



# Introduction

Dr Rivka Kfir, Chief Executive Officer,  
Water Research Commission

## INVESTING IN THE CREATION AND SHARING OF KNOWLEDGE

During 2010/11, the WRC continued to support the water sector and all its relevant institutions and partners. This was achieved by providing the sector with knowledge aimed at informing decision-making processes, improving monitoring and assessment tools, and making available a range of new and improved technologies related to water resource management, improved use of water in agriculture and the provision of water and sanitation services. The WRC continued to address the issue of climate change and the linked phenomena of extreme events. Research funded by the WRC will support the development of adaptive and mitigating strategies which will ensure the future sustainability of the country's water resources and services.

As the WRC aims to provide appropriate knowledge to further improve South Africa's ability and capacity to govern and manage its water resources, its research portfolio has to continue to incorporate various water uses in relation to applied land uses, with emphasis on issues of water quality, quantity and accessibility. Research projects will also focus on resource protection and its sustainability.

The research portfolio for 2010/11 was set on the basis of the WRC's strategic plan. The WRC continued to invest in the creation of knowledge via its four main key strategic areas (KSAs). These areas include: **Water Resource Management, Water-Linked Ecosystems, Water Use and Waste Management, and Water Utilisation in Agriculture.** In general, the portfolio as planned for the year under review was well-received by the various stakeholders. These research KSAs are supported by the Water-Centred

Knowledge KSA. This structure continued to form the core operating framework for WRC-funded R&D and was further consolidated during the year.

**Water Resource Management** - The water cycle plays a key role in the chemical, physical and biological processes that sustain ecosystems and influence Earth's climate and associated global change. Clouds, water vapour, and precipitation alter heating and cooling of Earth's surface and atmosphere which, in turn, affect global circulation and precipitation patterns. Hydrological data from atmospheric, surface, and subsurface stations are critical to the development of more accurate predictions of water distribution and availability, cloud formation and precipitation in a changing climate. The Water Resource Management KSA carries out a variety of studies, workshops, and meetings and publishes numerous reports on science-policy issues related to most aspects dealing with the water cycle and its impact on the management, protection, use, control, administration and sharing of water resources. The KSA continued to follow pertinent developments taking place nationally and internationally with regards to water resources. It also continued to lead the understanding of 'wicked problems', offering a safe space for experimenting and learning to address the numerous challenges faced in water resource management. In so doing, the KSA has provided guidance for policy implementation and the development of policy instruments in areas of: water resource assessments, such as WR2005; water quality, focusing on environmental health and endocrine disrupting compounds; groundwater potential and closing

the gap between surface water and groundwater assessments models; and the management of common property resources, enforcement and compliance.

**Water-Linked Ecosystems** - Research in this KSA put strong emphasis on the creation of knowledge aimed at protection and ensuring the utilisation and sustainable management of water-linked ecosystems in our water-scarce country during a time of demographic and climate change. Research portfolios within this KSA promote critical issues about conservation of aquatic ecosystems in order to provide the knowledge for their sustainable functioning in terms of national legislation, commitments to international conventions, and the ongoing provision of goods and services which ecosystems deliver. The research in this KSA develops the understanding of the ecological processes underlying the delivery of goods and services and provides the knowledge to sustainably manage, protect and utilise aquatic ecosystems. Three main research areas were addressed during 2010/11: ecosystem processes, i.e., the biophysical processes, form and function of ecosystems; ecosystem management and utilisation, including issues such as the ecological Reserve and ecosystem health; and ecosystem rehabilitation, including rehabilitation and restoration of processes, form and function of estuaries, rivers and wetlands.

**Water Use and Waste Management** - During the year under review, this KSA focused mainly on research for the domestic, industrial and mining water sectors. The aim was to proactively and effectively lead and support the advancement of technology, science, management and policy relevant to water supply, waste and effluent management, for these sectors. The KSA continued to support studies on appropriate technologies for improving the quality and quantity of our water supplies for domestic use, with a focus on water supply and treatment technology serving urban, rural, large and small systems. Greater emphasis has been put on aspects related to energy efficiency and generation in the supply of services, reuse and beneficiation from water supply and wastewater treatment, as well as adaptation and mitigation strategies at a water services level to deal with future challenges associated with climate change. Waste and effluent, as well as reuse technologies that can support and improve management in the municipal, mining and industrial sectors, were also addressed, and innovative, integrated solutions for water and waste management in the industrial and mining sectors were studied. The research areas included water services (institutional and management issues); water supply and treatment technology; sustainable municipal wastewater and sanitation, industrial and mine-water management; sanitation and hygiene education, and the WaterSmart Fund which supports the demonstration and development of innovative solutions.

**Water Utilisation in Agriculture** - Research carried out in this KSA aimed at increasing household food security and improving the livelihoods of people at farming, community and regional levels, through efficient and sustainable utilisation and development of water resources in agriculture. More specifically, this research focused on increased biological, technical and economic efficiency of water use, the reduction of poverty through water-based agricultural activities, increases in profitability of water-based farming systems, and the sustainable use of water resources through protection and restoration practices. All agricultural sub-sectors are addressed including irrigated and dry-land agriculture; woodlands and forestry; grasslands and livestock watering; aquaculture and inland freshwater fisheries. During 2010/11 emphasis was placed, through new projects, on quantification of water use and the nutrient content of economically important food crops in diets of the rural poor; assessment of the potential of small and large storage dams for inland freshwater fisheries to produce fish for food security in rural areas; promotion of the efficient conservation of water resources and water inputs within food-value chains for emerging farmers as part of land and water allocation reform projects; developing technical and financial standards for drainage of irrigated land with high water tables and salinity levels; determination of the magnitude of pollution by agricultural chemicals and the potential risks for human health and the environment; developing guidelines for rainwater harvesting; and livestock production on natural grasslands for generation of biogas as renewable energy. This research output will support development and application of approaches, models, techniques, practices and guidelines for efficient and beneficial agricultural water management.

### Supporting research projects

During the year under review, the WRC managed 328 research projects at various stages of project life cycle, of which about 79% (259 projects) were active projects and the balance were mostly projects that have been finalised and in the process of being financially closed. In the year under review (as in the previous financial year), the number of finalised projects (76) was very similar to the number of new projects initiated at the beginning of the financial year (77), providing a steady throughput of knowledge to the sector. The WRC published about 109 research reports and products in this period. The various funding streams included both non-solicited projects, accommodating projects within the broad research strategy of each KSA, and solicited projects, where research projects are developed in accordance with clear terms of reference, aimed at solving specific problems. About 33% of the total number of projects were solicited projects.

During the past five years the WRC has finalised 338 research projects, indicating a significant contribution to

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knowledge in the water sector. An average number of 68 projects were finalised per year, over the past five years. Over the same five-year period 324 new projects were initiated, ensuring the continuous contribution of new knowledge to the sector. An average number of 65 new projects were started per year, for the past five years.

Total investment in the support of knowledge creation, sharing and dissemination amounted to R110.7 m. This represents a decrease of 4% from the previous year (R115.8 m. total investment was reported in 2009/10). This investment includes about R2.6 m. for the Water Information Network (WIN-SA), R3.2 m. for the Framework for Education and Training in Water (FETWater), and other income leveraged for projects during the year under review. Both the investments in research projects and in research support, expressed as a percentage of total expenditure, were close to the set budgeted ratios and almost identical to that of previous years. The ratio addressing funding of the creation of new knowledge (research projects only) is 62%, equal to that for 2009/10 and the planned ratio of 62%. The ratio for research support is 73%, compared to 74% in 2009/10, and is equal to the planned ratio of 73%.

### Leveraging income for the creation, sharing and dissemination of water-centred knowledge

During the year under review the WRC continued to leverage levy income by striving to obtain funds from other sources to support water research. During

2010/11 this drive had been fairly successful but substantial amounts were rolled over to 2011/12. The WRC income originating from sources other than the levy for 2010/11 amounted to R14.8 m. Leveraged income included funds allocated to a number of KSAs for direct support of research projects and funds provided for capacity building, knowledge sharing and dissemination (e.g. WIN-SA and FETWater). Leveraged income was obtained from both local and international sources, where the main source of income was due to support by various government departments for specific research and other knowledge-sharing projects. Sources of income other than the levy for 2010/11 amount to about 13% of the total income.

## BUILDING CAPACITY

The WRC aims at providing South Africa with future researchers as well as a source of skilled human capital for other institutions within the water sector. This is done by encouraging project leaders to include students on their projects, enabling them to participate in water research through the various projects supported by the WRC. During the year under review, the WRC continued to place strong emphasis on building research capacity in South Africa as well as supporting a number of related capacity-building initiatives in Africa. In many areas of research supported by the WRC, it is evident that students who participated in earlier WRC projects are now leading WRC-funded research projects and serving as members of steering committees as well as reviewers of new proposals.

### Capacity building by lead organisations in 2010/11

The table below reflects the number of students involved in WRC projects, as reported for the various lead organisations contracted by the WRC, in the 2010/11 financial year.

Contract lead organisation	No. of historically disadvantaged students	Total no. of students
African Remediation Technology	1	1
Agricultural Research Council	2	5
ATL-hydro	3	6
Aquagreen Consulting	1	4
ASSET Research	0	5
Association for Water and Rural Development (AWARD)	1	1
BioAssets Consultants	0	4
Cape Peninsula University of Technology	17	22
Centre for Environmental Economics and Policy in Africa	3	3
Corporate Research Consultancy	1	1
Council for Scientific and Industrial Research	21	32
Counterpoint Development	0	1

CPH Water	0	1
DH Environmental Consulting cc	0	2
Durban University of Technology	3	3
Emanti Management	4	5
Freshwater Consulting Group	0	2
Golder Associates Africa (Pty.) Ltd.	7	7
Groundwater Africa	0	1
Hlathi Development Services	1	1
Hydrosoft Institute	1	1
Institute for Groundwater Studies (UFS)	8	11
Institute of Natural Resources	2	2
IWR Water Resources (Pty.) Ltd	1	1
Jeffares & Green (Pty.) Ltd.	1	2
Nelson Mandela Metropolitan University	3	10
Nemai Consulting	2	2
Ninham Shand Consulting Engineers (Aurecon)	2	7
North-West University, Potchefstroom Campus	2	11
Partners in Development (PID)	4	4
Pegasys Strategy and Development (Pty.) Ltd.	0	1
Pegram and Associates (Pty.) Ltd.	6	8
Prime Africa Consultants (previously CIC International)	6	7
Re-Solve Consultancy	1	1
Rhodes University	20	28
Sigma Beta	4	8
South African Weather Service	2	3
SSI Engineers and Environmental Consultants (Pty.) Ltd.	4	5
Sustento Development Services	0	1
Tshwane University of Technology	12	12
Umgeni Water	7	7
Umvoto Africa	4	5
University of Cape Town	10	32
University of Fort Hare	11	11
University of Johannesburg	1	5
University of KwaZulu-Natal (all campuses)	26	55
University of Limpopo	3	5
University of Pretoria	17	27
University of South Africa	2	5
University of Stellenbosch	23	51
University of the Free State	19	34
University of the Western Cape	21	26
University of the Witwatersrand	5	7
University of Venda	14	15
Virtual Consulting	0	1
WRP Consulting Engineers	2	2
<b>TOTAL</b>	<b>311</b>	<b>520</b>

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### Capacity building initiatives

In addition to its support for the training of students, the WRC has initiated and supported a number of national capacity building initiatives. These include support to national and local government as well as the development of new training material for different levels of learners and for academic institutions. Examples of such initiatives are given below.

#### Strategic meetings with capacity building organisations

As the main funder of water research in the country, the WRC's relationship with the water research community is crucial for its effective operation. During 2010/11 the WRC put emphasis on meeting with as many universities as possible, to discuss their challenges and their current and future contributions to water research. The WRC representatives visited research organisations in the country and had informal discussions with the research directors/ deputy vice-chancellor for research and senior researchers. Meetings were held with:

- Tshwane University of Technology (14 July 2010)
- Cape Peninsula University of Technology (21 July 2010)
- University of the Western Cape (21 July 2010)
- University of Stellenbosch (22 July 2010)
- University of Cape Town (22 July 2010)
- University of KwaZulu-Natal (23 August 2010)
- Durban University of Technology (23 August 2010)
- Mangosuthu University of Technology (25 August 2010)
- University of Zululand (25 August 2010)
- University of Pretoria (20 October 2010)
- Rhodes University (21 October 2010)
- University of Fort Hare (22 October 2010)
- North-West University (25 October 2010)

#### WRC 101 for project leaders

The WRC developed an informative one-day course for aspiring and new project leaders, to increase their understanding of the WRC research cycle, research priorities and fund allocation. During 2010/11, participants were guided on how to prepare a comprehensive proposal, with tips provided as to how to improve the chances of success, as well as guiding principles on how to manage the technical, administrative and financial aspects of a WRC project. The course also includes information on contractual and financial audit requirements. The WRC 101 courses were held on 3 May 2010 in Kempton Park, on 14 June 2010 in Cape Town and on 21 June 2010 in Durban.

#### South African Youth Water Prize

The WRC continues to support the South African Youth

Water Prize (SAYWP). The WRC intellectual property manager and knowledge dissemination officer served on the adjudicating panel of the annual national SAYWP schools competition, held at Leriba Lodge, Centurion, on 4 June 2010. The WRC also exhibited the WRC school-based material at this event.

#### Training courses for the Department of Water Affairs

The WRC presented a course on 'Water economics and governance in South Africa: Basic issues and operational tools' to staff of DWA at DWA's Roodeplaat Training Centre. A WRC Director presented a case study on 'Development and financing of irrigation schemes' and the available WRC guidelines on the revitalisation of smallholder irrigation schemes were explained.

In addition, the WRC presented a two-day course, on 24 and 25 June 2010, at the DWA Roodeplaat Training Centre, for DWA personnel who are tasked with training the regional offices on the South African Sludge Guidelines developed by the WRC and DWA. The course focused on the correct implementation of the sludge guidelines.

#### The Framework for Education and Training in Water (FETWater)

During the year under review, the WRC continued to support FETWater. This national capacity-building initiative is aimed at the development of competencies and capacity regarding water resource management. FETWater is a joint UNESCO, Belgian and South African programme, which is currently in its second phase. Phase I of this programme was successfully completed under the custodianship of the WRC.

#### Water Information Network – WIN-SA

The WRC continued to serve as the implementing agent for DWA for the Water Information Network (WIN-SA). WIN-SA is aimed at knowledge sharing and capacity building for local government, in recognition of the critical importance of competence at local government level.

## INNOVATION AND KNOWLEDGE APPLICATION

The WRC supports the protection and transfer of innovative methods and technologies that may result from WRC-funded research, where and if required. Some technologies, processes and products require commercial involvement in order to make them publicly available and some academic organisations have required WRC support in this regard.

## New innovations

### Map of stable isotopes in tap water

Creating a map of stable isotopes in tap water across South Africa, for hydrological, ecological and forensic applications, is a first for South Africa. It is innovative in that it provides a link between water resource management, ecology, global climate change and forensics. The research is technically supported by Purdue University in the USA.

### Early detection of environmental pollutants

The ongoing project entitled 'Pollution-induced in-vivo lipid autoxidation in fish and the subsequent development of pansteatitis in crocodiles' intends to find complementary, non-sacrificial parameters that may be used, together with existing indexes, to allow for accurate, sensitive and early detection of more chronic, sub-lethal pollution episodes, before bio-magnification and mortalities of organisms at the top of the food chain occur. A link between pollution-induced in-vivo lipid autoxidation in fish and the subsequent development of pansteatitis in crocodiles has not previously been elucidated.

### Guidelines for improved irrigation water management from dam wall release to root zone

The research project on 'Standards and guidelines for improved efficiency of irrigation water use from dam wall release to root zone application' has contributed to innovative knowledge. The report promotes an investigative approach to improving efficiency, rather than relying on water accounting alone. The guidelines developed aim at improving irrigation water management from dam wall release to root zone application and will assist both water users and authorities to achieve a better understanding of how irrigation water management can be improved. This in turn will result in building human capacity, allowing targeted investments to be made with lower social and environmental costs.

## New patents

The following two new patent applications were filed. Neither of these has been granted and both are still being prosecuted.

### Remote data collection

This invention aims to address the requirement to install a remote data logger in a location where data is to be collected, logged and intermittently retrieved. The invention includes a data recorder and a monitoring system. A South African patent application for this invention was filed on 22 July 2010.

### A membrane bioreactor

This invention relates to an immersed membrane bioreactor, and to a method for treating water. Existing membrane bioreactors have the disadvantage that they are damaged when dried, due to a change in the polymers from which they are manufactured. The membranes are also subject to damage when not handled carefully, i.e. by scouring or scratching. Existing membranes also require periodical chemical cleaning. This invention aims to address some of these shortcomings. A South African patent application for this invention was filed on 25 June 2010.

## KNOWLEDGE REVIEW 2010/11

What follows is a summary of the WRC's investment in the creation and sharing of water-centred knowledge, over the 2010/11 financial year. This reflects the organisation's strategic focus based on assessment and integration of the needs, opportunities and priorities presented by the current context and challenges facing the water sector in South Africa, and globally.