer has paid for his water it is his to use as he pleases.

### Benchmarks

Most bench marks mentioned in the DWA guidelines pertain to on farm activities. Generally, few benchmarks have been established as the *water user associations* regard on farm activities as the province of the farmer and do not involve themselves at that level. The findings are as follows:

- Water requirement per crop. Orange Riet, Orange Vaal and Kalkfontein have bench marks for water requirement per crop
- Calculation of crop water requirements. Orange Riet, Orange Vaal and Kalkfontein establish crop water requirement pre-season, in consultation with farmers.
- Check actual use against norm. Orange Riet do so by direct measurement, and Orange Vaal do so indirectly by measurement of the planted area.
- Farmers' use of above for on farm management. Orange Riet, Orange Vaal and Kalkfontein farmers use the above information for on-farm management.

### Water Auditing: Accounting & Disposal Reporting

- Monthly & annual disposal report. Eight *water user associations* produce a monthly report, four also produce an annual report, of which two *water user association* indicated the report is worthless due to faulty measuring structures.
- Source of water. Dams are the source of water in all cases.
- Spill recovery system. Only Vaalharts has a *de facto* system as spills find their way into the Spitskop Dam. All of the other *water user association*, with the exception of Orange Riet and Orange Vaal, have canals located next to a river and spills find their way back to the river almost immediately. Spills are not recovered and the water is lost to downstream users.
- Delivery method. The majority of *water user associations* work on a delivery schedule on request.

- Restrictions on source. Kalkfontein and Sand Vet supply municipalities with water. To ensure adequate water for municipal use they are prohibited from drawing down their dams below a certain level.
- Changes or additions next 5 years. All *water user associations* have plans for the next 5 years. The plans vary from installing more telemetry to a total rehabilitation of a scheme. The ownership of infrastructure issues, however, makes long term planning very difficult.
- Water accounting
  - Kalkfontein and Orange Riet account for all inflows, the rest measure only inflows to canals.
  - Storage change is monitored regularly by those *water user associations* who have dams under their control
  - Consumptive use. Kalkfontein and Orange Riet record full consumptive use, the rest only record process use.
  - Kalkfontein and Orange Riet measure all outflows, Boegoeberg and Kakamas do not measure any outflows, and the rest only measure canal outflows.
  - All *water user associations* have quality issues. Orange Vaal has severe water quality problems while Vaalharts and the lower Riet River portion of the Orange Riet *water user association* have less severe problems but the levels are still cause for concern. Schemes lower down, like Boegoeberg, Upington and Kakamas, have periodic problems with slugs of poor quality water arriving at extraction points.
  - Five of the *water user associations* do weekly or monthly water quality monitoring. Four *water user association* rely on the DWA monitoring programme.
- Performance indicators. No *water user association* uses the performance indicators published in the DWA guidelines as a management tool.
- Water auditing. Only 1 *water user association* is audited annually by DWA.

### **Best Management Practices for water user associations**

The findings on primary and secondary BMPs as defined in the DWA guidelines are as follows:

#### **Primary BMPs**

- No *water user association* has a dedicated WC/WDM person. WC/WDM functions are performed by various existing staff but are not the responsibility of a single person.
- No *water user association* provides information to farmers to improve on-farm management practices.
- Two *water user associations* provide pre-season determination of weekly crop requirements.
- No *water user association* estimates the impact of climatic variation during the season.

- *water user associations* measure farmer use mostly by calibrated sluice or in line water meter. Orange Vaal calculates use pre-season and verifies areas post planting. If no measuring equipment is installed then some *water user associations* determined water use by measuring the area planted. Some *water user associations* do not measure unmetered use.
- No *water user association* routinely sends out water quality data to farmers. Data is available to farmers on request.
- Kalkfontein and Orange Riet have implemented R/m<sup>3</sup> pricing. The rest bill on a m<sup>3</sup>/ha/yr basis.
- All *water user associations* have similar measures in place to prevent and deal with unlawful withdrawals. Unlawful use is detected various means. These include downstream complaints of insufficient water, spot checks by Water Control Officers, observations by Water Control Assistants or canal guards while going about their duties and by inspection of the area under crop. All have an escalating procedure to deal with unlawful withdrawals starting with a first warning, then second warning, then a fine. Some also make use of peer pressure by notifying downstream users of the unlawful use so that they can take legal or other action against the guilty party, and some have a 'name and shame' policy whereby a person guilty of an unlawful withdrawal has his name mentioned at the next Board meeting.
- No *water user association* has a 5 year operations and maintenance plan. All have at least an annual O&M plan.
- All the CEOs of all the *water user associations* attend regular Association of *water user association* meetings where WC/WDM issues are communicated. This information is then disseminated at Board meetings.

## Secondary BMPs

- No *water user association* provides any support services to farmers to enable more efficient water use.
- All *water user association* have an idea of trends of specific irrigation methods and their impact on WC but no *water user association* formally quantifies these trends.
- All *water user associations* have plans for reducing conveyance losses. These range from installing more telemetry to rehabilitation of the entire scheme.
- All *water user associations* have documented management procedures for staff in place.
- No *water user association* has plans to improve on management procedures. This could indicate a reluctance to change or it could be that their operations have become so routine over the years that the scheme runs like clockwork and there is no perceived need for improvement.
- All *water user associations* provide in-service training for their staff. They also make use of DWA courses which are open for attendance by *water user association* personnel.

- No *water user association* facilitates financing for small scale farmers. *water user association* with small farmers administer the sliding scale tariff subsidy for small farmers on behalf of DWA. The Board of the Sand Vet *water user association* elected to not bill small farmers for water until their subsidy is in place. To date the *water user association* has supplied approximately R 1 million of free water to its small farmers..
- All *water user associations* allow temporary transfers of water allocations and deal with them in the same way. Voluntary water transfers are negotiated between users and must be approved by the *water user association* to determine if the infrastructure capacity is adequate. Typically transfers from downstream users to upstream users are permitted but not visa versa.
- No *water user association* has a major problem with invasive species in their servitudes as they are eradicated as part of the regular O&M programme.
- No *water user association* provides assistance to farmers with invasive species problems. Farmers requiring assistance with eradication of invasive species are referred to the Department of Agriculture's (DOA) Working for Water programme.
- Only Vaalharts *water user association* monitors water logging and salinity as they have a major problem with it.
- For the planning and implementation of sub-surface drainage works farmers are referred to DOA.
- Some water user associations have soil conservation works and some don't. In the lower Orange River levees were constructed by the DOA following floods in 1988. One of the water user associations accepts the maintenance of these structures as the responsibility of the water user association and performs routine maintenance on them. The other two water user associations view the levees as belonging to DOA as the water user associations never requested the levees to be constructed. The DOA constructed the levees of their own initiative and the water user associations is of the view that DOA should maintain them. DOA views the levees as being the property of the water user associations. Consequently no maintenance is performed to these levees.

#### *Issues identified by water user associations*

At the conclusion of the formal discussions during visits the *water user association* was given the opportunity to raise any issues which they felt was pertinent. Issues identified by *water user associations* include the following:

- A number of water user associations expressed a need for training of *water user association* management personnel in the operation of a *water user association*.
- The *water user association* which have a large flood irrigated component expressed a need for training of farmers and their labour in the operation of flood irrigation systems.
- One *water user association* felt that if the audit function was emphasised and performed regularly by DWA, more *water user associations* would give attention to WC/WDM.

- Water savings by *water user associations* and farmers will only happen if a business case can be made for it. For example, an export table grape producer in Upington practices irrigation scheduling not to primarily save water but to satisfy the requirements of the buyer of his export table grapes. The buyer, as part of their environmental responsibility drive requires documented proof that the minimum amount of water is used in the production of the product. Other examples are laser levelling of flood irrigation beds for labour saving and scheduling of irrigation to minimize electricity costs. These practices often result in improved water conservation though this is not the primary motivation for implementation of the practices.

## **Water Markets**

Water markets are very much in their infancy in South Africa. This is borne out by the following:

- The Sand Vet *water user association* and Orange Riet *water user association* both operate a water bank. Unused water allocations can be surrendered to the *water user association* who on-sells at a premium to a willing buyer, typically 30% above the normal tariff.
- Water markets on schemes fed by canals are constrained by system capacity in that they can only transfer water from the lower end of the canal to the upper end.

### **4.4.3.5 Key findings from a visit to the Regional Office of the RSA Department of Water Affairs**

A key finding from a visit to the Bloemfontein office of DWA is that diffuse irrigation (not part of a formal scheme) in Orange River basin above Gariep Dam is not measured. DWA do not have the means or personnel to do so. It is therefore difficult to determine what the exact water-use situation is in these areas.



## 5 WORKSHOPS

### 5.1 Introduction

As part of the consultation phase of the study one day workshops were held to present the findings of the visits to *water user association*/IBs and to interested and affected parties.

Workshops were held at:

- Noordoewer in Namibia;
- Upington in the RSA, and
- Kimberley in the RSA.

### 5.2 Objectives of the workshops

The objectives of the workshops were to:

- Identify BMPs for distributors and set benchmarks for distributors,
- Identify BMP sites for irrigators using different irrigation systems for use as demonstration sites, and
- Prioritize future actions that will have the most impact on WC/WDM.

Following on from the workshops, visits to BMP sites for irrigators were set up to observe their systems, approaches and efficiencies, and to set initial benchmarks at irrigator level.

### 5.3 Noordoewer/Vioolsdrift –

#### 5.3.1 Introduction

The workshop was held at the Orange River Lodge in Noordoewer in Namibia. The workshop programme and attendance list are provided in **Appendix 2**.

#### 5.3.2 Presentations and Discussions

Before discussions with the stakeholders, the team made a PowerPoint presentation according to the workshop programme. A more complete description of the discussions is provided in **Appendix 2**. The key issues raised and debated by the delegates are summarised below.

The following is a summary of the discussions which took place at the workshop:

#### Measurement of Water Use

- No one knows how much water is really used as there is no measurement. Sluice readings at the main diversion weir are taken but just sent somewhere. There is no feedback.
- Currently farmers pay according to an allocation of 18 000 m<sup>3</sup>/ha/annum.

#### Wasteful and or Illegal Use

- There are no policies or mechanisms in place to address wasteful or illegal use. One idea used at Hardap is to highlight the worst farmers ( wall of shame/peer pressure concept)
- Alternative could be to reward good/efficient farmers

### **Incentives**

- There are no incentives for either farmers or WUAs to save water.
- If a farmer saves water what is he going to do with it? In theory water trading is possible but is not supported by the authorities.
- The Noordoewer/Vioolsdrift scheme is situated at the lower end of the Orange River where there is “never” a water shortage. There is therefore no perceived necessity to change as the water “just flows down to the sea anyway”.
- There has to be a financial incentive to save water. Water savings by WUAs and farmers will only happen if a business case can be made for it.
  - For example, at Hardap farmers who have changed to centre pivots have paid for them in 2 years through higher yields and reduced labour costs.
  - The use of shade netting at Noordoewer/Vioolsdrift results in more efficient water use. Shade netting is used because it leads to better yields and quality rather than to save water per se.
  - Incentives need to be there right along the supply chain.

### **Policy and Legislation**

- More policy/legislation is not favoured. A few key policies and laws only are required. Making farmers more aware of the business case for saving water is the key to improved water use efficiency.

### **Scheduling**

- There is a need to implement/improve scheduling. This will only happen if a business case can be made for it.

### **Water Revenue**

- The Noordoewer/Vioolsdrift scheme used to be an irrigation board and is now a Joint Irrigation Authority. It operates in a similar fashion as a WUA.
- There are no problems in farmers paying for their water. The JIA is firm in collecting revenue and does not allow debt to accumulate.

### **Education and Capacity Building**

- Although the WUA/JIA is in the best position to promote this, they do not see it as their function to make information on WC/WDM available to farmers.
- Many farmers are not keen to share their experiences and successes.
- WUAs do not always have the expertise to perform their functions effectively.

### **Critical Issues and Ideas on Best Management Practices**

- At the scheme level inflows and outflows should be properly measured.
- Look at incentives at all levels.
- Provide information to farmers to show WC/WDM is good business.

### 5.3.3 Identification of BMP Demonstration Sites

A number of proposals were made for BMP demonstration sites at both the supplier and irrigator levels. The JIA itself was chosen as a supplier site. The selected BMP sites are given in chapter 6.

## 5.4 Upington

The workshop was held at the Protea Hotel in Upington in South Africa. . The workshop programme and attendance list are provided in Appendix 2.

### 5.4.1 Presentations and Discussions

Before discussions with the stakeholders, the team made a PowerPoint presentation according to the workshop programme. A more complete description of the discussions is provided in Appendix 2. The key issues raised and debated by the delegates are summarised below.

### 5.4.2 Discussions

#### Affordability and paying for Water

- Has any study been done on the affordability of water? DWA looks only at cost of infrastructure in evaluating what people should pay - not at potential benefits

#### Measurement of water

- Lengthy discussion on issue of payment on volumetric basis. Agreed that this would provide an incentive to farmers to use water more efficiently. Paying for an allocation does not encourage this. Caveats to be considered:
- Measurement is required. This could have significant cost implications.
- If the result is less water being used then the *water user associations* may have a shortfall to cover their operation and maintenance costs remaining. Partial solutions could include:
  - Splitting user charge into a fixed part and a measured consumption part
  - Water meters could be unaffordable. Outside funding may be required – possibility of cross-subsidisation could be considered. DWA had already promised to assist with measurement at the distributor level. Could Government assist at the farmer level?
  - Farmers are concerned that with volumetric measurement improved efficiencies could result in reduced allocations.

## Water Markets

- Good if possible for the farmer to sell his saving.
- Grape farmers need to get long-term transfers, currently not possible
- Suggestion that water markets could work but should be ring-fenced around individual schemes
- Transfer of allocations to other schemes upstream or downstream mean that farmer sells allocation but the operation and maintenance costs are not reduced/sold. Could also have an influence on the schemes (could find some schemes distribution systems operating way under design capacity and some operating above)
- For water market to be realistic there needs to be a real demand for the unused allocations. What happens if the excess is not sold? The farmer who didn't sell it should still pay for it?
- Concept of water banks could be considered
- Some farmers don't wish to pay volumetrically but do want to be able to use their savings for extending their surface. They are currently not allowed to do this.

## Scheduling

- Karstens Boerdery spend huge amounts of time and money on scheduling and have got really good results. Application rates of 12 000 m<sup>3</sup>/ha/year are possible, They use specialized moisture probes reporting relative moisture at 100, 200...800mm below surface. These have had very positive results. They have two main incentives - lower energy cost and the need to maintain a good image with overseas client who advertise the issue of water efficiency (irrigation footprint). They have also installed climate stations (3500 R each) to further improve the accuracy of weather reports.

## Extension Services and capacity building

- On the issue of extension responsibilities of *water user associations* it was pointed out that responsibilities cited as expected are a lot: If water user associations were to carry out these functions they would need more personnel, expertise, training – the result would be a higher user charge.
- Dept of Agriculture has disappeared in its support role, needs to come back. Currently only supporting RPFs, not commercial farmers

## General points

- Some discussion on the low carbon footprint of irrigation and a need to look holistically (social issues, employment, urban migration etc) at the role that the much maligned irrigation sector plays
- Mining impact on water quality should be paid by mines

## 5.5 Kimberley

### 5.5.1 Introduction

The workshop was held at the Protea Hotel in Kimberley in South Africa. . The workshop programme and attendance list are provided in Appendix 2.

### 5.5.2 Presentations and Discussions

Before discussions with the stakeholders, the team made a PowerPoint presentation according to the workshop programme. A more complete description of the discussions is provided in Appendix 2. The key issues raised and debated by the delegates are summarised below.

#### ***Water User Associations and their role in WC/WDM***

The Water Act is one of the best in the world but its implementation by DWA is very slow.

There are differing interpretations of the Water Act with regard to the establishment of *water user associations*.

The different statutory requirements of Irrigation Boards (in terms of old legislation) and *water user associations* (in terms of new legislation) is a major constraint to irrigation development and improved water use efficiency.

Concern expressed that the principal of devolution of water management to the user level (e.g. the *water user association*), as provided for in the Water Act, is being violated and reversed (particularly with respect to the transfer of water within a *water user association*).

There is a tangible gap in the chain of water demand management (through *water management plans*) at *catchment management agency/DWA* level. *water user associations* pay charges to *catchment management agency/DWA* but little feed-back. *catchment management agencies* or their equivalent should be established as quickly as possible.

The principles of the *water management plan* are excellent but they not being enforced by DWA.

Many aspects of the guidelines for WMPs are not being implemented by *water user associations* because of complexity.

There is no incentive for *water user associations* to improve efficiency when the “catchment management charge” is based on the total allocation to the Scheme. Allocations from DWA to *water user associations* should include an efficiency factor which would provide *water user associations* with a limited amount of surplus water, thus allowing *water user associations* the incentive to save and sell on to willing buyers at a premium.

*Water user associations* should be assisted to develop there own data bases with respect to irrigation water allocations, irrigated areas and cropping patterns etc in their Schemes which are compatible with catchment and national data bases.

Most irrigation scheme infrastructure is owned by DWA but is not always being maintained by them. This makes the management of Scheme irrigation infrastructure by the *water user association* very difficult.

There is a lack of clarity with the terms “repair”, “refurbishment” and “repairs following a natural disaster” and the DWA’s involvement with these is inconsistent.

If some farmers don’t pay their levies to their *water user association* then the remaining farmers have to make up the deficit for the *water user association* to survive. This can lead to the collapse of a *water user association*.

The Act requires that elected representatives on a *water user association* must be paid-up members of the Association. This is not the case with some emerging farmer representatives.

The existing water pricing strategy should be reviewed as, at present, it only considers infrastructure cost.

Farming is shown to represent just 2,3% of the GDP but this is not the true picture of what it contributes to the economy. The linkages are not adequately factored into the equation. To understand the value of farming to the economy one must look at what the effect will be if farming did not take place, especially in the lower Vaal and Lower Orange where farming and related industries are often the only economic activity, and farming is consequently the largest employer. Water pricing should relate to this value and not just the cost of infrastructure.

Research and support needed in the management of real-time water use and related disposal reporting.

## **Water transfers**

Temporary transfers are conditional.

Water transfers in the Sand-Vet *water user association* are being blocked by DWA because of the preference of water reallocation to emerging farmer schemes.

Temporary transfers of irrigation water from one irrigator to another within a *water user association* should be able to become permanent transfers. If farmers are using transferred water for the production of permanent crops like table grapes the assurance of a permanent water allocation is essential.

Temporary and permanent transfers of irrigation water should preferably be the sole responsibility of *water user associations*.

Transferring of water within *water user associations* with open canal reticulation systems will be limited to transfers upstream of the source and not downstream because of the limited capacity of the canals to transfer the additional water downstream.

One of the risks of water transfers is the reduction of revenue for the source *water user association*. This has been resolved in the Orange–Riet *water user association* by agreeing that the recipient *water user association* pays the water charges to the source *water user association* and charges the user the normal charge .

### **Illegal water use**

Illegal water use is a significant problem in many *water user associations* and requires attention.

### **Technical and financial aspects of WC/WDM**

Drainage is required in a number of schemes but the lack of government subsidy support is making it unaffordable for farmers.

The rapidly increasing cost of electricity is having significant impact on the cost of irrigation and in itself is creating a growing awareness of the need to irrigate more efficiently.

Electricity costs now up to 14% of production costs in the Orange-Riet Irrigation *water user association*. This is having impact on viability of certain crops.

In some areas, the Cooperatives provide technical support to farmers (e.g. irrigation requirements, fertilizer requirements, plant protection chemical requirements etc.)

### **Water metering**

Metering is essential for improved management and monitoring of water use. Water meters should be owned and managed by the water users and not by the *water user association*.

### **Water quality issues**

Water quality is impacting on crop selection.

Poor quality water is resulting in increasing irrigation requirements (more frequent irrigations and provision for leaching fractions).

### **Water shortages**

There is concern that a reduction in supply of water to a *water user association* (due to drought) will result in reduced revenue for the *water user association* as well as the impact on the irrigators.

A major constraint for farmers to upgrade to higher value crops such as orchard or vine crops is the assurance of supply of irrigation water. Farmers cannot risk the high capital investment of such an upgrade if there is a high probability of water restrictions in any given year. Farmers are also hesitant to invest in new, more efficient, irrigation technology when the assurance of supply is low. An example of where farmers react to an improved assurance of supply is on the Orange/Riet Scheme where water transfers from the Eastern Cape has provided a more stable supply compared to previous years.

### **New storage infrastructure in the Basin**

Water quality is impacting on crop selection.

Poor quality water is resulting in increasing irrigation requirements (more frequent irrigations and provision for leaching fractions).

### **Communication issues**

There is a link missing in getting the recommendations from such a study as this down to the farmer level. There needs to be a “roll-out” plan to get the message to the farmer.

Some *water user association* managers face the challenge of irrigators maintaining a veil of secrecy over their production practices and yields for fear of income tax exposure. The secretive approach makes information sharing and transparency difficult.

To maintain good communications with farmers is a challenge for *water user associations*. Irrigators are reluctant to attend meetings and consequently miss vital information.

### **Irrigated agriculture as a business**

Over the last 25 years on the Orange-Riet Irrigation Scheme only 19% of new farmers entering the Scheme have proved successful and sustainable.

The lack of viability of small farms is forcing consolidation of commercial farms. This is a lesson to emerging farmer projects where small, unviable farms are allocated to new farmers with disastrous effects.

### ***Best management practices***

BMPs should not be evaluated at distributor and farmer level only but should also be evaluated at DWA level (i.e. how well is the government doing?).

The policy makers should be made aware of the findings of this study.

### **5.5.3 Identification of BMP Demonstration Sites**

A number of proposals were made for BMP demonstration sites at both the supplier and irrigator levels. The selected BMP sites are described in chapter 6.



## **6 BEST MANAGEMENT PRACTICE SITES**

### **6.1 Introduction**

#### **6.1.1 Background**

One of the aims of the stakeholder workshops was to select “best-practice demonstration sites” (BPDS) for evaluation. The objective of best-practice demonstration sites is, in turn to identify irrigation water use best practice within the major irrigation areas of the catchment and to capture the elements of this best practice as a reference source for all irrigation water suppliers and users in the catchment. Because of the relatively limited duration of the study, covering only a small portion of the growing season, the evaluation process concentrated on visiting the sites, obtaining a first-hand view of the best-practice operation and observing their systems, approaches and efficiencies.

#### **6.1.2 Rationale for Site Selection**

It was decided during the course of the study that the demonstration sites should include both irrigation water supply institutions (supplier sites) and individual irrigators (irrigator sites). The chosen **supplier sites** should represent the main types of water distribution and water management systems in the catchment and should include specific aspects of best practice which can provide an example to other water supply authorities and can provide benchmarks for the various elements of best practice.

The chosen **irrigator sites** should represent the main irrigation systems being used, the main crops being grown in the catchment and the main irrigation management and scheduling systems being practiced. The irrigator sites should also demonstrate specific aspects of best practice which can provide an example to other irrigators and can provide benchmarks for the various elements of best practice.

#### **6.1.3 Selected Sites**

Three supplier sites were selected, namely, The Orange Riet Water User Association in the central region of the catchment, Boegoeberg Water User Association on the lower Orange and Noordoewer/Vioolsdrift Joint Irrigation Authority on the border between Namibia and South Africa which includes both Namibian and South African irrigators.

The irrigator sites include Soetmelkvlei Farm which is situated in the Orange Riet Water User Association, Liebenberg farm which is situated in the Boegoeberg Water User Association and Shelanu farm which forms part of Karsten Boedery (Pty) Ltd and is situated in the Upington Main Irrigation Board.

## 6.2 Supplier Sites

### 6.2.1 Orange Riet Water User Association

#### 6.2.1.1 Introduction

The Orange-Riet *water user association* is situated within the Upper Orange Catchment Management Area and near the town of Jacobsdal which is about 40km south-east of Kimberley. The management area of the Orange-Riet Water User Association includes all the properties entitled to use water from the Orange River via the Scheiding pumping station at Vanderkloof dam, and includes all irrigation along the 113km Orange-Riet canal, the Riet River Settlement and selected areas along the Riet River and the Modder River. The total area under irrigation is 17 050ha.

The Orange-Riet *water user association* has been selected as a “supplier” best practice demonstration site as it represents the “state-of-the-art” in water demand management and water use efficiency within the Orange River Basin and provides a practical and affordable approach which may have application in other parts of the basin over time.

The *water user association* personnel who assisted the study team in preparing this report were:

- Nic Knoetze                      CEO
- Sydney Montshiwa      Operations manager
- Reta Malan                      Operations official

#### 6.2.1.2 Background to the formation of the water user association

The original form of irrigation in this area was water abstraction from the Riet and Modder Rivers. In 1945 the Riet River Settlement Scheme comprising a canal system was completed. This Settlement formed part of the Riet River Scheme and received water from the Kalkfontein Dam from 1945 to 1987. The area under irrigation in 1987 was 7 897ha.

The Orange-Riet Canal was completed in 1987 and now supplies water from the Orange River to the original 7 897ha of the Riet River Settlement and a further 4 484ha along the length of the Orange-Riet canal itself. Furthermore, since the completion of the Vanderkloof canal, the Irrigation Boards of Scholtzburg (641ha) and Lower Riet River (3 853ha), which abstract water from the Modder and Riet Rivers and supplied from the Krugersdrift dam, are now able to make use of water from the Orange River. This increased both the volume and assurance of their water supply. It also increased the assurance of other irrigators higher up along the Modder River as they no longer share water with irrigators of Scholtzburg downstream.

The settlement of Ritchie developed small holder irrigation plots in 1932 with 65ha of irrigation, pumped from the Ritchie Weir on the Riet River. They are currently irrigating 96,8ha and the *water user association* also supplies water to Ritchie Municipality.

All these irrigation areas (summarized in Table 6-1 below) have been consolidated to form the Orange Riet Water User Association. After the constitution was approved on 25 August 2000 the transformation to a *water user association* was effected on 15 September 2000 as per Government notice No. 911. The *water user association* took over the maintenance of all infrastructure from the Department of Water Affairs in November 2001. The ownership of the infrastructure remains vested in the Department of Water Affairs.

**Table 6-1: Orange Riet Water User Association Irrigated Area**

Site	Area under irrigation (ha)
Riet River settlement	7827
Irrigators along canal	4617
Lower Riet	3873
Scholtzburg	646
Ritchie settlement	97
<b>Total</b>	<b>17050</b>

### 6.2.1.3 The purpose of the Orange Riet Water User Association

The purpose of the Orange Riet *water user association* is:

- To operate and maintain the main canal from Vanderkloof Dam, the Scheiding pump station and Orange-Riet Canal as well as the water distribution works for the provision of water from the pumping station.
- To provide water to people who are entitled to water in terms of Article 22(1) of the National Water Act of 1998 (Act 36 of 1998) by means of the waterworks under the jurisdiction of the Association. To ensure that people use water in accordance with the water users' entitlement as stipulated in Article 22(1) of the National Water Act of 1998 (Act 36 of 1998).

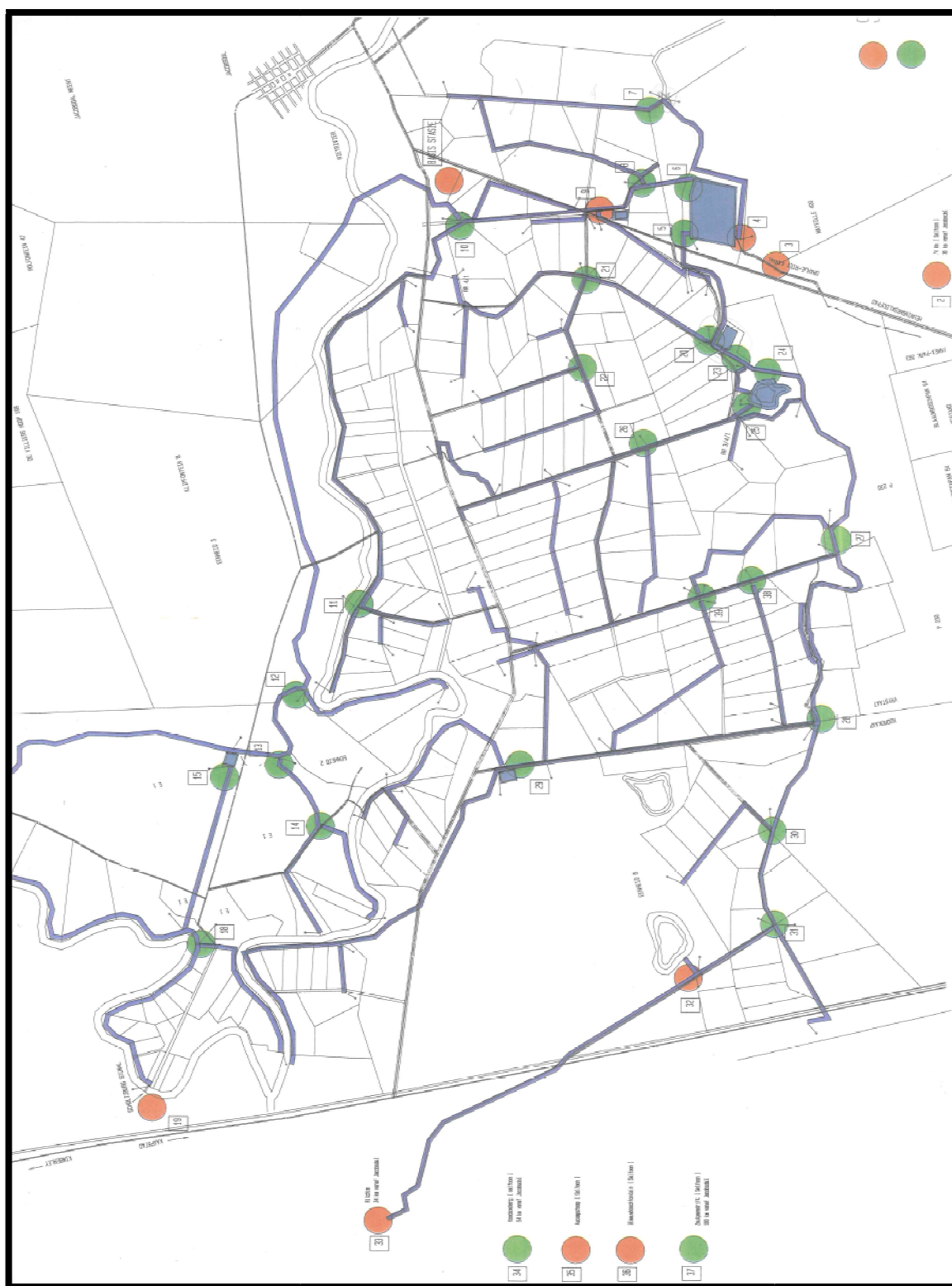
### 6.2.1.4 Best Practices

The key irrigation best management practices that are demonstrated by the Orange Riet WUA are listed below:

- The most noticeable aspect of best management practice in the Orange Riet WUA, is the sense of awareness of all staff members of the importance of efficient irrigation water management and conservation. The management team has a common goal and very specific objectives to achieve that goal. This professional and focused approach is reflected in the successes they are achieving.
- The management team maintains a high level of service to irrigators and good control of overall water distribution by means of a computerised telemetry system (see

Figure 6-1) which is integrated through all levels of water management from bulk flow measurement right to the invoicing of irrigators for water used.

- The WUA provides water to 371 irrigators via 314 calibrated sluices and water meters where water is extracted from the river or directly from the canal. Water meters are purchased by the farmer at a subsidized price and belong to him. If a meter is not functioning then the user is charged according to the area under production and the crop type using the attached table. This is always more than he would pay if his meter was working and a direct incentive to get the meter back in working order as soon as possible.
- The WUA has a clear but simple set of regulations for each of the Irrigation Schemes within the Association (an example of the regulations for the Riet River Settlement is included in Appendix 3. The main regulations include:
  - Water allocations per irrigator, the conditions under which the allocation can be restricted and the allowed abstraction rate.
  - Irrigators are responsible for the setting, opening and closing of sluices and all sluices must be securely locked, and are responsible for ensuring that the requested allocation of water is received.
  - Only the owner or authorised individuals may request water.
  - Water may be transferred from one property to another in a season via a rigorous process which is driven by the WUA.
  - Water allocations may be transferred permanently (sold) from one property to another within the area of the Orange Riet WUA also via a rigorous process which is driven by the WUA.
  - Strict regulations regarding the unlawful abstraction of water including fines and charging for work done by the WUA which otherwise would be done by the irrigators themselves.
  - A year planner that has to be completed by each irrigator
  - Recording of all crops grown under irrigation
  - Control over the submission and payment of water accounts.
- The WUA prepares an annual Water Management Plan which, in terms of the South African Water Act, is a fundamental requirement for the sustainable application of water conservation and water demand management. The plan allows for a systematic and practically achievable improvement in water management and water-use efficiency.



**Figure 6-1: Layout of Telemetry operated gates on Oranje-Riet Scheme**

- The SAPWAT computer program is currently being used to calculate the crop water requirement and the crop irrigation requirements which are correlated with the

practical irrigation experience in the area, and modified to produce an irrigation benchmark for each crop. Each irrigator's requirements are then projected through the season. The benchmark may be amended each year based on previous season experience.

- All sluices are measured at the outlet. A record is kept of every irrigator's requests and receipts.
- The water management programme "WAS" is used to manage the water measurements and prepare accounts for irrigators.
- The WUA prepares an annual disposal report, an annual water- accounting report and specific performance indicators. These reports are forwarded annually to DWA for auditing (in the future it will be the responsibility of the catchment management Agency to audit the WUA).
- Unlawful use of water is monitored using a spot-check system, reported shortages in the canal, telemetric measurement and comparison with benchmark crop water use.
- The WUA has identified the need for a balancing dam on the Orange Riet canal as an important addition to the Associations infrastructure to improve water use efficiency. The balancing dam was part of the original design of the range Riet canal but was never constructed. DWA has now agreed to fund this and construction is due to start this year (2011).

## **6.2.2 Boegoeberg Water User Association**

### **6.2.2.1 Introduction**

The Boegoeberg *water user association* is situated within the Lower Orange Catchment Management Area and near the town of Groblershoop, which is about 110km south-east of Upington. The management area of the Boegoeberg Water User Association includes all the properties entitled to use water from the Orange River via the Boegoeberg dam and the river below the dam. The total area under irrigation is 9198 ha.

From a WC/WDM perspective there is little to choose between Boegoeberg WUA, Kakamas WUA and Upington Islands Main IB in terms of best practice demonstration sites as they are similar in design, being predominantly flood irrigation schemes, and all are operated in a similar fashion, and, from an operational perspective, all are well run. However none of these schemes represent "state of the art" when it comes to WC/WDM. The Boegoeberg *water user association* has been selected as a "supplier" best practice demonstration site as its management showed a keen interest in water demand management and water use efficiency, and were keen to learn as much as possible. They showed a genuine desire to improve their WC/WDM practices and are likely to adopted practical and affordable WC/WDM approaches which could then find application in other parts of the basin over time.

The *water user association* personnel who assisted the study team in preparing this report were:

- Johan Botha                      CEO
- Fanie Marais                      Senior Water Control Officer

### 6.2.2.2 Background to the formation of the water user association

The Boegoeberg *water user association* is an amalgamation of the Boegoeberg GWS, the Gariep IB, the Northern Orange IB, a portion of the Middle Orange Irrigation Area, and the Karos Geelkoppan Water Board. The Boegoeberg GWS, Gariep IB and Northern Orange IB were all served by common infrastructure which was operated by the Department of Water Affairs. The total area under irrigation is 9198 ha. The Boegoeberg GWS was established in 1931.

All these irrigation areas (summarized in Table 6-2) have been consolidated to form the Boegoeberg Water User Association. The announcement of the formation of the *water user association* was made on 4 May 2001 as per Government notice No. 369. The Minister of Water Affairs signed final approval in March 2003 and *water user association* took over the maintenance of all infrastructure from the Department of Water Affairs. The ownership of the infrastructure remains vested in the Department of Water Affairs.

The Boegoeberg *water user association* supplies water to 306 irrigators. Nine livestock farmers, previously supplied by the Karos Geelkoppan Water Board, are also supplied with water for domestic and animal use. The total area of livestock farming supplied is 60 000 ha.

**Table 6-2: Boegoeberg Water User Association Irrigated Area**

Site	Area under irrigation (ha)
Boegoeberg GWS and Gariep IB canals	6713.8
Boegoeberg GWS and Gariep IB river extraction	1310.1
Northern Orange IB canals	966.1
Portion of Middle Orange Irrigation Area river extraction	208
<b>Total</b>	<b>9198</b>

The bulk of the Boegoeberg *water user association* scheme consists of lined canals on one or both sides of the Orange River which more or less track the river course. It is a long narrow scheme with the longest canal being 182 km from the dam to the end of the canal. Table 6-3 below indicates the different canals and their lengths.

**Table 6-3: Boegoeberg Water User Association Canals**

Canal	Length (km)
Main (Boegoeberg) canal	174
Northern Orange canal	40
Gariep canal	38

Rouxville West canal (starts below the end of the main canal)	8
<b>Total</b>	<b>260</b>

### 6.2.2.3 Best Practices

The key irrigation best management practices that are demonstrated by the Boegoeberg WUA are listed below:

- The most noticeable aspect of best management practice in the Boegoeberg WUA, is the sense of awareness of the management of the importance of efficient irrigation water management and conservation, and the interest shown to learn as much as possible.
- The management team maintains a high level of service to irrigators. Water is requested weekly by canal users by means of a request letter. Post boxes are situated along the canals in which request letters can be posted.
- The active promotion of laser levelling of flood irrigation areas is resulting in an increase in laser levelling with 30% of the flood irrigated area already laser.
- Control of overall water distribution. Farmers open and close their own sluice gates according to a published schedule. Control is exercised by Canal Assistants and Water Control Officers doing who do regular inspections of sluices and water meters.
- Invoicing of irrigators for water used is done every 6 months retrospectively. A record is kept of every irrigator's requests and receipts.
- The WUA provides water to 306 irrigators of which 297 are measured.
- Canal users are measured with calibrated sluices.
- River abstraction is measured by in line water meters. Water meters are purchased by the farmer and it is his responsibility to maintain them and ensure they are accurate.
- 80% of the scheme is planted to grapes or other permanent crops and water requirements do not change from year to year.
- An Excel spreadsheet is used to manage the water measurements and prepare accounts for irrigators.
- The WUA prepares an annual disposal report. These reports are forwarded annually to DWA for auditing.
- Unlawful use of water is monitored using a spot-check system and reported shortages in the canal.

### 6.2.3 Noordoewer/Vioolsdrift Joint Irrigation Authority

#### 6.2.3.1 Site Description

The Noordoewer/Vioolsdrift Joint Irrigation Scheme was built in 1934 and is managed by the Noordoewer/Vioolsdrift Joint Irrigation Authority (JIA) which was established through a



bilateral agreement between Namibia and South Africa in 1992. Farmland is situated on both sides of the river and is privately owned. The operation and maintenance of the canal and inverted siphon distribution system is done by the JIA with own funds. The reticulation system is in a fair state and the Namibian Government as well as the South African Government contributed towards the upgrading of two of the canals and the installation of a new siphon through the Orange River. Many farmers still use flood irrigation, but several are beginning to switch over to centre pivot, micro and drip irrigation. Water usage is not measured and there is little incentive for farmers to switch to more efficient irrigation technologies. **Table 6-4** clearly indicates the decrease in the number of farmers over the years, with a subsequent increase in area per farmer. This can mainly be attributed to economical viability.

**Table 6-4: Irrigation Areas at the Joint Vioolsdrift/Noordoewer Scheme**

Country	Area (ha)*	Number of farmers	ha/FARMER
South Africa	600,5	Decreased from 38 in 1994 to 12 in 2010	Increased from 15,8 to 50
Namibia	283,3	Decreased from 20 in 1994 to 4 in 2010	Increased from 14,2 to 70.8
Total	883.8	Decreased from 58 in 1994 to 16 in 2010	Increased from 15.23 to 55.2

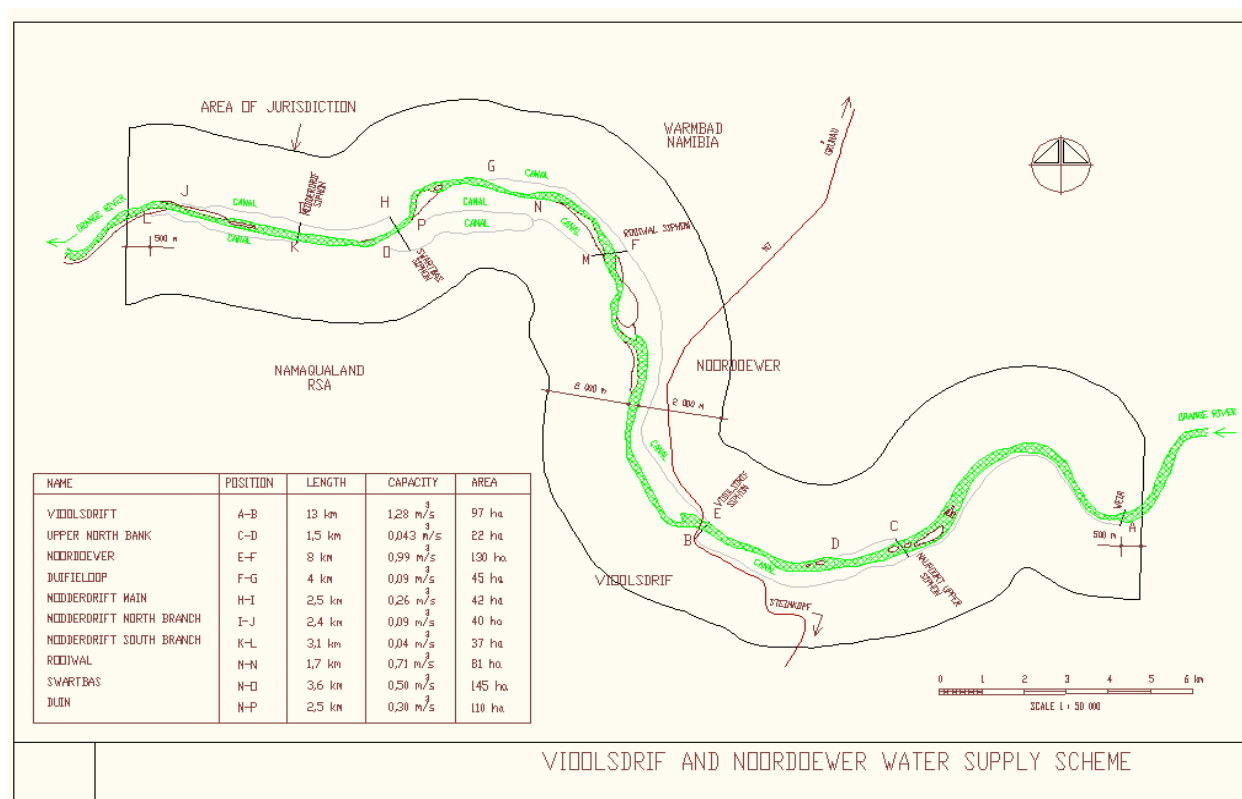


Figure 6-2: Layout of Vioolsdrift and Noordoewer Water Supply Scheme

Farmers have moved away from the traditional planting of lucerne because of the poor and remote markets. Sweet corn and vegetables like tomatoes, green peppers, onions, water melons, sweet melons and eggplant (aubergine) are now the primary crops. The vegetables are mostly irrigated through drip irrigation, while centre pivots are used for the sweet corn. Table grapes under micro irrigation is also gaining momentum.

#### **6.2.3.2 Best Practices**

The JIA is managed by a board consisting of 3 farmers from the Namibian side and 3 farmers from the South African side, as well as one official from the Ministry of Agriculture, Water and Forestry (Namibia) and one official from the Department of Water Affairs and Forestry (South Africa). Meetings are held on a quarterly basis.

The day to day operation and maintenance is managed by a technician with 5 workers. An additional 2 workers operate the pumps on both sides of the river which are used to supplement the canal sections when shortages occur. These shortages normally occur during summer months and are mainly caused by the Rooiwal Siphon which cannot deliver enough water (There might be an obstruction inside the pipe).

Each farmer is allocated 0.042 m<sup>3</sup>/s/ha (1.5 ft<sup>3</sup>/s/ha) for a period of 6 hours per week (fixed sluice gate setting). The board does not have a water bailiff and control is exercised by the farmers

themselves. Due to the small size of the scheme and the limited number of farmers, no problems in this regard are experienced. Farmers will quickly take up transgressions with each other.

Farmers are not allowed to pump directly from the canal, but pumping from behind the sluice gates or directly from the river are allowed and several farmers exercise this option. Both the South African Government and the Namibian Government contributed towards upgrading of the infrastructure in the recent past (RSA R6 million and GRN N\$2 million) and the Swartbas, Swartmodder and Rooiwal sections of the canal were renovated. Budget is still available and the Modderdrif canal section will be raised during 2011.

**Figure 6-3: Photographs of Irrigation on the Namibian Side of the Lower Orange River**

Noordoewer – Vioolsdrift Scheme Aerial View



Irrigation on the Vioolsdrift side in South Africa



Table grapes on the Namibian side of the Orange River

## 6.3 Irrigator Sites

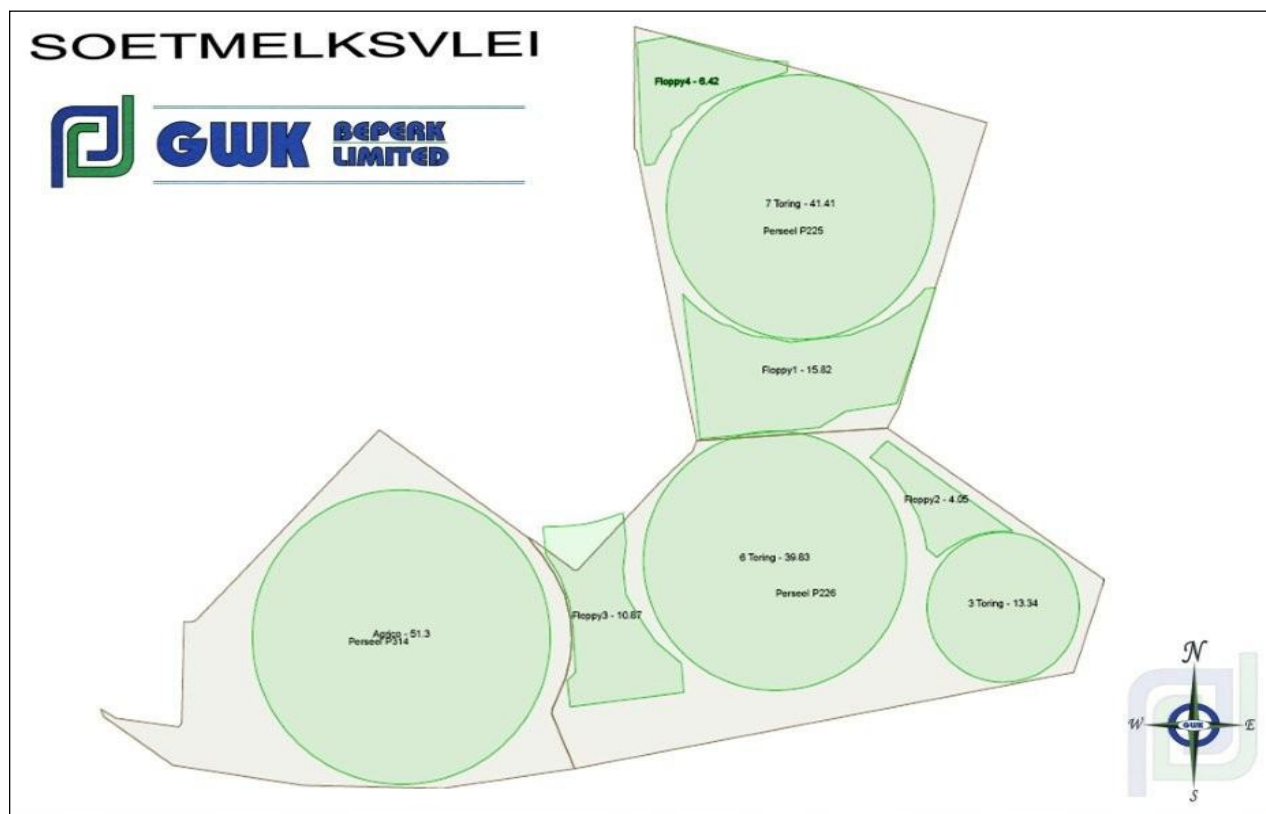
### 6.3.1 Soetmelkvlei Farm

#### 6.3.1.1 Overview

Soetmelkvlei, which is a maize, wheat and lucerne producing farm using centre pivots and a solid set sprinkler system filling the spaces between the centre pivots, can best be described as a farm with “state of the art” technology and high-level management. It is interesting to note that this multi-million Rand operation, with 183Ha under irrigation, is run by the owner-manager, an assistant manager and three full-time employees..

The layout of the farm is provided in **Figure 6-4** and a selection of photographs are shown in **Figure 6-5**.

Centre pivots are the main form of irrigation with a permanent overhead sprinkler system installed for the areas between the Centre Pivots. The overhead sprinkler system is the “Wind fighter 2000” system with Nelson sprinkler heads



**Figure 6-4: Layout of Soetmelmvlei Farm**



**Figure 6-5: Photographs of Soetmelkvlei Farm**

Level-control side weir on Riet canal and distribution sluice gate to Soetmelkvlei Farm



Main on-farm canal leading to storage dam



Pump station controlling distribution of irrigation water from storage dam to irrigation areas



Maize under permanent overhead irrigation system ("Wind fighter 2000")



DACOM soil moisture probe in maize field



Lucerne and maize, the main crops on Soetmelkvlei Farm

Details of the farm are as follows

- Name of farm: Soetmelkvlei

- Owner: Willie du Plooy Trust
- Farm manager: Nicky du Plooy
- Total area of farm: 199 Ha
- Total area under irrigation: 183Ha
- Crops grown at present: Maize/wheat/dry bean rotation (92 ha), Lucerne (91ha)
- Water user association: Orange-Riet

Irrigation water allocation: 11 000m<sup>3</sup>/ha/a (126ha), equivalent to volume of 1.386Mm<sup>3</sup>/a

### 6.3.1.2 Best Practices

Progress made toward realisation of best practices is summarised in **Table 6-5**.

**Table 6-5: Progress made towards achieving Best Practices**

Best practice criteria	Actual progress made
Establishing benchmark irrigation water requirements of selected crops in relevant climatic zone	Irrigation scheduling is done by means of soil moisture (capacitance) probes and a sophisticated computerised monitoring and management system. This "DACOM" telemetric system is fully automated which provides daily data and graphs on the status of soil moisture and irrigation requirements. Soil temperature is also recorded. Each probe serves an area of 10ha and gives reading at 10cm depths to 80cm (or 120cm if required). It is important to note that the system is supported by a commercial service provider. The farmer has the possibility of buying the probes as a package together with supplier-supported software and live internet updates (weather forecasts etc) etc). The software interprets the probe readings and provides information on soil water deficit and on how much irrigation water is to be applied. Financing options are also available.
Selecting the most efficient (but affordable) irrigation system for the specific crop and establishing a benchmark for the efficiency of that system	Centre pivots are the main form of irrigation with a permanent overhead sprinkler system for the areas between the Centre Pivots. The overhead sprinkler system is the "Wind fighter 2000" system with Nelson sprinkler heads. Irrigation efficiency is in the order of 85% against a benchmark of 80%.
Practicing irrigation scheduling to meet irrigation requirements	The scheduling system is as described above.
Maintaining on-farm canals, pipelines and dams to minimise wastage	Water is released onto the farm from a level-control side weir on the Riet River Settlement canal through a sluice gate and Parshall flume flow meter. The on-farm canal of about 300m in length, leads to an unlined storage dam. Seepage losses are limited due to the rock base of the dam.
Ability to measure irrigation water both incoming to the farm and that to crops.	Water released onto the farm is measured with a "Parshall flume" flow meter which is common on the Scheme. Water pumped from the on-farm storage dam into the irrigation system is accurately measured with in-line flow meters.
Maintaining irrigation equipment to ensure efficient application of the correct amount of water	All irrigation equipment is regularly monitored and maintained.
Installing (where necessary) and maintain irrigation drainage facilities	The Riet River Scheme is characterised by a relatively high water table. On-farm drainage canals (which drain back into the Riet River) ensure that water logging and related salinity problems are avoided.

Maximise financial returns per unit volume of water used

The agronomic practices on the farm are of a very high standard which includes a "fertigation" system using soluble fertilizers that are specially mixed to meet the crop requirements and applied through the irrigation system. The precise irrigation requirement applied together with a precise nutrient requirement minimises losses through leaching of both irrigation water and expensive fertilizers which otherwise would contribute to nutrification and salinisation of ground water and downstream surface water. A service provider (from a fertilizer company) takes pre-season soil samples to calculate crop nutrient requirements. The results of the analysis are then discussed with the farmer and the most cost-effective fertilizer mixtures, to meet the crop requirements, are specially mixed and delivered to the farm (standard commercial mixtures are not used).

Crop yields on Soetmelkvlei are significantly higher than the average on the Scheme.

Crop	Soetmelkvlei (t/ha)	Scheme Ave. (t/ha)
Maize (early)	16,0	12.0
Maize (late)	14,0	10.0
Wheat	6.5	4.5
Dry bean	2.5	2.0
Lucerne	20.0	18.0

Based on the above yields, the resulting gross margins per crop and the estimated average water use per crop, the net return per unit volume of water used is summarised below for Soetmelkvlei and for the Riet River section of the Orange-Riet *water user association*.

Crop	Gross margin (R/ha)		Water use (m <sup>3</sup> /ha)		Efficiency (R/m <sup>3</sup> )	
	Soetm.	Schem	Soetm.	Schem	Soetm	Schem
		.		.		.
Maize	6 192*	4 000	5 000	7 700	1.55	0..52
Wheat	3 373*	1900	5 750	6 300	0.59	0.30
D'bean	2 111	2 000	3 000	3 500	0.70	0.57
Lucerne	7 459*	5 307	11 000	12 750	0.68	0.42

\*Actual 2010/11

The results illustrate the significant impact of optimised crop production and minimised irrigation water use on the overall efficiency of irrigated crop production expressed in R/m<sup>3</sup>.

The intensive crop rotation on Soetmelkvlei of maize and wheat, with a short season dry bean crop every third year, also contributes to irrigation efficiency by maximises land use in that environment.

Soetmelkvlei farm crop rotation and irrigation efficiency

Year 1		Year 2		Year 3	
Maize (early)	Wheat	Maize (late)	Wheat	Drybean	Fallow

5 crops in 3 years

	<p>Sum of GMs for the rotation = R18 422/ha/3yrs (Ave. R6 141/a )</p> <p>Sum of irrigation water-use = 22 000m<sup>3</sup>/ha/3yrs (Ave. 7 333m<sup>3</sup>/a )</p> <p>Net return / unit volume of water = R0.84/m<sup>3</sup></p>
General comment	<p>The operation is characterised by its business focus and the adoption of an integrated approach where equal importance is placed on all the key elements of irrigated farming namely:</p> <ul style="list-style-type: none"> <li>• Crop production practices</li> <li>• Irrigation practices</li> <li>• Marketing</li> <li>• Financial controls and</li> <li>• Overall farm management</li> </ul> <p>The attitude is one of acknowledging that farming is now an agribusiness that requires dedicated management, appropriate technology and financing arrangements like any other business. The natural risks associated with farming only add to the need for exceptional management standards for a sustainable operation.</p> <p>This demonstration site illustrates (a) the importance of technical support from commercial agribusiness companies which make it possible for small individual farmers to implement state of art technologies and (b) the importance of financing facilities for capital and operating costs from financial institutions and service providers.</p> <p>The overall Soetmelkvelei operation illustrates an attitude of investing to maximising returns rather than the commonly applied farming approach of minimising inputs to make savings.</p> <p>Irrigation water saved in a particular season by Soetmelkvelei has been sold to other irrigators lower down the canal within the Orange Riet <i>water user association</i>. This facility, which is built into the operating rules of the <i>water user association</i>, is a significant incentive for irrigators as it provides a double benefit of firstly the direct savings such as reduced pumping costs and optimum utilisation of applied fertilizers and secondly the indirect benefit of additional income from the sale of irrigation water.</p>
Performance ratios	Performance ratios are not measured

### 6.3.2 Shelanu farm (Karsten Boerdery (Pty) Ltd. Upington Main *water user association*)

#### 6.3.2.1 Overview

Shelanu farm is situated on the Orange River about 5 km below the Augrabies Falls and 25 km upstream of the Namibian border. It is a small but highly intensive farm focussing on table grape production. The state of the art technology includes a fully automated micro-jet irrigation system, an on-farm telemetric weather station, shade-cloth over most vineyards and good management.

Details of the farm are as follows

- Name of farm: Shelanu
- Owner: Karsten Boerdery (Pty) Ltd
- Farm manager: Jasper Stoop



- Total area of farm: 28.7ha
- Total area under irrigation: 28.7ha
- Crops grown at present: Table grapes,
- *Water user association*: The farm falls outside a *water user association* and is classified as a diffuse water user.
- Irrigation water allocation: 15 000m<sup>3</sup>/ha/a (28.7ha)

The layout of the farm is shown in **Figure 6-6** and a selection of photographs presented in **Figure 6-7..**



Figure 6-6: Layout of Shelanu (Eastern Component)

**Figure 6-7: Photographs of Shelanu (Eastern Component) Farm**

Overall view of Shelanu Farm under Table Grape production



Shelanu farm: Water filtration and "fertigation" system in the pump station



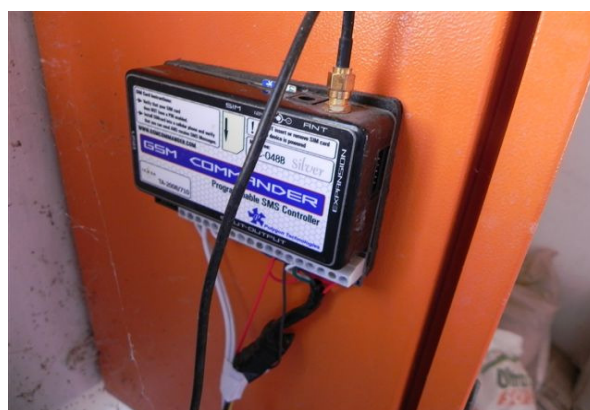
Shelanu Farm on Orange River: Intensive Table Grape production with 60% under shade cloth.



Weather station integrated with the "Irricheck" logging system for automated irrigation.



Protected soil moisture probe installed permanently in a grape orchard



"GSM Commander" programmable SMS controller allowing the manager to adjust the irrigation programme from his cell phone

### 6.3.2.2 Current Best Practices

Progress made toward realisation of best practices is summarised in **Table 6-6**.

**Table 6-6: Progress made towards achieving Best Practices**

Best practice criteria	Actual progress made
Establishing benchmark irrigation water requirements of selected crops in relevant climatic zone	Irrigation scheduling is done by means of “DFM” soil moisture (capacitance) probes and a sophisticated computerised monitoring and management system. The fully automated “Irricheck” telemetric logging system provides daily data and graphs on the status of soil moisture, climatic conditions, and irrigation requirements. Each probe serves an area of 2,5ha and gives reading at 10cm depths to 80cm (or 120cm if required). The automated system allows variable irrigation cycle time depending on soil type and soil moisture status. The system is supported by a commercial service provider.
Selecting the most efficient (but affordable) irrigation system for the specific crop and establishing a benchmark for the efficiency of that system	The automated micro-jet irrigation system provides the most efficient system for grape vines. The efficiency of the system is enhanced by inter-row mulching with wheat (which reduces direct evaporation from the inter-row and reduces soil temperature) and the erection of shade-cloth covers that modify the micro-environment around the crop by reducing ambient temperature, increasing humidity and reducing air movement. These micro-environment modifications result in reduced evapotranspiration (and reduced irrigation requirement), improved growing conditions for the crop and protection from bird damage. The efficiency of the system is illustrated by irrigation application rates as low as 35mm/week compared to the Karsten Boerdery norm for that area of about 55-60mm/week. The automated system is monitored by “sms” allowing the manager’s full control of the system from his cell phone.
Practicing irrigation scheduling to meet irrigation requirements	The scheduling system is as described above.
Maintaining on-farm canals, pipelines and dams to minimise wastage	Water is pumped directly from the Orange River into a lined farm storage dam from where it is booster-pumped into the irrigation system.
Ability to measure irrigation water both incoming to the farm and that to crops.	Water pumped from the river and from the on-farm storage dam into the irrigation system is accurately measured with in-line flow meters.
Maintaining irrigation equipment to ensure efficient application of the correct amount of water	All irrigation equipment is regularly monitored and maintained.
Installing (where necessary) and maintain irrigation drainage facilities	Shelanu is situated on the banks of the Orange River. Any return flows or seepage flow directly back into the river. However the precision of the system is such that return flows are minimal.
Maximise financial returns per unit volume of water used	The agronomic practices on the farm are of a very high standard which includes a “fertigation” system using soluble fertilizers and applied through the irrigation system. A service provider (from a fertilizer company) takes pre-season soil samples to calculate crop nutrient requirements. The results of the analysis are then discussed with the farmer and the most cost-effective fertilizer mixtures, to meet the crop requirements, are sourced. The precise irrigation requirement applied together with a precise nutrient requirement minimises losses through leaching of both irrigation water and expensive fertilizers which otherwise would contribute to nutrification and salinisation of ground water and downstream surface water.
General comment	The operation is characterised by its business focus and the adoption of an integrated approach where equal importance is placed on all the



	<p>key elements of irrigated farming namely:</p> <ul style="list-style-type: none"><li>• Crop production practices</li><li>• Irrigation practices</li><li>• Marketing</li><li>• Financial controls and</li><li>• Overall farm management.</li></ul>																					
Crop Gross Margins (gross sales less operating costs) and net returns/m <sup>3</sup> water used	<p>The achieved Gross Margin for table grapes, irrigation water use and net return per m<sup>3</sup> of irrigation water at Shelanu for 2010 is compared, in the table below, with the industry norm in the region (district).</p> <table><tr><th>Crop</th><th colspan="2">Gross margin (R/ha)</th><th colspan="2">Water use (m<sup>3</sup>/ha)</th><th colspan="2">Efficiency (R/m<sup>3</sup>)</th></tr><tr><td></td><td>Shelanu</td><td>District</td><td>Shelanu</td><td></td><td>Shelanu</td><td>District</td></tr><tr><td>Table grapes</td><td>115 000</td><td>90 000</td><td>12 000</td><td>15 000</td><td>9.58</td><td>6.00</td></tr></table>	Crop	Gross margin (R/ha)		Water use (m <sup>3</sup> /ha)		Efficiency (R/m <sup>3</sup> )			Shelanu	District	Shelanu		Shelanu	District	Table grapes	115 000	90 000	12 000	15 000	9.58	6.00
Crop	Gross margin (R/ha)		Water use (m <sup>3</sup> /ha)		Efficiency (R/m <sup>3</sup> )																	
	Shelanu	District	Shelanu		Shelanu	District																
Table grapes	115 000	90 000	12 000	15 000	9.58	6.00																
Performance ratios	Performance ratios are not measured																					

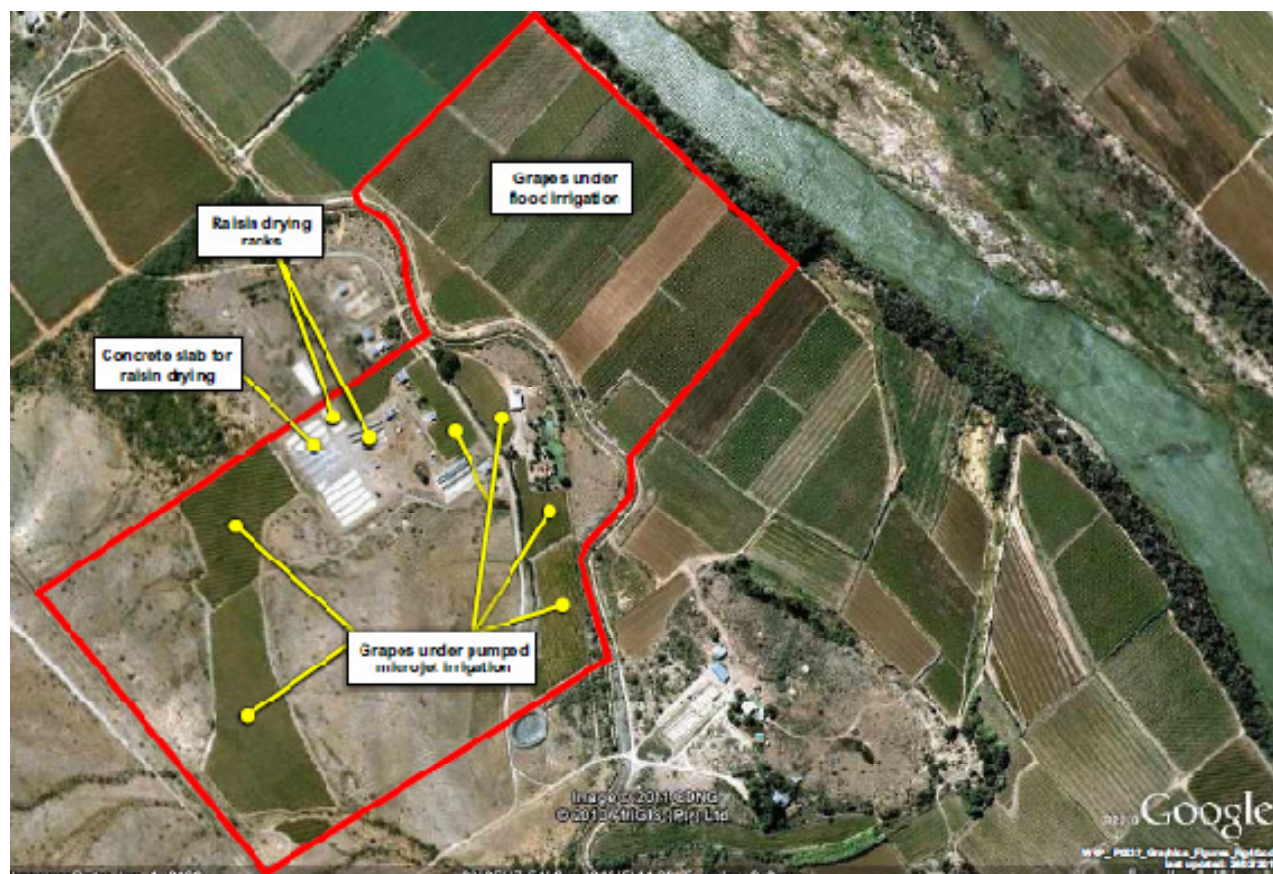
### 6.3.3 Liebenberg Boerdery (Boegoeberg water user association)

#### 6.3.3.1 Overview

Details of the farm are as follows

- Name of farm: Trio Pearre farm
- Owner: Pearre Liebenberg
- Farm manager: Owner manager
- Total area of farm: 50ha
- Total area under irrigation: 30ha (20ha flood irrigation from Boegoeberg canal and 10ha micro-jet irrigation pumped directly from Orange River to a farm storage dam).
- Crops grown at present: Raisin grapes (24 ha), Wine grapes (3 ha), Table grapes (3 ha)
- Water user association: Boegoeberg
- Irrigation water allocation: 15 000 m<sup>3</sup>/ha/a

A satellite image of the farm is shown as **Figure 6-8**. Photographs of the farm are provided as **Figure 6-9**.

**Figure 6-8: Satellite Image of Trio Pearre Farm****Figure 6-9: Photographs of Liebenberg Boerdery**

Siphoning system from in-field canal to laser-levelled vineyard flood beds



Wine grapes in flood irrigated vineyards



Raisin grapes in micro-jet irrigated vineyards



Raisin drying on open concrete slabs



Raisin drying on covered racks

### 6.3.3.2 Current Best Practices

Progress made toward realisation of best practices is summarised in **Table 6-7**.

**Table 6-7: Progress made towards achieving Best Practices**

Best practice criteria	Actual progress made
Establishing benchmark irrigation water requirements of selected crops in relevant climatic zone	Established irrigation water requirement for grapes using flood irrigation = 15 000 m <sup>3</sup> /ha and micro-jet irrigation system = 12 000 m <sup>3</sup> /ha.
Selecting the most efficient (but affordable) irrigation system for the specific crop and establishing a benchmark for the efficiency of that system	Flood irrigation areas that are fed directly from the Boegoeberg canal have all been laser- levelled. This procedure, which takes place when an old vineyard is replaced, significantly improves the efficiency of flood irrigation by eliminating uneven distribution, ponding and related water-logging and over-irrigation.  The micro-jet irrigated areas have water pumped from the Orange River (which runs adjacent to the farm) into a farm dam from which it is booster-pumped to the vineyards. All planned new developments (up to 5ha new vineyards) will have micro-jet systems because of the improved efficiency. Achieved flood irrigation application rates are 15 000m <sup>3</sup> /ha while micro-jet systems are achieving the target



	12 000m <sup>3</sup> /ha.
Practicing irrigation scheduling to meet irrigation requirements	No formal scheduling system is applied but the introduction of soil moisture probes is being considered. On the flood areas a 14 day cycle is applied.
Maintaining on-farm canals, pipelines and dams to minimise wastage	All infrastructure is well maintained.
Ability to measure irrigation water both incoming to the farm and that to crops.	On the flood irrigated areas the allowed 150m <sup>3</sup> /hr water application is measured using "Parshall flumes (three sluices for the 20ha). Flow meters are not used on the micro-irrigation area. Control of application rates is achieved through the size of the pump which can only just apply the required amount for the given area.
Maintaining irrigation equipment to ensure efficient application of the correct amount of water	.All irrigation equipment is well maintained
Installing (where necessary) and maintain irrigation drainage facilities	The farm is situated on the banks of the Orange River. Any return flows or seepage flow directly back into the river.
Maximise financial returns per unit volume of water used	The agronomic practices on the farm are of a high standard which includes a "fertigation" system using soluble fertilizers applied through the irrigation system for the areas under micro-jet irrigation. Fertilizers on the flood irrigation areas are applied in the conventional way.
General comment	The operation is characterised by its business focus and the adoption of an integrated approach where equal importance is placed on all the key elements of irrigated farming namely: <ul style="list-style-type: none"> <li>• Crop production practices</li> <li>• Irrigation practices</li> <li>• Marketing</li> <li>• Financial controls and</li> <li>• Overall farm management.</li> </ul>
Crop Gross Margins (gross sales less operating costs) and net returns/m <sup>3</sup> water used	Gross margins were not available for the farm
Performance ratios	Performance ratios are not measured



## 7 CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Conclusions

#### 7.1.1 Global Trends in Water Resources Management

Water conservation and water demand management (WC/WDM) initiatives in the Orange River Basin should be aligned to three important global trends in water resource management, namely:

- integrated water resource management within catchment boundaries;
- decentralised management, operation and maintenance of water delivery; and
- improved management of existing water resources to promote water use efficiency and water conservation.

All of these trends are evident, to a greater or lesser extent, in member-state legislation and/or policy on water management which provides a sound foundation for their implementation over time.

#### 7.1.2 The Role of Water Management Institutions in Water Conservation and Water Demand Management

With respect to the need for decentralized management, operation and maintenance of water delivery, effective improvements in water conservation and water demand management in the basin will primarily depend on strong and active water management institutions at the water-user level. The *Water User Associations (water user association)*, which are currently being established in South Africa, in terms of the Water Act, are a good example of the effective devolution of water management responsibility.

The *water user associations* should not have to operate in isolation and require mentorship and monitoring from a catchment management agency (*catchment management agency*) which initially will be country-based. *Catchment management agencies* for the South African portion of the Orange River Basin (one for the Vaal River catchment and one for the remainder of the Orange River basin) have not yet been established. In the interim the Department of Water Affairs (DWA) fulfils the responsibilities of a *catchment management agency*.

In South Africa, *water user associations* are required, in terms of the Water Act, to submit *water management plans* to their *catchment management agencies* or Department of Water Affairs, in the absence of a *catchment management agency*. However there is evidence in the Orange River Basin that the Department of Water Affairs is not yet enforcing this legislation nor as yet encouraging *water user associations* to prepare *water management plans*. However, plans are afoot within DWA to use consulting services to assist *water user associations* in preparing *water management plans*.

The development of a Water Management Plan (WMP) by a *water user association* is central to implementing WC/WDM in the agricultural sector.

A *water management plan* is not an end in itself but is a process with an annual cycle, which can assist *water user associations* and their irrigators in realising the economic and social benefits of improved water use efficiency.

The water management plans may be rudimentary to start with and may be lacking in certain data, but it can be improved annually during the review process

In addition, the development of the plans provides an opportunity to improve agricultural water management by stimulating self-analysis and forward thinking on the part of farmers, their water suppliers, *catchment management agencies*, officials, consultants and advisors. The plans can be used as a management tool for *water user associations*, Department of Water Affairs and the *catchment management agencies* to compile catchment databases and determine national water balances. Developing a *water management plan* and reviewing it annually is a major stimulus to efficiency, provides input to the business planning process, promotes coordinated action and facilitates negotiations with the *catchment management agencies* and other stakeholders. The process involves analysing current water use, setting targets for improved efficiency and planning a realistic means of reaching these targets.

A set of implementation guidelines for water management have been prepared for the irrigation industry in South Africa by the Department of Water Affairs and provide a valuable framework for the preparation of water management plans and the establishment of best practice in the sector. These guidelines have relevance to all member states.

The water management plans must identify appropriate best practice for a specific water supplier and its irrigators.

### **7.1.3 Best practice for irrigation water suppliers and irrigators**

#### **7.1.3.1 Irrigation water suppliers**

In the case of irrigation water suppliers, best practice can be divided into primary and secondary elements. Examples of primary best practice include:

- Appointing a person with responsibility for Water Conservation Coordination (apart from normal *water user association* management roles).
- Ensuring that available information for improved on-farm water management is distributed to farmers.
- Making progress towards the use of acceptable measuring devices or techniques (*You can't manage what you can't measure*).
- Making progress towards measuring the quality and quantity of inflows and outflows, and measuring losses and water supplied to customers,
- Making progress towards establishing GIS type data bases on irrigated lands, crop types and areas, irrigation requirements and actual applications, etc.
- Making progress towards implementing a water pricing structure to facilitate water conservation.

- Maintaining and improving infrastructure, according to a long-term maintenance plan, supported by a financial plan.
- Positively promoting good communication between all concerned in water management and
- Preventing unlawful withdrawals of surface and groundwater.

Examples of secondary best practice for irrigation water suppliers include:

- Facilitating support services to enable farmers to use water more efficiently on-farm.
- Coordinating the evaluation of energy and water efficiency of pumps, distribution and irrigation systems belonging to *water user associations* or private irrigators.
- Considering the suitability of irrigation methods and crops to an area.
- Reducing losses by lining canals, balancing dams, etc .
- Promoting better management procedures for water bailiffs and other management staff.
- Training *water user association* personnel.
- Facilitating the financing of capital improvements for on-farm irrigation systems.
- Facilitating voluntary water transfers.
- Eradicating invasive alien plants.
- Practising adequate soil conservation and drainage measures.

#### 7.1.3.2 Irrigators

While the role of a water management authority is critical for the sustainable improvement in water use efficiency and water demand management, the role of individual irrigators in this initiative is equally important. Examples of best practice for irrigators include:

- Establishing benchmark irrigation water requirements of their selected crops in their climatic zone
- Establishing benchmarks for the relative efficiency of their different irrigation systems
- Practicing irrigation scheduling to meet irrigation requirements
- Installing flow meters or other appropriate measuring devices for accurate measurement of irrigation water. Without the ability to measure application rates it is not possible to manage irrigation efficiently. The lack of good water measurement impacts directly on the ability to:
  - transfer water from one irrigator to another within a WUA (water trading),
  - effectively schedule irrigation,
  - monitor abuse of water allocations to farmers, and
  - apply almost any aspect of water management best practice.

These are all aspects which can encourage farmers to use water efficiently.

- Maintaining on-farm canals, pipelines and dams to minimise wastage

- Maintaining irrigation equipment to ensure efficient application of the correct amount of water
- Installing (where necessary) and maintain irrigation drainage facilities.
- Improving production practices to optimise net returns from crops per unit volume of irrigation water used..

#### **7.1.4 Incentives for best practice**

It became clear during our interaction with water supplier and irrigators that any WC/WDM initiatives are unlikely to be effective unless there is a tangible benefit to the supplier and/or the irrigator. Examples of tangible incentives include:

- Cost savings (e.g. pumping costs and user charges )
- Improved yield and quality of crop (improved income)
- Easier management, especially with automated systems
- Income from sale of saved water (water market)
- Irrigate larger area with same water allocation
- Long-term assuredness of supply of adequate water.

Without the ability to measure water flow, all incentives for improved water use efficiency are undermined.

#### **7.1.5 Cooperation between Basin States in water conservation initiatives**

The Noordoewer/Vioolsdrift Irrigation Scheme which includes land owners and irrigators from both South Africa and Namibia and is governed by a Joint Irrigation Authority is an excellent example of international cooperation on water management within the Basin and provides an opportunity for establishing a demonstration site where the principles of international cooperation and related best practice can be established and demonstrated. The benefits of South Africa's legislation with respect to the establishment of *water user associations* and the related preparation of *water management plans* can be shared and tested with a neighbouring Basin State.

#### **7.1.6 Water Markets**

Water markets are very much in their infancy in South Africa. However this is considered an important mechanism for improving water use efficiency. Examples of successful irrigation water marketing include the Sand Vet *water user association* and Orange Riet *water user association* which both operate a water bank. Unused water allocations can be surrendered to the *water user association* who on-sells at a premium to a willing buyer, typically 30% above the normal tariff. This additional income makes a contribution to the costs of managing the *water user association* and improving overall water use efficiency.

Water markets on schemes fed by canals are constrained by system capacity in that they can only transfer water from the lower end of the canal to the upper end.

Water markets can only function in a system where water can be measured accurately as applies in the Orange Riet *water user association* for example.

### 7.1.7 Measuring and Monitoring of Diffuse Irrigation

A key finding during the study is that diffuse irrigation (not part of a formal scheme) in the easterly region of the Basin, above Gariep Dam, is not measured or adequately monitored by the DWA which appears not to have the means or personnel to do so. Better control of irrigation in this area would result in significant water savings.

Illegal water use in the South African portion of the Basin has been identified as a significant cause of water “loss”. The DWA is aware of the problem and is taking certain steps to address it. However it would be far more effective when this responsibility falls on *water user associations* (when they are formed to cover the whole of the Basin) as they will see illegal water use in their area as “stealing their own water”.

### 7.1.8 Improved Crop Net Income per Unit Volume of Irrigation Water Used

It was observed at a number of the irrigator demonstration sites that maximising net financial returns per unit of irrigation water used was not only a water-use–efficiency objective but was fundamental to the viability and sustainability of their agribusiness based on irrigation. With the inevitable increase in irrigation water costs over time the “improved crop per drop” concept must become increasingly important. This can be achieved through one or more of the following factors:

- Increased yields and crop quality through improved agronomic practices,
- Selection of higher value orchard and vineyard crops such as grapes and citrus and high annual fruit and vegetable crops such as melons and potato,
- Improved irrigation efficiency through appropriate system selection and irrigation scheduling

### 7.1.9 Specific views from the irrigation sector

At the conclusion of the formal discussions during the workshops the *water user associations* were given the opportunity to raise any issues which they felt was pertinent. Issues identified by *water user associations* outside of the broad conclusions outlined above were as follows:

- A number of *water user associations* expressed a need for training of *water user association* management personnel in the operation of a *water user association*.
- The *water user associations* which have a large flood irrigated component expressed a need for training of farmers and their labour in the operation of flood irrigation systems.
- One *water user association* felt that if the audit function was emphasised and performed regularly by DWA, more *water user associations* would give attention to WC/WDM.
- There was a common interest in the adoption of a GIS type system which will provide a dynamic data-base of irrigation lands, crops grown, irrigation requirements etc for

improving management efficiency at the level of a water management institution such as a WUA. The need for assistance in the establishing of an appropriate system (including the training of personnel) was expressed by all WUA involved in the workshops.

- Water savings by *water user associations* and farmers will only happen if it makes business sense. For example a farmer in Upington practices irrigation scheduling not to save water primarily but to satisfy the buyer of his export table grapes who requires documented proof that the minimum amount of water is used in the production of the product.
- Financially successful Irrigation farming has become a highly complex, multidisciplinary business with large amount of fixed capital and operating capital at risk. Irrigation water use efficiency is becoming one of the important elements of these agribusiness ventures.
- A water provision for 12 000ha has been made available by DWA for resource-poor farmers in the Basin. Development of projects has commenced throughout the basin. There is strong evidence however that the sizes of irrigated land allocations are too small for financial viability and many of the projects are in financial difficulty and productivity is very low. Efficient irrigation under these circumstances is always poor.

## 7.2 Recommendations

### 7.2.1 Legislative and institutional issues

ORASECOM should interact with South Africa's Department of Water Affairs to encourage them to implement their legislation with respect to (a) the formation of a *catchment management agency* for the Vaal River Basin and the remainder of the Orange River Basin and (b) the formation of Water User Associations and, in turn, to encourage, support and monitor the implementation of annual Water Management Plans by *water user associations* as a primary tool for improving water conservation and water demand management.

ORASECOM should also encourage other member states to accommodate the above approach to water conservation and water demand management in their legislation which is presently being formulated. The use of the Noordoewer/ Vioolsdrift Joint Irrigation Authority provides the ideal venue for such an initiative on a trial/demonstration basis.

### 7.2.2 Technical issues

The need for improved irrigation water measurement at both the distributor and irrigator level has emerged as an important factor limiting effective water management and the improvement in irrigation water use efficiency. It is recommended that an investigation into the extent and cost of this need should be facilitated by ORASECOM and funding opportunities identified.

ORASECOM should investigate the possibility of assisting WUA in the establishing of an appropriate GIS-type data base of irrigation lands, cropping patterns, irrigation, requirements

etc (including the training of personnel) to improve water management and water use efficiency.

The value of modern, commercial irrigation scheduling systems and the professional back-up that comes with them is well illustrated on two of the irrigator demonstration sites. It is recommended that opportunities for the expansion of these systems to a far higher proportion of irrigators should be investigated and promoted.

### **7.2.3 Best practice demonstration sites**

The Best Practice demonstration sites (for both irrigation water suppliers and irrigators) should be used as a means of spreading the news about irrigation best practice. It is proposed, to this end, that ORASECOM accommodate them in any future planning or recommends them to any other donor initiative that is seeking to further the objectives of water conservation and water demand management in the Orange River Basin.

Examples of best practice on the demonstration sites that have not been mentioned above include:

#### **7.2.3.1 Supplier**

Water measurement: The allocation of irrigation water to irrigators on an accurately measured volumetric basis for which a unit charge applies is a fundamental step towards improved irrigation water use efficiency. It is recommended that every water user association should strive towards this objective as a high priority best practice.

#### **7.2.3.2 Irrigator**

Improved agronomic and irrigation practices to improve net farm income per unit of water used and to reduce wastage of fertilizers, reduce groundwater pollution, waterlogging and salinisation.

Applying a business approach to irrigated agriculture by investing to maximising returns rather than the commonly applied farming approach of minimising inputs to make savings.

Laser levelling of flood irrigation beds for permanent crops such as vineyards.

### **7.2.4 Water markets**

Water markets should be encouraged, particularly within *water user associations*, but also between *water user associations* provided the integrity and viability of the source *water user association* is not violated. This can be prevented by the intervention and monitoring of a *catchment management agency*.

### **7.2.5 Illegal water use**

The issue of illegal water use requires urgent attention in South Africa. Although there are initiatives in place to try and deal with this pervasive problem it is most likely to be controlled

in a sustainable way when the responsibility is passed to the water users through their *water user associations*.

#### **7.2.6 Smallholder irrigation viability**

The viability of smallholder irrigation schemes for resource poor farmers should be investigated with the view to finding more sustainable and viable models for this important initiative.

The need for on-site training in various spheres, including *water user association* management and irrigation management training for farm labourers, is clearly evident and might be an intervention that ORASECOM could facilitate.



## **APPENDICES**

APPENDIX A: Questionnaire on Management Practices

APPENDIX B: Best Management Practices Workshops

APPENDIX C: Rules and Regulations; Riet Water User Association

## Appendix A: Questionnaire on Management Practices

### Support to Phase 2 of the ORASECOM Basin-wide Integrated Water Resources Management Plan

#### Work Package 6: Water Demand Management in the Irrigation Sector

#### Best Management Practices Evaluation Questionnaire

##### 1. Basic Information

###### 1.1. History

Water User Association Name: \_\_\_\_\_

Date WUA formed: \_\_\_\_\_

Original size: \_\_\_\_\_ ha

Persons representing WUA at the discussion:

1) \_\_\_\_\_

2) \_\_\_\_\_

3) \_\_\_\_\_

###### 1.2. Operating Rules and Regulations

Does the WUA have a water supply policy?

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What are the official and actual lead times for water orders and shut-off?

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What are the WUA policies on return-flows and drainage?

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What are the WUA policies on water transfers by the WUA and its customers?

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### 1.3. Water Shortage Allocation policies

Does the WUA have a water shortage policy? How are reduced water supplies allocated?  
How is provision made for priority needs during times of shortage?

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Does the WUA have a policy that addresses wasteful use of water? How is it enforced?

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## 2. Benchmarks for Agricultural Water Use

### 2.1. Scheme/canal design capacity vs allocation

Has a benchmark been established?

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### 2.2. Irrigation water requirement benchmarks per crop per homogenous area

Have benchmarks been established?

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What procedure is used to calculate crop water requirements and crop irrigation requirements (SAPWAT? – see Table 1 for an example of irrigation water use per crop, and Table 3 for calculation of WUA irrigation water requirements)

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Does the WUA monitor members actual water use against the accepted norm or benchmark?

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Do farmers use the calculated crop water requirements to plan their on-farm management and to monitor their own actual water use efficiency against the benchmark?

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### 2.3. Canal losses management/distribution losses management

Has a benchmark been established for distribution losses for each canal section/river reach?

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How is it monitored?

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### 2.4. Irrigation efficiencies of different irrigation systems

How are efficiencies and leaching requirements determined? (see Table 2 for an example)

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### 2.5. Productivity of water use (crop returns per unit volume of water used; R/m<sup>3</sup> or kg/m<sup>3</sup>)

Have benchmarks per crop been established?

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### 2.6. Assured yields over time

Has the WUA established assured yields over time per crop type?

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### 3. Water Auditing: Disposal Reporting and Water Accounting with Performance Indicators

#### 3.1. Annual Summary Disposal Report

Does the WUA produce monthly Disposal Reports and by extension an Annual Summary Report? (see Table 5 for an example)

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#### 3.2. Location and Facilities

Source of irrigation water?

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What storage facilities does the WUA have at its disposal?

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Does the WUA have accurate measurements of its different conveyance systems? eg. unlined canals, lined canals, pipes, etc.

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Does the WUA have a spill recovery system?

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Does the delivery system provide immediate, scheduled, rotation, or other delivery method?

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Are there any restrictions on the WUA's water source/s?

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What change or additions are proposed to the WUA facilities and/or operations for the next 5 years?

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### 3.3. Water measurement and Accounting Procedures

Total number of users? \_\_\_\_\_

Total number of measured users? \_\_\_\_\_

Does the WUA keep a register of the numbers of each type of measurement device, their accuracy, calibration intervals and maintenance intervals?

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Describe the WUA's water-use data accounting procedures, (how records are kept and archived, availability of data to customers, number of years of records available, etc.)

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### 3.4. Water Accounting

Does the WUA produce a water accounting report? (see Table 7 for an example)

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#### 3.4.1. Inflow

Does the WUA keep records of all inflows (groundwater, surface drainage and abstraction from farm dams)? (see Table 6 for an example)

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### 3.4.2.Storage Change

Does the WUA record changes in reservoirs and balancing dams?

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### 3.4.3.Consumptive use

Does the WUA record consumptive use?

- Process consumption
- Non process consumption
  - Beneficial (ecological uses)
  - Non beneficial (alien vegetation, evaporation, seepage not usable downstream, leakage, operational spills not usable downstream)

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### 3.4.4.Outflow

Does the WUA record Outflows (committed outflow for downstream use and operational spills used by downstream users)?

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### 3.4.5.Source Water Quality Monitoring Practices

Does the WUA have any surface or ground water quality problems?

What water quality monitoring programmes are in place for surface and groundwater?

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### 3.5. Performance indicators

What performance indicators does the WUA monitor? (see Table 8 for an example)

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### 3.6. Water Auditing

Does DWA perform regular water audits on the WUA?

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## 4. Best management Practices for WUAs

### 4.1. Primary Best Management Practices for WUAs

#### 4.1.1. Person/s responsible for water conservation coordination

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_

Are the functions of the water conservation coordinator well defined ( see Table 9 for an example of possible tasks)?

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#### 4.1.2. Distribution of information for improved on-farm water management

What information services relating to improved on-farm water management are provided by the WUA? (see Table 10 for a example of services that can be provided)

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#### 4.1.3. Development and Implementation of Irrigation and water management strategies

Are farmers provided pre-season with estimated weekly crop irrigation requirements?

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Are they provided during the season with estimates of the impact of climatic variation on crop water use?

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#### 4.1.4. Water quantity data

How is farmer water use measured/estimated and recorded? In what format is this information transmitted to the farmer?

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The measurement of water quantities.

Question	Answer
Is a bulk quota or allocation applicable?	
What kind/type of measuring equipment is used in the distribution system?	
Who is responsible for measuring?	
Is the distribution measuring equipment DWA approved and calibrated?	
At what intervals are inspections done?	
What is the time lag in providing information required for facilitating distribution management?	
How is water metered to farmers?	
Are the meters or structures effective, tamper proof and affordable?	
Are meters DWA approved, calibrated, certified and regularly inspected?	
Is any financial and technical support available to farmers for water metering?	
Is drainage gauged?	

How is the total quantity supplied to a farm determined where no measuring devices at farm turnouts exist?

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Is water quality data during the season obtained and transmitted to the farmer?

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#### 4.1.5. Water pricing structure related to the actual volume supplied to customers

What progress has been made by the WUA towards implementing a water pricing structure that is related to the actual volume supplied to its customers?

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#### 4.1.6. Prevention of unlawful withdrawals

What measures are in place to control unlawful withdrawals, including incentives and mechanisms for members to report unlawful use?

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#### 4.1.7. Maintenance and improvements to infrastructure – long term

Does the WUA have a 5 year plan for maintenance and improvement of infrastructure in place?

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#### 4.1.8. Good communications in water management

What actions does the WUA take to promote regular good communications with others involved in water management?

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### 4.2. Secondary Best management Practices for WUAs

#### 4.2.1. Support services to enable more efficient water use

What support services does the WUA provide to farmers? (see Table 11 for a list of possible services)

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#### 4.2.2. Suitability of irrigation methods and crops

Does the WUA quantify the extent and trend of specific irrigation methods and their impact on water conservation? (see Table 12 for an example)

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#### 4.2.3. Reduction of losses in conveyancing

What plans does the WUA have for improving the distribution system to reduce losses?

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#### 4.2.4. Better management procedures for water bailiffs and water management staff

Does the WUA have management procedures for water bailiffs and water management staff in place? What plans are in place for future improvements?

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#### 4.2.5. Training of WUA staff

What training is available for WUA personnel?

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#### 4.2.6. Financing of improvements for on-farm systems for small scale farmers (only applicable to WUAs who have small scale farmers in their domain)

Does the WUA facilitate financing for improvements for its small scale farmers?

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#### 4.2.7. Voluntary water transfers

How does the WUA manage voluntary water transfers between members?

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#### 4.2.8. Eradication of invasive alien plants

Does the WUA have a major problem with alien invasive plants? What programme does the WUA have to eradicate these plants?

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#### 4.2.9. Practice of adequate soil conservation and drainage measures

Does the WUA's monitor areas of water logging and salinisation, and facilitate the planning and implementation of sub-surface drainage works?

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Is the WUA responsible for any soil conservation works and structures, and does it have maintenance programmes in place for such?

#### 5. Best Management Practices by Individual Farmers

Please provide the names and contact details of at least three individual farmers in your area who, in your opinion, consistently apply best management practice at farm level in WC/WDM.

Name	Tel No.	Cel.No.	email



**Table 2: Example of a list of assumed efficiencies and leaching requirements**

[illegible]

**Table 3: Example of calculation of the WUA irrigation water requirements**

Crop	Crop area (ha)	Current best estimate of irrigation requirement per crop		Total irrigation water requirement of the WUA per crop (SAPWAT)	
		(m <sup>3</sup> /ha/a)	(10 <sup>6</sup> m <sup>3</sup> )	(m <sup>3</sup> /ha/a)	(10 <sup>6</sup> m <sup>3</sup> )
Total					
<b>Scheme irrigation water requirement</b>					

**Table 6: Example of water inflows**

Period: \_\_\_\_\_ WUA: \_\_\_\_\_

Month	Volume of water abstracted		
	Groundwater (10 <sup>6</sup> m <sup>3</sup> )	Surface drainage from outside WUA area (10 <sup>6</sup> m <sup>3</sup> )	Farm dams (10 <sup>6</sup> m <sup>3</sup> )
Apr			
May			
Jun			
Jul			
Aug			
Sept			
Oct			
Nov			
Dec			
Jan			
Feb			
Mar			
Total			

Table 7: Example of a water accounting report

		Total Year
<b>Inflow</b>		
Diversions and abstractions from surface water sources (pumping and canal from dam and river)		
Abstractions from groundwater (pumping from boreholes)		
Abstraction from rivers and streams (for drinking, agricultural, etc.)		
Abstraction from rainwater (for drinking, agricultural, etc.)		
Abstraction from other sources		
<b>Storage change</b>		
Storage change in reservoirs and balancing dams inside the domain		
<b>Net inflow</b>		
<b>Consumptive use</b>		
Process consumption (water used for production or other human purposes)		
Irrigation		
Municipal, industrial, and livestock		
Domestic and stock water		
Other (specify)		
<b>Total process consumption</b>		
Non-process consumption (water that is used, but does not produce outputs for human purposes)		
Beneficial		
Nutritional		
Ecological uses (e.g. indigenous riverine vegetation)		
Others (specify)		
Evaporation		
Seepage which is not usable downstream		
Leakage which is not usable downstream		
Operational spills, not usable downstream (disturbance from thin oil, operational spills, not recoverable)		
<b>Total non-process consumption</b>		
<b>Total consumption</b>		
<b>Outflow</b>		
Committed		
Committed to downstream use		
Operational spills that are used downstream		
Sub-surface drainage that is used downstream		
<b>Total committed outflow</b>		
Uncommitted		
Operational re-usable spills not currently used by downstream users		
Final effluent outflows		
Surface run-off not stored (e.g. storm-flow, reservoir operation losses)		
<b>Total uncommitted outflow</b>		
<b>Total outflow</b>		
Available water		
Net inflow – committed outflow		



**Table 8: Example of performance Indicators**

Depletion Fraction Net DF <sub>net</sub>	Consumptive/Net Inflow	0.97
Depletion factor Gross DF <sub>gross</sub>	Consumption/Gross Inflow	0.97
Depletion fraction Available DF <sub>available</sub>	Consumption/Available water	1.00
Process Fraction Depleted PF <sub>depleted</sub>	Process consumption/Total consumption	0.19
Process Fraction Available PF <sub>available</sub>	Process consumption/Available water	0.19

**Table 9: Possible functions of the Water Conservation Coordinator**

Category	Subject
Direct water losses of WUA	Attend to leaks and spills
	Organise water bailiffs and develop and review their operational procedures
	Ensure proper mechanical and structural maintenance
Procedural	Facilitate the development, implementation and annual review of WUA Water Management Plan
	Develop, implement and review water ordering procedures for farmers
	Address insular policies of water suppliers
	Ensure adequate liaison with neighbouring WUAs
On farm	Address blatant over irrigation
	Address doubtful irrigation practices
	Address leaking canals, furrows and pipelines
	Highlight evidence of salinisation
New techniques	Remain abreast of new equipment, scheduling procedures, etc.
Liaison	Responsible for technical liaison with CMA, DWA. Departments of Agriculture, national organizations, etc.
Facilitation of farmer support services	As described under other BMPs
Other	

**Table 10: Possible information services for improved on-farm water management that can be provide by the WUA to the farmer**

	Activity	Pre-season	During season	Post-season
1	Irrigation and water management strategies	Weekly crop water requirements	Estimated weekly crop water consumption	Estimated total water use
2	Water quantity data	Predicted weekly water availabilities and deliveries	Farm water deliveries vs. allocations	Total water deliveries vs. allocations
3	Water quality data	Anticipated quality variations and problems	Significant local quality variations	Review of seasonal variations and problems

**Table 11: Possible services that can be provided to the farmer**

Service	Is it available?	Who provides?	Who should provide?
<b><u>Soil/water</u></b>			
Soils analysis			
Soil water retention curves			
Fertigation advice			
Soil/irrigation advice			
Drainage specifications			
Soil erosion monitoring assessment			
<b><u>Irrigation systems and methods</u></b>			
Selection			
System management and guidance			
Training in the use of systems			
Field evaluation – new			
Field evaluation – old			
Water use efficiency			
Pump efficiency			
<b><u>Managing irrigation</u></b>			
Crop water requirements			
Atmospheric demand			
Irrigation programmes			
Weekly crop water use			
Scheduling – ET demand			
Scheduling – measurement			
Scheduling – combination			
Water ordering			
<b><u>Other Services</u></b>			

**Table 12: Extent and impact of irrigation methods on water conservation (% or m<sup>3</sup>)**

Irrigation method	1990		2000		2010	
	Extent (ha)	Impact (% or m <sup>3</sup> )	Extent (ha)	Impact (% or m <sup>3</sup> )	Extent (ha)	Impact (% or m <sup>3</sup> )
Flood						
Flood (laser leveled)						
Flood (furrow)						
Sprinkler						
-Permanent set						
-Hand move						
-Dragline						
-Boom						
Pivot						
Micro						
Drip						
Open hydraulics						
Electronic control						
<b>Total</b>						

## Appendix B: Workshops

**B1 Programme****Potential for Water Demand Management in the Irrigation Sector****STAKEHOLDER WORKSHOPS****Noordoewer (23 November 2010), Upington (25 November 2010), Kimberly (3à November 2010)**

<b>Time</b>	<b>Agenda item</b>	<b>Presenter</b>
08h30 – 09h00	Registration and tea	
09h00 – 09h20	Background to ORASECOM	Steve Crerar
09h20 – 09h35	Definition of Water Conservation and Water Demand Management (WC/WDM)	Steve Crerar
09h35 – 09h50	Study objectives	Steve Crerar
	GIS database	
	Assessing instruments for enhancing productivity	
	Detailing Best Management Practice (BMP)	
	Selection of BMP demonstration sites	
09h50 – 10h00	Methodology	Nic de Wet
10h00 – 10h30	Findings to date	Nic de Wet
10h00 – 10h20	GIS database/WARMS/Previous studies	
10h20 – 10h30	Instruments	
10h30 – 10h50	Tea	
10h50 – 11h20	Findings to date continued	Nic de Wet
	Key findings with selected <i>water user association</i> /IB	
	Differences between <i>water user association</i> /IBs	
	Scheduling	
	Common issues	
	Bench marks	
	Water Management Plans	
	Water markets	
11h20 – 12h20	Discussion on key findings	All
12h20 – 12h50	Prioritize future actions that will have the most impact	All
12h50 – 14h00	Lunch	
14h00 – 15h00	Selection of demonstration sites	All
	Distribution ( <i>water user association</i> /IB)	
	Flood	
	Flood – laser levelled	
	Centre pivot	
	Micro/drip	
15h00 – 15h30	Open discussion on WC/WDM BMP	All
15h30 – 15h45	Closing & Tea	

B2 Noordoewer/Vioolsdrift Workshop; Orange River Lodge, Noordoewer, Namibia

### Attendance List

Attendance was adversely affected by the fact that many farmers were busy with harvesting. The following attended the workshop

Name	Postion/Organisation	Telephone	E-mail
André Jansen			
Abie Olivier			
André Brand			
Elize van Zyl			
Tertius Basson			
Piet Liebenberg			
Nic de Wet	GIZ Phase 2 ORASECOM Support Project Irrigation Specialist/Golder		
Jon Rutherford	GIZ Phase 2 ORASECOM Support Project Irrigation Specialist/Golder		
Peter Pyke			
Christoph Mor	UNDP/GEF ORASECOM Support Project Manager		
Steve Crerar	GIZ Phase 2 ORASECOM Support Project Project Manager/WRP		stevec@wrp.co.za

### Discussions

#### Measurement of Water Use

- Few studies have been done in the area to see how much water is really used. Major problem is that there is no measurement. South African water act requires that all users must register their use.
- What should be done? At the scheme level inputs and outflows should be properly measured. Sluice readings at the main diversion are taken but just sent somewhere. There is no feedback
- Currently farmers pay according to 18 000 m<sup>3</sup>/ha/annum. 4 farmers on the Namibian side and 15 on the South African side.

#### Incentives and Wasteful Use

- There are no incentives for either farmers or “*water user association*”s to save water
- No policies on wasteful use. One idea used in Namibia at Hardap is to highlight the worst farmers – wall of shame concept
- Alternative could be to reward good/efficient farmers
- No perceived necessity to change
- Financial incentives are required

- If a farmer saves water what is he going to do with it? In theory water trading is possible but not supported
- At Hardap farmers who have changed to centre pivots have paid for them in 2 years through higher yields and reduced labour costs
- Incentives need to be there right along the supply chain
- There are “never” water shortages at the scheme
- Farmers are becoming more water efficient mainly because of it leading to better yields and quality (use of shade netting)

### **Policy and Legislation**

- More policy/legislation is not necessarily favoured. A few key policies and laws are required. Making farmers more aware is the key

### **Scheduling**

- Need to implement/improve scheduling

### **Water Revenue**

- The Noordoewer/Vioolsdrift scheme used to be an irrigation board, now a Joint Irrigation Authority. Similar to *water user association* now.
- There are not problems in farmers paying for their water. Most revenue is captured. The JIA stands firm and does not allow debt to build up

### **Education and Capacity Building**

- The *water user association* is in the best position to promote this. They don't have the job to give out information
- Many farmers are not keen to share their experiences/successes
- *water user associations* do not always have the expertise to do their jobs effectively

### **Priorities and Issues**

- Incentives at all levels are important
- Provision of information to farmers
- Improved measurement
- Biggest problem/issue is border red tape which is a huge time-waster and inconvenience

### **Selection of Demonstration Sites**

- At distributor Level possibilities are Hardap and the JIA. JIA is proposed. All the information is easily available
- At irrigator level, possibilities are
  - Abie with focus on laser leveling for improved flood irrigation and microjet/drip irrigation at Hardap
  - Hansie Jansen with focus on microjet/drip and use of shade netting at Noordoewer

- André Vermaak with focus on scheduling at Aussenkehr

## Appendix B3: Upington Workshop; Protea Hotel, Upington, South Africa

**Attendance List**

Name	Postion/Organisation	Telephone	E-mail
Stanley Chamberlain	Upington Islands Main IB	054 334 0067	chamberlainstanley@gmail.com
Willem van Aarde	Karsten Boerdery	082 826 1409	willemva@karsten.co.za
Pierre Liebenberg	Farmer - Bwater user association	082 495 8698	gpliebboerdery@vodamail.co.za
Johan Botha	CEO Bwater user association	082 651 82115	ceowua@boegoebergwater.co.za
Stephan van Zyl	Farmer - Bwater user association	084 206 2046	turbine@lantic.net
PJJ Goussard	Farmer - Bwater user association	082 689 5220	-
Nic de Wet	Golder Associates	072 2918 352	ndewet@golder.co.za
Jon Rutherford	Golder Associates	082 900 8663	jrutherford@golder.co.za
Steve Crerar	WRP	012 346 3496	stevecrerar@cegetel.net stevec@wrp.co.za

**Discussions****Affordability and paying for Water**

- Has any study been done on the affordability of water? DWA looks only at cost of infrastructure in evaluating what people should pay - not at potential benefits

**Measurement of water**

- Lengthy discussion on issue of payment on volumetric basis. Agreed that this would provide an incentive to farmers to use water more efficiently. Paying for an allocation does not encourage this. Caveats to be considered:
- Measurement is required. This could have significant cost implications.
- If the result is less water being used then the *water user associations* may have a shortfall to cover their operation and maintenance costs remaining. Partial solutions could include:
  - Splitting user charge into a fixed part and a measured consumption part
  - Water meters could be unaffordable. Outside funding may be required – possibility of cross-subsidisation could be considered. DWA had already promised to assist with measurement at the distributor level. Could Government assist at the farmer level?
  - Farmers are concerned that with volumetric measurement improved efficiencies could result in reduced allocations.

**Water Markets**

- Good if possible for the farmer to sell his saving.

- Grape farmers need to get long-term transfers, currently not possible
- Suggestion that water markets could work but should be ring-fenced around individual schemes
- Transfer of allocations to other schemes upstream or downstream mean that farmer sells allocation but the operation and maintenance costs are not reduced/sold. Could also have an influence on the schemes (could find some schemes distribution systems operating way under design capacity and some operating above)
- For water market to be realistic there needs to be a real demand for the unused allocations. What happens if the excess is not sold? The farmer who didn't sell it should still pay for it?
- Concept of water banks could be considered
- Some farmers don't wish to pay volumetrically but do want to be able to use their savings for extending their surface. They are currently not allowed to do this.

### **Scheduling**

- Karstens Boerdery spend huge amounts of time and money on scheduling and have got really good results. Application rates of 12 000 m<sup>3</sup>/ha/year are possible, They use specialized moisture probes reporting relative moisture at 100, 200...800mm below surface. These have had very positive results. They have two main incentives - lower energy cost and the need to maintain a good image with overseas client who advertise the issue of water efficiency (irrigation footprint). They have also installed climate stations to further improve the accuracy of weather reports.

### **Extension Services and capacity building**

- On the issue of extension responsibilities of *water user associations* it was pointed out that responsibilities cited as expected are a lot: If water user associations were to carry out these functions they would need more personnel, expertise, training – the result would be a higher user charge.
- Dept of Agriculture has disappeared in its support role, needs to come back. Currently only supporting RPFs, not commercial farmers

### **General points**

- Some discussion on the low carbon footprint of irrigation and a need to look holistically (social issues, employment, urban migration etc) at the role that the much maligned irrigation sector plays
- Mining impact on water quality should be paid by mines



## Appendix B4: Kimberley

**Attendance List**

Name	Postion/Organisation	Telephone	E-mail
Willie Bruwer	Orange Vaal WUA	0825756828	aqua@douglas.co.za
Abe Abrahams	DWA: Northern Cape	082 883 6741	abrahamsa@dwa.gov.za
Jannie Schoeman	Lower Modder WUA	082 852 4427	jpsprod@telkomsa.net
Nic Knoetze	Orange Riet WUA	053 591 9201	nic@oranjeriet.co.za
Nic Knoetze	Lower Modder WUA	082 872 9751	nic@oranjeriet.co.za
Kobus Nel	Orange Riet WUA	082 9482478	kobusbabsie@yahoo.com
Nicky du Plooy	Orange Riet WUA	082 568 7760	soetmelksvlei@vodamail.co.za
Leon Caldwell	DWA Potchefstroom	082 884 9982	caldwell@dwa.gov.za
Andre Kruger	Sand Vet WUA	082 339 4256	ajjkruger@gmail.com
Andries Labuschagne	Sand Vet WUA	078 800 5045	alabuscagne@sandvet.co.za
Mike Mokgwabone	DWA: GP Upper Vaal WMA	083 635 5130	mokgwabonem@dwa.gov.za
Richard Tloubatla	DWA: FS Region	083 640 5584	tloubatlal@dwa.gov.za
Peter Pyke	DWA: OA	082 809 5290	peterp@dwa.gov.za
Nic de Wet	Golder Associates	072 291 8352	ndewet@golder.co.za
Jon Rutherfoord	Golder Associates	082 900 8663	jrutherfoord@golder.co.za
Steve Crerar	WRP Consulting	012 346 3496	stevec@wrp.co.za

**Discussions**

The discussions points and comments presented in the following paragraphs have been re-grouped under a number of sub-headings to provide easier reading. They are not presented in the actual that discussions took place.

**Water User Associations and their role in WC/WDM**

- The South African Water Act is one of the best in the world but its implementation by DWA is seriously lacking at present - It appears as if the DWA does not understand the usefulness of the tool that they have in the Water Act.
- There are differing interpretations of the Water Act.
- The establishment of *water user association* is dragging on for too long and its more rapid and consistent implementation should be enforced by government. This would solve a lot of problems
- The different statutory requirements of Irrigation Boards (in terms of old legislation and *water user associations* (in terms of new legislation) is a major constraint to irrigation development and improved water use efficiency.
- Concern was expressed that the principal of devolution of water management to the user level (e.g. the *water user association*), as provided for in the Water Act, is being

violated and reversed (particularly with respect to the transfer of water within a *water user association*) by interference from DWA/higher authorities.

- There is a tangible gap in the chain of water demand management (through Water Management Plans) at *catchment management agency/DWA* level. *water user associations* pay charges to *catchment management agency/DWA* but little feedback. *catchment management agencies* or their equivalent should be established as quickly as possible.
- The principles of the Water Management Plans (WMP) are excellent but they not being enforced by DWA.
- Many aspects of the guidelines for WMPs are not being implemented by *water user associations* because the guidelines are too complicated. Simplify WMPs and then enforce them. DWA should assist with the cost of implementing WMPs.
- There is no incentive for *water user associations* to improve efficiency when the “catchment management charge” is based on the total allocation to the Scheme. Allocations from DWA to *water user associations* should include an efficiency factor which would provide *water user associations* with a limited amount of surplus water, thus allowing *water user associations* the incentive to save and sell on to willing buyers at a premium.
- *water user associations* should be assisted to develop their own data bases with respect to irrigation water allocations, irrigated areas and cropping patterns etc in their Schemes which are compatible with catchment and national data bases.
- Most irrigation scheme infrastructure is owned by DWA but is not always being maintained by them. This makes the management of Scheme irrigation infrastructure by the *water user association* very difficult. The issue of ownership and maintenance responsibility is not clear. There is a lack of clarity with the terms “repair”, “refurbishment” and “repairs following a natural disaster” and the DWA’s involvement with these is inconsistent.
- If some farmers don’t pay their levies to their *water user association* then the remaining farmers have to make up the deficit for the *water user association* to survive. This can lead to the collapse of a *water user association*.
- The Act requires that elected representatives on a *water user association* must be paid-up members of the Association. This is not the case with some emerging farmer representatives.
- Research and support needed in the management of real-time water use and related disposal reporting.

### **Water Pricing and the Role of the Irrigation Sector**

- The existing water pricing strategy should be reviewed as, at present, it only considers infrastructure cost. Farming is shown to represent just 2,3% of the GDP but this is not the true picture of what it contributes to the economy. The linkages are not adequately factored into the equation. To understand the value of farming to the economy one must look at what the effect will be if farming did not take place, especially in the lower Vaal and Lower Orange where farming and related industries

are often the only economic activity, and farming is consequently the largest employer. Water pricing should relate to this value and not just the cost of infrastructure.

### **Water transfers**

- Temporary transfers are conditional.
- Water transfers in the Sand-Vet *water user association* are being blocked by DWA because of the preference of water reallocation to emerging farmer schemes.
- Temporary transfers of irrigation water from one irrigator to another within a *water user association* should be able to become permanent transfers. If farmers are using transferred water for the production of permanent crops like table grapes the assurance of a permanent water allocation is essential.
- Temporary and permanent transfers of irrigation water should be the sole responsibility of *water user associations*.
- Transferring of water within *water user associations* with open canal reticulation systems will be limited to transfers upstream of the source and not downstream because of the limited capacity of the canals to transfer the additional water downstream.
- One of the risks of water transfers is the reduction of revenue for the source *water user association*. This has been resolved in the Orange–Riet *water user association* by agreeing that the recipient *water user association* pays the water charges to the source *water user association* and charges the user the normal charge .

### **Illegal water use**

- Illegal water use is a significant problem in many *water user associations* and requires attention.

### **Technical and financial aspects of WC/WDM**

- Drainage is required in a number of schemes but the lack of government subsidy support is making it unaffordable for farmers.
- The rapidly increasing cost of electricity is having significant impact on the cost of irrigation and in itself is creating a growing awareness of the need to irrigate more efficiently.
- Electricity costs now up to 14% of production costs in the Orange-Riet Irrigation *water user association*. This is having impact on viability of certain crops.
- In some areas, the Cooperatives provide technical support to farmers (e.g. irrigation requirements, fertilizer requirements, plant protection chemical requirements etc.)

### **Water metering**

- Metering is essential for improved management and monitoring of water use. Water meters should be owned and managed by the water users and not by the *water user association*.

### **Water quality issues**

- Water quality is impacting on crop selection.
- Poor quality water is resulting in increasing irrigation requirements (more frequent irrigations and provision for leaching fractions).
- In areas where soil salinity is becoming a significant problem there is a need to include a leaching fraction in the crop irrigation requirement.

### **Water shortages**

- There is concern that a reduction in supply of water to a *water user association* (due to drought) will result in reduced revenue for the *water user association* as well as the impact on the irrigators.
- A major constraint for farmers to upgrade to higher value crops such as orchard or vine crops is the assurance of supply of irrigation water. Farmers cannot risk the high capital investment of such an upgrade if there is a high probability of water restrictions in any given year. Farmers are also hesitant to invest in new, more efficient, irrigation technology when the assurance of supply is low. An example of where farmers react to an improved assurance of supply is on the Orange/Riet Scheme where water transfers from the Eastern Cape has provided a more stable supply compared to previous years.

### **New storage infrastructure in the Basin**

- Opportunity for additional storage infrastructure on the Orange River still exists but the options are becoming less and less financially viable.
- Concern expressed about excessive losses of water during flood situations. More storage would reduce these losses.

### **Communication issues**

- There is a link missing in getting the recommendations from such a study as this down to the farmer level. There needs to be a “roll-out” plan to get the message to the farmer.
- Some *water user association* managers face the challenge of irrigators maintaining a veil of secrecy over their production practices and yields for fear of income tax exposure. The secretive approach makes information sharing and transparency difficult.
- To maintain good communications with farmers is a challenge for *water user associations*. Irrigators are reluctant to attend meetings and consequently miss vital information.

### **Irrigated agriculture as a business**

- Over the last 25 years on the Orange-Riet Irrigation Scheme only 19% of new farmers entering the Scheme have proved successful and sustainable.
- The lack of viability of small farms is forcing consolidation of commercial farms. This is a lesson to emerging farmer projects where small, unviable farms are allocated to new farmers with disastrous effects.

### **Best management practices**

- BMPs should not be evaluated at distributor and farmer level only but should also be evaluated at DWA level (i.e. how well is the government doing?).
- These studies take place in isolation.
- The policy makers should be made aware of the findings of this study.

## Appendix C: Scheme Regulations for Riet River (Part of Oranje-Riet WUA)



# SKEMA REGULASIES RIETRIVIER SCHEME REGULATIONS RIETRIVER

## 1. *BESKRYWING EN STATISTIEKE* *DISCRIPTION AND STATISTICS*

Rietrivier skema het 138 besproeiers met 'n watergebruiksreg van 7 754,3ha. 'n Kanaal netwerk van 184km verskaf water aan 265 persele deur 327 gekalibreerde 250mm drukbeheerde perseelsluise.

Rietrivier scheme has 138 irrigators with water user rights of 7 754,3 hectares. The canal network of 184 km supply water to 264 plots through 327 calibrated 250 mm pressure control sluices.

Oppervlak, dreinerings- en eindpuntwater word tot in die Rietrivier afgevoer met 'n dreineringskanaal netwerk met 'n totale lengte van 50km.

The surface, drainage and endpointwater are being transfered to the Rietriver by a drainage canal network with the length of 50 km.

## 2. *INLEIDING* *INTRODUCTION*

'n Waterjaar vir die betrokke skema is vanaf 1 April tot 31 Maart van die volgende jaar.

A water year for this scheme runs from the first of April to 31st March the following year.

Voor die aanvang van 'n waterjaar word 'n periodelys uitgegee aan besproeiers, wat die droë periodes aandui, asook die piek besproeiings periodes.

Before every water year becomes effective, irrigators are issued period tables indicating of when there will be dry periods as well as the peak periods for the irrigations.

## 3. *INDELING VAN SKEMA* *SCHEME DIVISIONS*

Die skema is in drie seksies (wyke) verdeel naamlik:

- Kloksfontein
- Holpan
- Klipfontein

The Scheme is divided in three wards, namely:

- Kloksfontein
- Holpan
- Klipfontein

Die vereniging het vanaf 1 Oktober 2008 oorgeskakel na 'n ge-outomatiseerde stelsel met vier Watervloei Operateurs wat al drie seksies hanteer naamlik:

- Tjaart Vorster
- Harison Ngozo
- Norman Kok
- Reagan Gewers

Die volgende nommers kan 24 uur per dag geskakel word:

Kantoor - 053-591 9208

Selfoon - 082 948 2863

The association, as of 1 October 2008 now makes use of an automated system where four Waterflow Operators manage all three sections namely:

- Tjaart Vorster
- Harison Ngozo
- Norman Kok
- Reagan Gewers

The following numbers are available 24 hours per day:

Office - 053-591 9209

Cellphone - 082 948 2863

#### 4. **KWOTA / WATERGEBRUIKSREG**

##### **QUOTA/WATER USER RIGHT**

Kwota word jaarliks voor die waterjaar deur Dept. Waterwese en Bosbou bepaal. In 'n normale jaar met voldoende water in die opgaardamme is die toekenning 11 000m<sup>3</sup>/ha per jaar.

Department of Water Affairs and Forestry determine the quota yearly. In a normal year with sufficient water in the dams, the allocation is 11 000 m<sup>3</sup>/ha per year.

In paragraaf 3.2.2 van die Witskrif word die spits daaglikse watervoorsiening op 80m<sup>3</sup>/ha gestel wat 8mm per dag is. Die totale regmatige maksimum water gebruik is derhalwe 56mm per week. Hierdie toediening kan as 11mm per dag oor 120 uur per week geneem word. Dit beteken 'n maksimum ontrekkingsreg (M.O.R.) van 1.3L/s per hektaar watergebruiksreg.

In paragraph 3.2.2 of the Whitepaper the distribution of water is 80 m<sup>3</sup>/ha, that is 8 mm per day. The correct maximum water use per week is 56 mm. per week. It is an application of mm/day over 120 hours. That means a maximum abstraction right (MAR) of 1.3 L/s per hectare water use right.

Voorbeeld: 50ha X 1,3L/s X 3,6 = 234m<sup>3</sup>/uur. Omdat sluise slegs op 25m<sup>3</sup>/uur intervalle gestel kan word sal 250m<sup>3</sup> gelewer word.

Example: 50ha X 1,3L/s X 3,6 = 234m<sup>3</sup>/hour. Because sluices could only be open on 25 m<sup>3</sup>/hour, thus 250 m<sup>3</sup> will be delivered.

Indien 'n vol kwota nie aan die begin van die waterjaar toegeken word nie, kan 'n aanpassing binne die waterjaar gedoen word indien die omstandighede verander.

When a full quota cannot be allocated in the beginning of the water year, a revision can be done in the same water year when circumstances changes.

Balanse op kwota aan die einde van die waterjaar is nie oordraagbaar na die nuwe jaar nie. Individue moet hulle kwota so bestuur sodat hulle dit nie oorskry nie. Kwota balanse kan gedurende kantoorure verkry word.

Quota balances at the end of the water year cannot be transferred to the new year. Quotas should be managed properly by individuals, and not to exceed their limits. Quota balances are available during office hours.



## 5. **120 UUR/WEEK LEWERING** **120 HOUR/WEEK DELIVERY**

Die stroomsterkte (M.O.R.) waarteen water onttrek mag word is 1,3L/s per hektaar watergebruiksreg. Teen 1,3L/s per hektaar kan water vir slegs 120 uur gedurende spitsstye soos aangedui op aangehegde periode tydtafel onttrek word. Water kan enige 120 uur van die 168 uur per periode onttrek word. Indien water vir 168 uur per periode onttrek word verminder die M.O.R. na 0,93L/s per hektaar.

Voorbeeld: Indien besproeier egter in spitsstye 168 uur wil water neem, verminder sy MOR na  $120/168 \times 234\text{m}^3/\text{uur} = 167\text{m}^3/\text{uur}$ , dus kan hy  $175\text{m}^3/\text{uur}$  neem.

The rate of flow (M.A.R) that water may be abstracted is 1,3L/s per hectare water user rights. Only 120 hours during peak times as indicated on the period timetable at an abstraction rate of 1.3L/s per hectare may be allowed. Water may be abstracted any 120 hours from the 168 hours per period. If water is abstracted for 168 hours then the maximum abstraction right (M.A.R) reduces to 0,93L/s per hectare.

Example: If an irrigator wants to abstract 168 hours during peak hours, his M.A.R reduces to  $120/168 \times 234\text{m}^3/\text{h} = 167\text{m}^3/\text{h}$ , he may then abstract  $175\text{m}^3/\text{h}$ .

## 6. **AANVRAAG VAN WATER** **Water requests**

### 6.1 **Gewone aanvraag** **Normal request**

- Besproeiers mag telefonies aansoek doen (daaglik gedurende kantoorure voor 12:00).
- Irrigators may do requests telephonically (daily during office hours before 12h00)
- Aansoeke moet voor 10:00 op Vrydae gedoen word.
- Requests MUST be done on Fridays before 10h00.
- Besproeier is verantwoordelik vir oop en toemaak van sluise op vasgestelde tye soos aangevra deur besproeier.
- The irrigator is responsible for the opening and closing of sluices on that specific time as requested by the irrigator.
- Sluise moet ten alle tye vas gesluit wees in die posisie soos aangevra deur besproeier.
- All sluices MUST be securely locked in the position as requested by the irrigator.
- Sluise moet deur besproeier verstel word. Verstel tye is 06:00 en 18:00.
- The settings of sluices must be done by irrigators (setting times 06h00 and 18h00).
- Telefoniese aansoeke word nie meer voor die water gelewer word geteken nie. Dus moet besproeiers seker maak dat sy aansoek reg ontvang is. Indien water volgens besproeier nie reg gelewer is nie, sal in so 'n geval in die toekoms net 'n skriftelike aansoek aanvaar word.
- Telephonically requests may be signed only after water is delivered, it is thus the responsibility of the irrigator to see that the requests is done and received properly. If according to the irrigator the water is not delivered properly, in this case only written requests will be accepted in the future.
- Slegs die eienaar of persoon behoorlik deur hom gemagtig, mag water aanvra.
- Only the owner or a person with proper authorization may request water.
- Stroomsterktes word tot die volgende beperk.
- Flow rates of abstraction is limited to:
 

200m <sup>3</sup> /h	175m <sup>3</sup> /h	150m <sup>3</sup> /h	125m <sup>3</sup> /h	100m <sup>3</sup> /h
75m <sup>3</sup> /h	50m <sup>3</sup> /h			

 (m<sup>3</sup>/h = kubieke meter per uur)  
(m<sup>3</sup>/h = cubic meters per hour)
- Die kantoor behou die reg voor om stroomsterktes aan te pas na gelang van die dravermoë van die kanaal.



- The office have the right to adjust the flow rate according to the carrying capacity of the canal.
- Besproeiers is geregtig op 'n M.O.R. volgens hektaar inlysting op 'n kanaal per eiendom. (Sien punt 4)
- Irrigators have the right to M.A.R according to his hectare scheduling on a canal per property. (See point 4)

## 6.2 *Laat aansoek* *Late request*

- Laat aansoeke kan telefonies by kantoor gedoen word voor 12:00 van Maandae tot Donderdae, Vrydae tot 10:00.
- Special requests can be done telephonically at the office before 12h00 from Monday to Thursday, Friday till 10h00.
- Sluis verstellings is besproeiers se verantwoordelikheid. Verkeerde sluis verstellings kan 'n ander besproeier benadeel (kortlope).
- Setting of the sluices is the responsibility of the irrigator. A wrong setting will have a negative impact on the next irrigator (running short).

## 6.3 *Kansellaries* *Cancellations*

- Kansellaries kan voor 12:00 by die kantoor gedoen word, van Maandae tot Donderdae en Vrydae tot 10:00.
- Cancellations can be done before 12h00 at the office, from Monday to Thursday and Fridays until 10h00.
- Sluise moet nie toegemaak word voordat Waterbeheer kennis gegee is, wanneer pompe onklaar raak of met reën nie.
- Sluices may not be closed without informing the Water Control office. This includes malfunction of pump or rain etc.
- Kansellaries is onderhewig aan looptyd. Water wat by die bron uitgelaat is en nie meer uit die stelsel onttrek kan word nie, sal nie gekanselleer word nie. Dit sluit kansellaries as gevolg van reën in. Water word teen die besproeier geboek tot die volgende beurt.
- Cancellations are determined by running time. Water that is already released at the source and cannot be abstracted from the system, will not be cancelled, this include cancellations due to rainfall. Water is then billed to the irrigator until his next turn/cycle.
- Indien 'n krisis ontstaan en water nie betyds gekanselleer kan word nie, kan versoek word dat die sluis toegemaak word. Die water sal nietemin van die besproeier se waterkwota afgetrek word.
- In case of a crisis where water cannot be cancelled, the irrigator may request that the sluice must be closed, but the water will be subtracted from his quota.

## 7. *OORPLASINGS VAN WATER* *TRANSFER OF WATER*

### 7.1 *Tydlike oorplasings van water* *Temporarily transfer of water*

Aansoek kan gedoen word om water tydelik van die een perseel na 'n ander oor te plaas.  
Requests can be done to transfer water temporarily from one property to another.

Die volgende situasies van oorplasings sal oorweeg word.  
The following situations in the transfer of water will be considered.

- Indien eiendomme gehuur word en 'n huurkontrak getoon kan word.
- If the property is hired and a contract of proof can be shown.
- Water kan alles of gedeeltelik oorgeplaas word.
- All the water can be transferred or only partially.

## 8. **KOOPKONTRAKTE** **SALE CONTRACTS**

Sodra koopkontrakte na nuwe transaksies beskikbaar is, moet afskrifte deur die eienaar sowel as die nuwe eienaar se besonderhede by die kantoor ingedien word sodat die kantoor rekords op datum gebring kan word sowel die verdeling van die waterrekening.

As soon as these buying contracts are available, copies from the owner and new owner's details must be handed in at the office so that the necessary changes can be made to the records as well as the allocation of the water account.

## 9. **ONWETTIGE NEEM VAN WATER** **UNLAWFUL ABSTRACTION OF WATER**

Optrede van Raad, wanneer 'n besproeier se sluis oop of op die verkeerde stroomsterkte gevind word, wat verskil met sy aanvraag.

Actions that the association will take if the sluice of an irrigator is open or set on the wrong velocity which differ from his/her request.

### 1<sup>ste</sup> OORTREDING 1<sup>st</sup> OFFENCE

Die standaard briewe aan oortreder en besproeier wat kortloep as gevolg van oortreding.

A standard letter to offender and to the irrigators running short of water downstream due to this offence.

### 2<sup>de</sup> OORTREDING 2<sup>nd</sup> OFFENCE

Hoof Uitvoerende Beampte, Bedryfsbestuurder en Raadslid van die wyk besoek die besproeier om sy kant van die saak aan te hoor.

The Chief Executive Officer, Operational Manager and a Management Committee Member of the Association will visit the transgressor to hear his/her side of the story.

### 3<sup>de</sup> OORTREDING 3<sup>rd</sup> OFFENCE

Onmiddellike sluit van sluis deur die vereniging met ander slot. Skrywe aan oortreder waarin verwys word na hoe die situasie gehanteer sal word.

Immediately the sluice will be locked with different locks. Letters will be sent out to transgressor to explain how the Association will deal with his/her case.

- (i) Betaling van R1 500-00 voordat water weer voorsien sal word, moet aan die WGV as administratiewe en aansluitingsfooi betaal word.  
A payment of R1, 500.00 before water will be delivered again, must be paid to the WUA as administration and reconnection fee.
- (ii) 'n Persoon van buite word aangestel teen oortreder se koste vir twee (2) maande om sluis te hanteer. Maandeliks R1 500-00.  
A person will be appointed for two (2) months at the cost of the transgressor to handle the sluice at a monthly cost of R1, 500.00.
- (iii) Die afstand wat gery moet word vir die hantering van die sluis sal bereken word @ R2-50/km wat ook van oortreder verhaal sal word.  
The distance to drive to the sluice which needs to be handled will be calculated @ R2-50/km which will also be at the cost of the transgressor.



- Water moet jaarliks oorgeplaas word en kan nie van die een waterjaar na die volgende waterjaar oorgeplaas word nie.
- *Water must be transferred yearly and cannot be transferred from one water year to another.*
- Oorgeplaasde water sal nie gelewer word voordat goedkeuring van die HUB verkry is nie.
- *Water that has been transferred will not be delivered unless authorized by the CEO.*
- Oorplasings moet verkieslik voor 'n plantseisoen of jaar gedoen word.
- *Preferably, transfer of water must be done before the planting season of year.*
- Moet binne die dra vermoë van die kanaal waarheen geplaas word wees.
- *Must be within the carrying capacity of the canal that the water is transferred to.*

## 7.2 *Permanente oorplasings van water* *Permanent transfer of water*

Watergebruiksregte kan permanent vanaf een eiendom na 'n ander eiendom oorgeplaas word binne die bedryfsgebied van ORWGV

*Water user rights may be transferred permanently from one property to another, within the area of ORWUA.*

Die volgende dokumente word benodig:

*The following documents are needed:*

- Aansoek/vertoë
- Toestemming verbandhouders/bewys geen verbandhouders (Indien ENB Jacobsdal moet dit 'n brief van die bank vergesel)
- Koopkontrak van watergebruiksreg of toekenning
- Transportaktes van skenker eiendom sowel as ontvanger eiendom
- Landbouverslag Eiendom A - Ekonomiese eenheid (verkoper)
- Landbouverslag Eiendom B – Genoeg besproeibare eiendom (koper)
- Waterbelasting van verkoper tot op datum betaal
- Opseggingsverklaring (dat verkoper afstand doen van waterreg wat hy verkoop)
- Aansoek om lisensie, R114-00 (Tjek moet uitgemaak word aan Dept. Waterwese en Bosbou)
- Grondeise verslag (Land Claim Bfn of Kby)
- Eedsverklaring/Bewyse (dat grond sedert 1912 slegs in blanke besit was)
- Verklaring dat koper bewys is dat die skenker Sub-gebied tarief betaalbaar is
- Goedkeuring van betrokke Sub-gebied (indien in verskillende Sub-gebiede)
- Aanbeveling van ORWGV se Bestuurskomitee (moet 'n Raadsbesluit wees)
- Permanente waterreg oorplasings mag slegs na voorheen benadeelde besproeiers oorgeplaas word volgens Artikel 27 1 (b).
- *Recommendation by the Chief Director.*
- *Application of the permanent transfer of the water allocation.*
- *A sworn statement that there are no mortgaged registered on this water allocation.*
- *A letter of approval to license the volume of water use on the property.*
- *Permission to sell the water use entitlement to the buyer.*
- *Motivation to sell the water use entitlement.*
- *Termination of water use entitlement by the seller.*
- *Application for licensing*
- *Copy of the receipt for payment for the license application.*
- *A letter stating the purpose of use of the water use entitlement.*
- *A letter from the Land Claims Commissioner that there are no claims registered against the farm.*
- *Desktop Reserve determination for the drainage region.*
- *Title Deeds for the registered owner.*
- *Recommendation from ORWUA management committee.*
- *Permanent water rights transfers may only take place between prospective sellers and Previously disadvantaged irrigators*

Die besproeier sal dus ± R4 500-00 plus vervoerkoste betaal. Hierdie reëling geld tot volgende rekening se betaaldatum.

The irrigator will pay ± R4, 500.00 plus transport costs and this arrangement is valid until the next account's pay date.

#### 10. **SERWITUTE / SERWITUUTHEININGS / KANAALPAAIE EN STRUKTURE** **SERVITUDE / SERVITUDE FENCING / CANAL ROADS AND STRUCTURES**

- Indien serwitute, serwituutheinings, kanaalpaaie en strukture deur besproeiers of hul werknemers beskadig word sal hulle deur hul betrokke Raadslede besoek word om 'n ooreenkoms vir herstelwerk binne 'n sekere datum aan te gaan
- If servitude / servitude fences / canal roads and structures are damaged by an irrigator or their employees, they will be visited by a member of the Association in their region of which a date will be set for repairing of the broken structures.
- Herstelwerk sal deur die vereniging gedoen word vir die besproeier se rekening indien die besproeier dit nie herstel nie.
- If the irrigator does not fix what he/she has broken, the Association will fix it and add the cost to the irrigator's account.

#### 11. **JAARBEPLANNINGS** **YEAR PLANNING**

Jaarbeplannings moet aan die einde van MEI ingedien wees. Die verwerking sal gedoen word en u sal teen einde JUNIE skriftelik in kennis gestel word of u beplanning binne u watergebruiksreg val al dan nie.

Year planning's must be handed in at the end of MEI. The calculations will be done, and at the end of JUNE a written notice will be sent out telling whether your planning falls in your water user rights or not.

#### 12. **EKSTRA WATER** **EXTRA WATER**

Wanneer ekstra water benodig word, kan by mede besproeiers navraag gedoen word of by afdeling watervoorsiening. Indien water bekom is moet 'n tydelike huurooreenkoms sowel as tydelike oorpasing by watervoorsiening voltooi en geteken word, waarop duidelik aangetoon word of die oorpasing met of sonder MOR is.

When extra water is needed a query can be done at a fellow irrigator or at the water distribution office. If water is obtained a temporarily hiring contract as well as a temporarily transfer of water must be completed at the office also indicating whether (M.A.R) is included or not.

#### 13. **GEWASOPNAMES** **CROP RECORDS**

Word twee keer per jaar gedoen - Julie en Augustus en weer Desember en Januarie.

MUST be done two times per year – July and August and again December and January

#### 14. **SLUISLEWERING** **SLUICES**

Indien 'n besproeier beweer dat sy perseel se sluis te min water lewer kan sy sluis getoets word. 'n Deposito van R80-00 moet vooraf betaal word wat terugbetaalbaar is indien sluislewering foutief was. Indien die sluis korrek lewer verbeur die besproeier die deposito.

If an irrigator claims that his sluice is faulty and not delivering the right volume of water it can be tested. A deposit of R80.00 must be paid in advance if for whatsoever reason the sluice was



faulty the irrigator will receive this advance back but if there is no fault detected on the sluice the deposit will not be refunded.

**15. GEBRUIK VAN BOORGATWATER VIR BESPROEING  
USAGE OF BOREHOLE WATER FOR IRRIGATION**

Voordat water vanuit 'n boorgat vir besproeiing aangewend kan word moet die boorgat geregistreer wees of vir 'n lisensie aansoek gedoen word. Om te bewys hoeveel water vanuit die boorgat gepomp word, moet daar 'n goedgekeurde watermeter geïnstalleer word, of gewasgebruik sal toegepas word.

Before water can be abstracted from a borehole for irrigation, the borehole must be registered or an application for a license must be done. To prove how much water is pumped out of the borehole, an approved water meter needs to be installed or a crop factor will be determined.

**16. HUISHOUDELIKE- EN VEESUIPINGS AFTAPPE  
HOUSEHOLD AND STOCK WATERING**

Aansoek kan gedoen word vir die aftappe by die tegniese afdeling of by watervoorsiening. Aftappe van 19mm of 25mm word toegestaan. Die installerings koste kan by die tegniese afdeling verkry word en die jaarlikse tarief by die kassiere.

Applications can be done at the technical department or at water distribution. Stocks watering of 19mm or 25mm are available, the installation costs can be obtained from the technical department and the yearly tariff is available at the cashiers.

**17. KANAALKRUISINGS – PYPE OF OORGANGE  
CANAL CROSSINGS-PIPES OR BRIDGES**

Om kanale te kruis moet met die tegniese afdeling geskakel word vir die nodige spesifikasies, beplanning of installering. Die kostes sal vir die besproeier se rekening wees.

To cross the canal, the technical department needs to be contacted for the necessary specifications, planning's or installation. The irrigator will be held responsible for the costs.

**18. KENNISGEWINGS  
NOTICES**

Kennisgewings word per pos gedoen of per hand onder 'n dekllys waarop die ontvanger moet teken. Kort boodskappe word per SMS gedoen.

Notices are done per post or per hand with a checklist on which the receiver needs to sign. Short messages will be done per SMS.

**19. DROË PERIODES  
DRY PERIODS**

Periode tydtafels waarop die droë periodes aangedui word, word gedurende Januarie vir die volgende waterjaar uitgegee.

Period timetables where the dry periods are indicated will be sent during January for the next water year.

**20. BESOEDELING  
POLLUTION**

Besoedeling moet aan die kantoor gerapporteer word wat die probleem sal ondersoek en dit dan met Dept Waterwese en Bosbou sal opneem.

Pollution MUST be reported to the office. The office will investigate the problem and then take it up with the Department of Water Affairs and Forestry (DWAF).

**21. REËL TEN OPSIGTE VAN REKENINGE  
ACCOUNTS**

Rekeninge vir landbouwater word begin Januarie en begin Julie van elke jaar aan die besproeiërs gestuur wat dan aan die einde van Januarie en einde Julie van elke jaar betaalbaar is.

Accounts for agricultural water are sent to the irrigators in the beginning of January and the beginning of July of every year, which are payable the end of January and the end of July of every year.

Aan die begin van Februarie en begin van Augustus elke jaar word aanmanings aan alle besproeiërs wat nog nie betaal het nie gestuur.

Aan die begin van Maart en September van elke jaar word water toevoer gestaak indien nie betaal is, of reëlings getref is nie.

On the beginning of February and the beginning of August of every year, notices are sent to irrigators which have not yet paid their accounts. At the beginning of March and September of every year, water is stopped if the irrigator did not pay nor made arrangements for his/her account.

Uitstelle sal slegs goedgekeur word tot aan die einde van elke maand voor die volgende rekening uitgestuur word. Indien geen reëlings getref is nie moet die uitstaande rekening na 90 dae oorhandig word vir invordering in terme van ORWGV se Grondwet.

Extensions will only be approved until the end of each month before the next account is sent out. If no arrangements are made, the account that is in arrears must be handed over for collection after 90 days in terms of the ORWUA constitution.

Rekeninge vir industriële water word aan die begin van elke maand aan die verbruiker gestuur en is betaalbaar aan die einde van die betrokke maand.

Indien die verbruiker nie kan betaal nie, sal dieselfde reëls geld as by die besproeiërs.

Accounts for industrial water will be sent to users at the beginning of each month and are payable at the end of that specific month. If for whatsoever reason the user cannot pay the account the same rules as above will be processed.

Indien 'n tjek wat aangebied was as betaling verwys word na trekker sal 'n eerste en finale aanmaning aan u gestuur word.

If a cheque is given for payment and it "bounces" a first and final notice will be issued to user.

U sal die bedrag binne twee (2) weke in kontant/bankgewaarborgde tjek moet vereffen. Indien geen betaling gedoen is nie, word watertoevoer na die eiendomme gestaak, waarna die rekening oorhandig word vir invordering. Regskostes wat aangegaan word deur die WGV sal van die betrokke besproeier verhaal word.

You will be held liable to pay the account cash or by bank-guaranteed cheque within two(2) weeks if no payment is received the water towards the property will be stopped and the account will be handed over for collection. The irrigator will be held liable for all legal costs paid by the WUA.

Verdere rente sal gehef word vanaf die eerste betaaldatum tot op datum van tweede betaling teen heersende rentekoers soos afgekondig.

Interests will be put on the account from the first pay date up to the date of the second payment according to reviewed interest rates as announced.

Bankkoste soos gehef deur die bank sal ook van die besproeier verhaal word.

The irrigator will also be held liable for any bank charges set by the bank.

S SQUIRES  
VOORSITTER – RIETRIVIER SUB-GEBIED

DATUM /DATE







