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Water security in South Africa

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Note

This review paper provides a synopsis of a set of papers on the theme of water security that the Development Planning Division of the DBSA commissioned in 2009. There is a list of these papers at the back of this document.

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Executive Summary

This study considers whether South Africa is facing a water crisis and, if so, what the nature of the crisis is. It then reflects on whether the country is "water secure" and, if not, what is required to rectify the situation.

The study concludes that South Africa does not have a national water crisis at present. Regardless of effective water management and service provision, however, a number of serious problems could arise that could prove to be the seeds of future crises. In such situations, water-related problems would have a serious impact, causing the country's social and economic life to take a turn for the worse.

Thus, in well-off urban communities, water services are generally of a high standard. In many poor communities, however, taps that have run dry, unsafe water and unsanitary toilets (or no toilets at all) are part of people's daily lives.

While South Africa's water resources are limited, they support a dynamic, growing economy and provision of services. Even so, there are areas in which water is already, or could soon become, a constraint to economic and social development. For example, although flooding is limited to a few localities, drought and drought-related disasters regularly affect communities as well as the national economy. With poverty and inequality continuing to define the experience of the majority of South Africans, it is a cause for concern that many opportunities offered by the water sector for development and social transformation are not being exploited effectively.

Thus, if water security is achieved when the social and productive potential of water has been harnessed adequately to the benefit of all, and its destructive potential is sufficiently contained, South Africa cannot yet be considered fully "water secure".

Lack of water security is not primarily the result of not having enough water. Internationally, it is recognised that water scarcity does not, in itself, determine the success or failure of a country's economic and social development. It is more important – and this has been demonstrated at a global level – that countries should recognise the limits of their water endowments and "live within their means". Singapore, for example, is water scarce but has a booming economy, having developed water management competences that it is now selling internationally.

Although South Africa uses a relatively high proportion of its available water, studies have shown that there is enough water to meet all the country's needs until 2025 and beyond. Present problems and future challenges are related mainly to limited financial resources and institutional capabilities, rather than to limitations of the resource. Thus, water crises may arise if the right investments, innovations and management decisions are not made at the right time. This could see jobs and livelihoods being affected, taps running dry and diseases spreading unnecessarily.

The key message is, therefore, that South Africa's challenges relating to water need not constrain national growth and development if they are properly understood and responded to. However, effective water management is essential if the country is to achieve optimal social and economic performance in a sustainable manner.

To identify water issues and opportunities more accurately, a consultative process was followed and some of the issues were further analysed as thematic background papers. Some of these themes have recently appeared, in similar forms, in the election manifesto of the ruling party and the Water for Growth and Development (WfGD) Framework of the Department of Water Affairs and Forestry (DWAF), while others were highlighted during the Legacy Review of the Parliamentary Portfolio Committee on Water Affairs and Forestry. The themes focus mainly on the resource as such, rather than the services. This is because municipal services have already received a great deal of attention, and water resources are essential for these services to be provided and sustained. The themes identified were as follows:

- The management of water quality which, if not addressed, could result in water becoming unavailable for many uses.
- Municipal reform to promote better planning and management of those services that both use and pollute the water resource.
- Linking water resources management (WRM) more effectively to broader development planning at local, provincial, national and regional levels.
- Developing a coherent vision for rural redress and transformation, with effective institutional mechanisms for linking water management with agriculture, land, finance and other rural sectors – this ties in directly with the issue of food security.
- Identifying opportunities where innovation and human capacity building can help to ensure that water management contributes more effectively to social and economic development.
- A reality check on what essential WRM activities should be promoted immediately, and which could be postponed where operational capacity is limited.

An important conclusion is that key challenges can best be addressed by establishing effective arrangements for WRM. It is also emphasised that WRM can no longer simply be a technocratic exercise. As available water becomes fully used, any new activities requiring water will demand that difficult choices be made and water management be organised to make them. This requires the involvement of a wide range of interested parties with whom water managers should engage systematically to ensure that constraints are understood and coherent approaches are adopted. These should be technically feasible, guided by broader social and economic priorities.

1. Introduction and purpose

Objective

The purpose of the study is to generate timely and credible information to support current work in the water sector in order to develop an institutional and regulatory framework. It also proactively seeks to identify and highlight potentially critical issues for the sector and for broader development in both South Africa and the southern African region during the next 15–20 years.

The objective of this project is to draw together the expertise and experience of relevant sectors in order to explore the potential impact of different policy choices on water security, and the contribution of water to growth and development in the short, medium and long term.

Scope

In this study, in keeping with a focus on water and food security, issues of poverty and income distribution are considered within the broader context of overall social transformation.

The link between food security and water security is helpful, as it is widely recognised that the former needs to be considered at both household and national level. It is argued that water security should be considered in a similar way, particularly in the rural context.

Challenges in the water sector can broadly be grouped into those related to water resources (water in rivers and dams) and those related to water services (water and wastewater in pipes). In South Africa, many localities experience some difficulties in either category or both.

This study concentrates on water as a natural resource supporting the economy and society, rather than on water supply and sanitation services per se. While these services are important users of water resources and have a decided impact on them, their provision is largely a matter of municipal policy and management. This aspect of local government is already receiving a great deal of attention, although many challenges remain and performance still appears to be deteriorating. The focus of this study is, therefore, on the relatively neglected interface between services and resources, as well as the wider contribution that water makes to the country's growth and development.

Methodology

A structured process of consultation was undertaken with sector experts. Based on their preliminary inputs, a broader group of participants were involved in identifying key focus areas, which were then discussed during the DBSA's 2008 Knowledge Week. Further insights were provided by the Water for Growth and Development (WfGD) Framework (DWAF, 2009) of the Department of Water Affairs and Forestry (DWAF), and the Legacy Review of the Parliamentary Portfolio Committee on Water Affairs and Forestry.

The sector experts then developed papers addressing certain key areas and issues. They workshopped and revised the papers as inputs for this the final paper, which brings together the issues identified and the main conclusions made. A list of the background papers is provided at the back of this document.

It is considered that the nature of water security in relation to water resources and their management is not well understood. For this reason, the first section of this paper starts with a broader perspective on the issues of water security and development, thus providing a framework for analysing the South African situation.

2. Water security: an international perspective

2.1 Water security

Water security has been defined as "the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks" (Grey & Sadoff, 2007).

This definition does not focus on the so-called "big S" of national security relating to threats of violence or war – although related concerns, such as the intentional contamination of water supplies, or water-related disputes with neighbouring states, could be risks to national security. Nor does the definition address the detailed organisational requirements at local government level for achieving "small s" security through the supply of water services at household level. Rather, it raises two core questions:

- Is there enough water available – of adequate quality and with sufficient reliability – to sustain the wellbeing of society?
- Is society adequately protected from the extremes of floods and droughts – the variability that characterises the natural water cycle?

The way in which water is managed and used can have a significant impact on a country's social welfare and economic activity.

There is also a symbiotic relationship between water and a society. Economic and social activities can have a severe impact on the quality of the water resource, through direct and diffuse pollution that affects its availability to other users. The water environment is a resource in itself, underpinning a variety of activities, notably nature conservation and tourism, as well as other local livelihoods.

Water is clearly central to the economic growth and sustainable development of a nation. However, water and its management cannot be regarded as being simply a national matter; there are also regional issues to consider. South Africa, like many other countries, shares a substantial proportion of its water resources with its neighbours. Management arrangements and development proposals therefore need to take this relationship into account.

Given the complex array of interrelated factors in the water sector, there is an urgent need to draw together insights from different perspectives and disciplines. These should serve as an input into any decision making on ensuring water security in South Africa and in the southern African region.

2.2 Intensity of use is more important than scarcity

South Africa is recognised as a water-scarce country in terms of a commonly used definition, namely that of the average "total actual renewable water resources" (TARWR) per person per year. Using this definition, South Africa is the 29th driest country out of 193 countries, with an estimated 1110 cubic metres (m^3) of water per person in 2005. Most of the "drier" countries are either small islands or oil states in the Middle-East (UNESCO-WWAP, 2006).

The use of TARWR per person was proposed in an attempt to determine a country's water requirements for food self-sufficiency. According to Falkenmark (1986), a country faces *water stress* when per capita water resources fall below 1667 m^3 per capita, *water scarcity* when there are less than 1000 m^3 per capita, and *absolute water scarcity* when water resources are below 500 m^3 per capita.

Other useful indicators of water stress are the intensity of use, the proportion of TARWR actually used, and thus the extent to which water availability is a current constraint. South Africa, which uses 31% of its TARWR, is again a relatively extreme case. Only 31 out of 163 countries surveyed use water more intensively. These are mainly oil-rich or island states that rely on water from non-renewable sources, such as fossil groundwater or desalinated seawater. Countries such as India, Pakistan and Spain, however, which have extensive irrigated agriculture, use a greater proportion of their water than South Africa does. Water is frequently pumped from underground sources at a rate faster than can be replenished.

Although both indicators provide some perspective on a country's natural resource endowments, they should be interpreted with care. Their implications depend heavily on the nature of the geography and the economy of the country concerned. Thus, "arid" Botswana has a TARWR of 6820 m^3 per capita, which is more than six times that of South Africa. However, the water is located in the northwest, while the population is in the southeast, and almost all the water is reserved to sustain the Okavango Delta wetlands.

Another example of the limits to using TARWR is provided by the small island state of Singapore, which has a TARWR of only 139 m^3 per capita. Although apparently drastically constrained by limited water resources, the country's economy has boomed since it became independent of neighbouring Malaysia in 1965. When water imports from Malaysia came under threat due to diplomatic differences, Singapore embarked on a programme to achieve water security. This was done through a mixture of conservation, rainwater harvesting, desalination of seawater and the reuse of wastewater. In the process, Singapore's public utilities board and its associated industries gained so much water management expertise that they are now highly sought-after as management and technological consultants throughout the region.

If Singapore demonstrates that a limited water endowment need not constrain economic development, examples of water-rich countries, such as Bangladesh or the Democratic Republic of Congo (DRC), show that having plentiful water does not necessarily lead to development. This is either because the water creates hazards (e.g. flooding in Bangladesh regularly takes thousands of lives), or because other conditions do not allow the resource to be used (e.g. the situation relating to the DRC's hydropower potential).

A similar point was made in the 2006 World Water Development Report, in which South Africa was highlighted as an example of good performance in this regard:

> "For example, available per capita water resources in Peru are more than 60 000 cubic metres per year (m^3/y), but only 1000 m^3/y in South Africa. Yet the incidence of poverty in Peru is greater than in South Africa, which means that a large amount of available water resources is not sufficient in and of itself to combat poverty; good management of these resources is also necessary" (UNESCO-WWAP, 2006).

Countries with a high TARWR may have settlement patterns in which people are located far from surplus water, as in Brazil, where the main urban centres are thousands of kilometres away from the Amazon River. Alternatively, much of the water reflected in a high TARWR may become available through annual floods and cannot be stored, as in much of South and Southeast Asia. This is why cities in humid countries, such as Malaysia with its TARWR of 23 320 m^3 per year, still suffer water shortages in the dry season.

Against this background, a recent review of the data concluded that "the naturally available water resources of a country do not have a significant effect on the ability of that country to meet the basic needs of its population" (Chenoweth, 2008).

2.3 Variability may be the most important factor

While there does not appear to be a real relationship between the total amount of water available and a country's economic and social prosperity, the same is not true for the variable nature of water resources. In addition to the difference between dry and wet seasons, this variability may occur over short periods, such as a few days or weeks. This is enough time for crops to be damaged if rainfall is insufficient. Variability may also occur over periods of years or decades. A climatic drought, for example, is one year or more of low rainfall compared with annual averages.

The impact of variability can readily be seen in national economic accounts. Data collated from Ethiopia, Kenya, Mozambique and Zimbabwe by the World Bank has demonstrated that a country's national gross domestic product (GDP) can vary by as much as 10% per year as a result of floods and droughts.

This information has led many commentators to conclude that it is water's extreme variability, or "difficult hydrology", that accounts for apparent development failures in parts of Africa and Asia:

> "**Poverty and hydrology: a hypothesis.** Many (but not all) of the world's industrialised nations have an 'easy' hydrologic legacy and were able to achieve water security early in their path to growth. Many of the world's poorest countries today are characterised by a 'difficult' hydrologic legacy and, perhaps as a direct consequence of the scale of this challenge, have not achieved water security. We advance the hypothesis that many societies that have inherited a legacy of 'difficult' hydrology (and particularly combined inter-annual and intra-annual variability) have remained poor* and in a low-level equilibrium trap, in part because it has never been possible for them to make the comparatively large investments needed to achieve water security – investments that can only be resourced from the growth that water insecurity itself constrains" (Grey & Sadoff, 2007).
>
> * There will be exceptions of course, in particular where major injections of external skill and capital have enabled water security to be achieved (e.g. Australia and the western United States).

Grey & Sadoff (2007) further report that greater rainfall variability is statistically associated with lower per capita incomes (Figure 1).

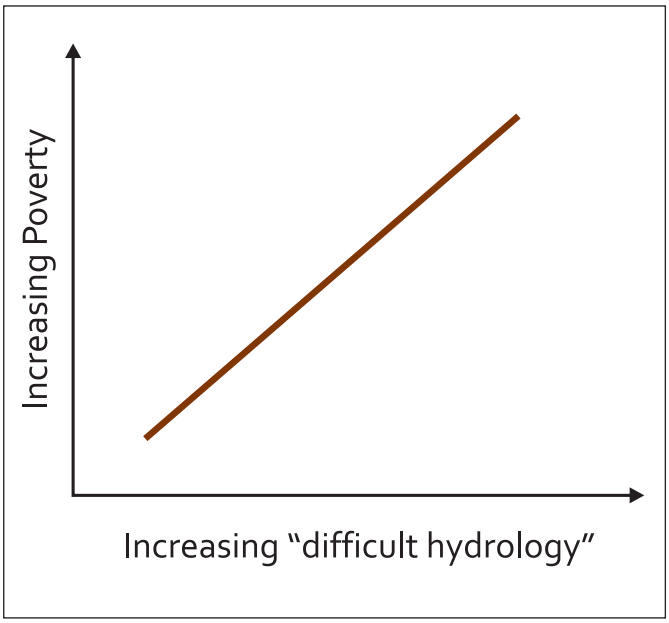


Figure 1: Poverty and hydrology

The implications for such countries are that, at the very least, they should invest more in managing their water resources. Countries that achieve a relatively good performance, despite having "difficult hydrology", have invested significantly in infrastructure for storing and transporting water, as well as in institutions for managing it. Often-cited examples in this regard are South Africa, Australia and the western United States.

In this context, the approach to managing variability needs to be understood. One requirement is a good understanding of the rainfall and river flow patterns over a long period, typically at least 30 years. This information is analysed by hydrologists, who advise water managers on the probability of high or low rainfall and river flow occurring. The water managers then decide what level of reliability they want, and can afford, for their water supplies or flood defences. They instruct the design and operation engineers accordingly.

In South Africa, supplies for critical activities, such as power generation, are typically planned for a 99.5% reliability; that is, on the assumption that they will fail only once in every 200 years. Urban supplies are planned for 98% reliability, implying failure once in 50 years. This is because some activities, such as garden watering, can be restricted when there is a shortage of water. On the other hand, irrigation supplies for annual agriculture may be planned for reliability as low as 80%, envisaging failure once in five years.

In disaster planning, where failure may cause catastrophic consequences, dams may be constructed with a probability of failure occurring only once in every 2000 or 10 000 years. However, in areas where it will be possible to evacuate the population, flood defences may aim to offer protection against an event that is likely to occur every 100 or 200 years.

2.4 Poverty and livelihoods: Equity, efficiency and water resources

If "difficult hydrology" can entrench poverty, good water management should be able to reduce poverty. For this to be achieved, however, it is necessary to be guided by a broad development strategy that reflects that hydrology. The key issue is a familiar one to South Africans, namely, the need to design strategies that will attain a balance between economic growth, development and social distribution that is acceptable to the national community.

In the context of water, an extreme approach would be to focus on economic growth alone. This would involve managing water so as to achieve maximum productivity from its use in terms of "dollars per drop".

Productivity can also be measured in social terms. So, for instance, decisions on water management could be guided by the number of "jobs created per drop". This measure is more developmental by nature, as it addresses the objective of ensuring that the use of water has both social and economic benefits. However, if the economic productivity arising from labour-intensive water uses is low, the state revenue may be affected, thus reducing a government's ability to spend on its social priorities.

Internationally, the general consensus is that ensuring access to adequate water supply and sanitation is critical to addressing many dimensions of poverty. There is, however, less clarity on how water management can reduce poverty by promoting better livelihoods.

In Chile, for example, water management reforms during the Pinochet dictatorship in the 1980s gave priority to economic uses through market-based allocation systems. While this approach was credited with promoting economic growth, it put many agricultural communities at a disadvantage. It has subsequently been revised to avoid speculation in water rights and to protect the interests of small-scale farmers.

More generally, it becomes clear that addressing poverty through water policy should be part of a broader overall strategy:

> "A recent major study on the poverty impacts of irrigation on poverty reduction in Asia showed mixed results in terms of the extent to which large-scale canal irrigation systems generated benefits for poor people. The overall conclusions were that where irrigation investments were accompanied by measures such as reforms to equalise land distribution, actions to reform and improve the efficiency of irrigation management agencies and the development of improved access to markets for poor people, then such large irrigation schemes can generate a range of substantial benefits for poor people. [...] In relation to pro-poor growth, the conclusions are clear: large infrastructure has much to offer, but these investments need to be part of a wider process of development and reform that is specifically targeted to make sure that the potentials they create for generating growth, and at the same time creating benefits for the poor, become a reality" (PEP, 2006).

Many studies focus on the impact of different approaches to water management within a single sector, usually agriculture, but also when considering environmental services. A challenge faced by many countries, however, is the growth of water consumption in other areas, notably the urban and industrial sectors.

A comparison of costs and benefits in these areas is more difficult because it requires an analysis of the impact water policies have in the context of broader socio-economic policies. In Chile, for instance, the water reforms supported massive increases in economic production in the mining and agricultural sectors. However, these benefits were not shared with the broader population until, under a new government, social welfare received more attention. The income generated from water-based economic activities helped the new Chilean government to adopt more redistributive social policies. The welfare impact of the water policies thus depended on the country's broader development policies.

Given the difficulty in analysing the role water plays in a nation's economy, it is not surprising that some water sector activists take a more radical approach that focuses on equity in the distribution of water itself, and thus considers the physical quantity of water available per person. Research done in South Africa to estimate a Gini coefficient for water shows that formal water allocations are made to very few people (Cullis & Van Koppen, 2007). However, when the investigation assessed the distribution of benefits from water use – considering mainly jobs in activities associated with water allocations –

the Gini coefficient was reduced towards the national average. It would have been even less if more water were made available to subsistence farmers, although it is not clear what impact that would have on overall income levels. It is thus necessary to consider carefully how water can best be used to achieve social as well as economic objectives.

2.5 Water resource interventions to manage variability

Water resources management (WRM) broadly involves, among other activities, developing infrastructure to store and transport water to users; allocating the resource to different users; implementing incentives for its efficient use; and protecting it. It also involves the financing and ongoing operational management of all the activities. There is a logical sequence to these activities:

- Initially, the focus of individual users is on the physical works required to take the water from the source and transport it to where it is needed.
- As the quantity used increases, the focus shifts to providing water security, by storing enough water to sustain supply during dry periods.
- As the number of users in an area grows, there is often an incentive to develop at least part of this capacity as a collective or public infrastructure.
- As the intensity of water use grows, it becomes more important to have a formal system for allocating available water to individual users. Thus, when demand grows to exceed supply, there will be a clear mechanism for managing competition among users.
- Moreover, as increased water use is often associated with increased generation of wastewater, the protection of the resource from uncontrolled pollution requires greater attention.

The sequence followed reflects the specific situation in each country:

> "In most developed countries significant infrastructure investments have been made (in some cases arguably excessive investments) and much greater returns are now derived from improving water resources management and infrastructure operations. In some of the world's poorest countries, infrastructure stocks may be so low that investments in management will not have significant returns. Without the infrastructure to store and deliver water and manage flows, water managers and institutions, no matter how sophisticated, are severely constrained.
>
> This suggests that, while developed countries with ample infrastructure stocks are appropriately focused on water management and infrastructure operations, in some developing countries it will be appropriate to place greater emphasis on infrastructure investments – just as developed countries did at a similar point in their development, but with the added advantage of drawing on global good practice to do so, proactively building institutions to match the need" (Grey & Sadoff, 2007).

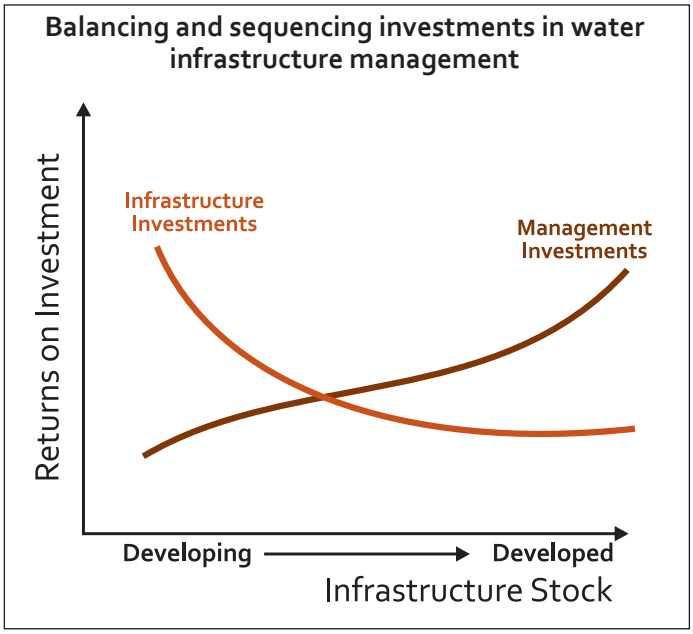


Figure 2: The hydrological transition

Source: Adapted from World Bank: Country Water Resources Assistance Strategy, 2002

As economies develop, and as the proportion of available water that is used rises, so the relative importance of investments in "hard" physical infrastructure declines and that of investments in "soft" management grows. This reflects the changing rate of return, as cheaper infrastructure investment projects are exhausted and the growing infrastructure stock provides greater scope for management interventions.

2.6 The nature of water resource crises

The preceding considerations help us to understand the nature and features of water crises. Such crises are defined here as situations in which water problems could have a serious and rapid impact, marking a turn for the worse in a community's social and economic life. Because water is a renewable natural resource with constantly varying availability, national or basin crises are difficult to predict and, once they occur, difficult to manage. Further, when they do occur, they often affect the poor in society first.

2.6.1 Shortage of supply

The most obvious water resource crisis, a shortage of supply, is easiest to manage. This is done through the construction and use of appropriate storage facilities, although lead times are often long and the facilities have to be in place before the shortage occurs.

For all but the smallest systems, this requires a degree of specialised expertise and timeous management intervention, guided by good knowledge of local hydrology and patterns of water use. Even when infrastructure is available, the variability of rainfall and river flows should constantly guide the rates of abstraction.

Often, the greatest risk in this respect is that stored water will be used too rapidly, leaving inadequate reserves. The management of drought thus requires a good understanding of the country's climate and hydrology. There is also a need to be disciplined in following operational rules designed to manage such risk.

2.6.2 Flooding

Similarly, when there is too much water, flooding poses an obvious and costly risk. Where financial resources for this purpose are available, vulnerable areas can usually be identified and floods managed, if not always prevented. Measures include the construction of physical defences, catchment rehabilitation, as well as management activities, such as controlling settlements and other land use on flood plains.

The cost of crises due to inadequately managed floods (and droughts) has been documented and can be substantial. In countries with inadequate infrastructure investments, weak water management, and where water security is consequently limited, economic losses due to floods and droughts routinely reach the level of 10% of the annual GDP.

2.6.3 Pollution

A more insidious problem, which can trigger a crisis, is water pollution. Water can become unusable for a variety of reasons that are often difficult to predict. For example, simple expansion of urban settlements and changes in agricultural practices can have serious effects. Once water is polluted, it may be difficult and expensive to remediate, particularly in the case of underground sources, which may be lost to use for long periods.

2.6.4 Allocations

Apart from inadequate pollution control or poor management of infrastructure that makes water use possible, a water-provoked crisis may also arise if allocations are not enforced. The resultant uncertainty could impair economic and social activity.

A more insidious crisis may result if water is allocated solely for economic purposes, without regard for social considerations, or solely for social considerations, ignoring economic needs. Although this would leave many people poorer and hungrier than they otherwise would have been, it is unlikely that their plight would be identified as a water issue.

The nature of the water resource-related crises described above highlights the following conclusion: What matters is not how much water a country has, but how it is used and by whom, and how well the variability of the resource is managed.

2.7 The global response: Integrated water resources management

The global response to challenges in WRM has been to encourage what was, at the time of the Rio Earth Summit in 1992, a relatively novel approach, namely that of integrated water resources management (IWRM).

While something of a mystique may surround IWRM at present, it is a relatively straightforward concept that initially sought to rectify certain defects in the approaches used before. Some advocates have called for all land and water use management to be integrated, but this is not what IWRM is about. Specific commonsense requirements of IWRM for "integration" include the following:

- All sources of water (rivers, lakes, groundwater, etc.) should be managed as parts of an integrated cycle, and river basins should be the basic unit of management.
- Different user sectors, such as agriculture, hydropower and urban suppliers, should work together.
- Water quality and quantity should be managed together.
- Water planning should be undertaken within the broader framework of national development planning.

Further, IWRM focuses on decision making that balances competing interests and objectives, following the approach adopted in Agenda 21, the conference decision made at the Rio Earth Summit:

> "Agenda 21 explicitly promotes the use of the resource base in ways that best support social equity, economic development and environmental sustainability objectives. The IWRM approach reflects this concern in that it seeks to achieve an optimum balance among the 'three Es': efficiency, equity and environment. IWRM provides a way of operationalising this part of Agenda 21, offering a problem-solving approach to address key water-related development challenges in ways that balance:
>
> - Economic efficiency – to make scarce water resources go as far as possible, and to allocate water strategically to different economic sectors and uses.
> - Social equity – to ensure equitable access to water, and to the benefits from water use, between women and men, rich and poor, across different social and economic groups both within and across countries, which involves issues of entitlement, access and control.
> - Environmental sustainability – to protect the water resources base and related aquatic ecosystems and, more broadly, to help address global environmental issues, such as climate change mitigation and adaptation, sustainable energy and sustainable food security.

> To achieve this balance, it is useful to view the IWRM approach as the operationalisation of what are often termed 'IWRM principles'. Our view is that these principles can be expressed very simply as the recognition that water is a public good with both social and economic values, and that good water resources management requires both a broad holistic perspective and the appropriate involvement of users at different levels" (Lenton & Muller, 2009).

This approach was confirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002. It was agreed that, as part of the Plan of Implementation, all countries should have developed an IWRM plan by 2005.

Some advocates, however, have insisted that the implementation of IWRM should include specific policy initiatives. Common misconceptions in this regard are that all water should be treated as an economic good by introducing tariffs and water markets, and that special-purpose river basin organisations should be established. A more serious fallacy in the African context is that infrastructure development should be omitted in favour of demand management. To avoid this misunderstanding, Agenda 21 specifically refers to integrated water resources *development* and *management*.

Due to arguments about the content of IWRM, less progress has been made with its implementation than initially hoped for. Nonetheless, governments of the world, through the United Nations Commission on Sustainable Development (UNCSD), remain committed to the IWRM approach to water management. South Africa has also supported this approach. Its policy, legislation and initial National Water Resource Strategy (NWRS) are often cited as practical examples of IWRM although, as elsewhere, implementation has not progressed fast enough.

3. South Africa's water resources

3.1 In general

As mentioned, South Africa is water scarce, being the 29th driest of 193 countries and having an estimated 1 110 m^3 of water per capita in 2005. Moreover, its rainfall varies dramatically from season to season, and the limited available water is distributed unevenly across the country. Because the South African economy and its urban settlements developed largely in response to mining opportunities, much of the demand for water comes from inland areas, far from major rivers or other sources of water.

This limited endowment has not prevented society from harnessing the water supply that is available. It is used to support social and economic activities in thriving urban areas, as well as in extensive, water-dependent mining operations. The water resource base also underpins extensive commercial

agriculture and sustains an environment sufficiently attractive to generate significant tourism activity. Where social needs persist, notably in rural areas but also in poor urban townships, this is more a reflection of poverty, an absence of livelihood opportunities and the lack of organisational resources, than of a shortage of water resources as such.

This is not to say, however, that water resources and their management can be ignored and that no challenges exist. As pointed out earlier, water in South Africa is already being used intensively, at 31% of the available water supply. Practical examples of the problems currently experienced include the following:

- Environmental deterioration occurs in heavily used river basins. As a result, recreational use of the Vaal, Crocodile and Pienaar Rivers in and around Gauteng is increasingly constrained.
- There are conflicts between users over limited resources. In dry years, there is conflict in the Komati River basin, for example, between small-scale sugar farmers and larger commercial operators, as well as with users downstream in Mozambique.
- Water supply is inadequate to meet local development objectives in some areas. The Limpopo province, for example, had to scale back the agricultural development targets in its Provincial Growth and Development Strategy, as not enough water was available to support them.
- Water-based opportunities for development are not being exploited. For example, more than 40 years after the Pongolapoort Dam (South Africa's third largest dam) was constructed, the water available to supply irrigated agriculture on the Makatini Flats in KwaZulu-Natal is still not being used productively. Also, the hydropower potential of the Umzimvubu River in the Eastern Cape has not been tapped.
- The reallocation of water resources to promote more equitable distribution has progressed slowly, although this is in part a reflection of the relatively slow pace of land and agriculture reform.
- There are administrative challenges. For instance, a total of 1 300 applications for water use licences is reported to be outstanding. According to the DWAF's 2007/08 Annual Report, only 90 licences were approved in that year (DWAF, 2008).

Many of these issues were raised, or foreseen, in the NWRS (DWAF, 2004). This strategy provides the most recent comprehensive overview of the situation concerning water resources in South Africa. It reviews the status of the resource, as well as plans and strategies for addressing future water needs of the country. The NWRS was due for a statutory revision in 2009.

3.2 Local solutions to local problems

As water is difficult and expensive to transport, many of the problematic issues arise at the local level, and solutions also begin at that level. For this reason, it is at the level of individual river basins that the resource challenges begin to be apparent and can best be addressed.

Under the National Water Act (NWA) (DWAF, 1998), South Africa is divided into 19 water management areas (WMAs) for management purposes. These areas reflect the major river basins of the country. Some larger river basins, such as the Orange and the Limpopo, are divided into a number of separate WMAs, while smaller basins, notably along the eastern coast, are grouped together in single WMAs.

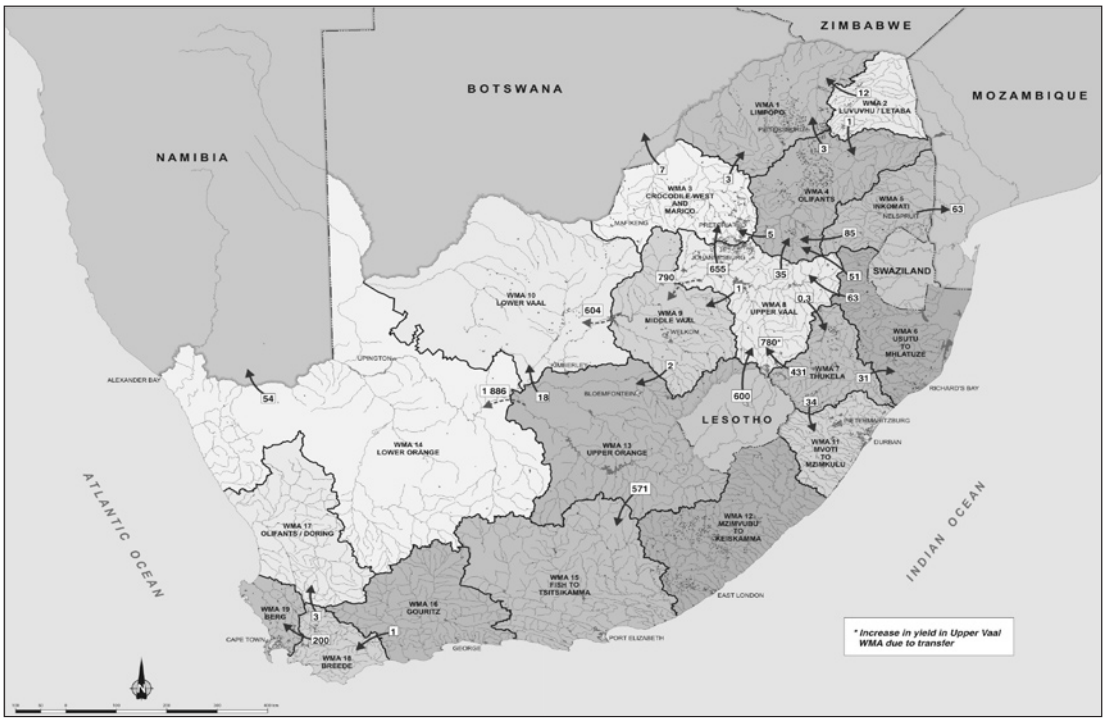


Figure 3: Location of water management areas and inter-water management area transfers

Source: DWAF, 2004

The NWA provides for water management to be carried out at the level of the catchments, subject to national overrides. These overrides relate to transfers between catchments that are made as strategic national allocations.

Estimates of water availability in the NWRS include underground water although, in most cases, this constitutes only a small proportion of available water (about 8% at national level). Where it is available in adequate quantities and quality, underground water is a useful source for small, dispersed requirements, such as the provision of domestic water in rural communities. In general, however, South Africa does not have extensive, high-yielding sources of underground water that can support substantial levels of consumption.

3.3 Water availability and use

The NWRS reports that nine of the 19 WMAs had a substantial deficit in 2000, which means they were using more water than was reliably available from both surface and groundwater sources. Even that was only possible because a number of WMAs, notably the Crocodile West, were receiving water transfers from others that had a surplus (Table 1).

Table 1: Reconciliation of water requirements and availability in 2000 (million m³ p.a.)

Water management area		Reliable local yield	Transfers in	Local requirements	Transfers out	Balance
1	Limpopo	282	19	325	0	(24)
2	Luvuvhu/Letaba	310	0	334	13	(37)
3	Crocodile West and Marico	693	656	1 328	10	11
4	Olifants	611	172	971	8	(196)
5	Inkomati	943	0	1 048	148	(253)
6	Usutu to Mhlathuze	1 010	32	693	114	235
7	Thukela	738	0	338	497	(97)
8	Upper Vaal	1 723	1 443	1 204	1 481	481
9	Middle Vaal	201	791	389	605	(2)
10	Lower Vaal	50	651	653	0	48
11	Mvoti to Umzimkulu	527	34	828	0	(267)
12	Mzimvubu to Keiskamma	855	0	375	0	480
13	Upper Orange	4 557	2	968	3 105	486
14	Lower Orange	(1 007)	1 886	834	54	(9)
15	Fish to Tsitsikamma	437	571	902	0	106
16	Gouritz	277	0	342	1	(66)
17	Olifants/Doring	335	3	373	0	(35)
18	Breede	868	1	637	203	29
19	Berg	501	203	738	0	(34)
	Total for country	**13 911**	**0**	**13 280**	**124**	**504**

Note: Deficits are indicated by insertion of brackets, e.g. (100)

While water quality is not monitored as systematically, problems in this regard have been identified in a number of WMAs, and recent research demonstrates a significant downward trend in quality (De Villiers & Thiart, 2007):

- Quality problems related to toxic cyanobacteria have been identified in 11 WMAs, which may occasionally restrict the use of the rivers and dams for recreational purposes.
- In eight WMAs, the levels of certain salts in some places exceed the desirable limits for human consumption.
- In six WMAs, water quality falls outside the limits for irrigation in certain locations, although this is in part due to natural conditions.

In addition, groundwater quality varies naturally from place to place and is often unsuitable for human consumption or agriculture. Groundwater is also vulnerable to local pollution by human activities, particularly in locations with high population densities or concentrations of economic activity.

The deterioration in water quality is a significant indicator of the degree of stress being placed on South Africa's water resources. It should be noted that having water that is too polluted to use is nearly as bad as having no water at all. A number of approaches to reconciliation are subsequently discussed.

A key objective of WRM is to reconcile the supply of water (of adequate quality) and demand. In the past, this inevitably meant increasing supply by developing new infrastructure. As the water resource is increasingly utilised, more attention needs to be given to the other side of the equation and demand needs to be managed. Despite the challenges identified in Table 1 above, the NWRS reached the following conclusion:

> "In general, sufficient water can be made available at all significant urban and industrial growth points in the country for water not to be a limiting factor to economic development" (DWAF, 2004).

The NWRS then proceeds to indicate how a balance between supply and demand can be achieved.

3.3.1 Supply management

Supply increases can be achieved in a number of ways, as discussed below.

Storage: Storage can be increased by building new dams to store water from the rainy season for use during the dry season, and to use water from wet years in dry years. There is a limit to this approach, however, as it is only useful to build dams if there is likely to be sufficient rainfall to fill them. South Africa's storage capacity is already relatively well developed, with a dam capacity of over 32 billion m^3. This is equivalent to about two-thirds of the average annual flow in all its rivers.

Water transfer: Water transfer, both within river basins and from other river basins, is another possibility as local supplies become fully developed. This is already being done extensively in South Africa. The best-known example is the Vaal River, which is supplemented with water brought from the Orange River via the Lesotho Highlands Water Scheme. Similar transfers occur between other basins (see Figure 3). Regions such as Gauteng, the Nelson Mandela Metropole in the Eastern Cape and significant parts of the North West and Limpopo provinces depend on such transfers.

Desalination and reuse of wastewater: These are further supply options. South Africa's coastal population is unlikely ever to face total water shortage, as desalination will increasingly become an affordable alternative for high-value uses. Inland, the recycling of polluted wastewater is already being practised extensively. Desalination of water in the Vaal River from the mines is becoming increasingly attractive as a solution to water quality problems, as substantial volumes of "clean" water are currently used to

keep salinity levels down. Transfer of reused water to other catchments also helps to reduce salinity loads on the Vaal River.

Natural environments are a final source of additional water. In terms of legislation, enough water must be left in rivers to sustain an acceptable natural environment, prior to any allocation for economic purposes. While there are sound policy reasons for protecting the environment as an objective in itself, the maintenance of "environmental flows" is also important with a view to safeguarding environmental attractions, such as the country's national parks and other sources of livelihoods. Nonetheless, environmental flows (and the levels of their protection) are socially and administratively determined. In periods of shortage, water reserved for the environment might be taken illegally for economic or social uses unless there is strict management oversight at the local level, supported by national priorities.

When these supply options are taken into account, the situation is not as serious as it appears at first. Although a number of WMAs depend on transfers to meet their needs, in only three (Limpopo, Olifants and Komati) will the volume of water required up to 2025 not be met by developing additional storage infrastructure (Table 2).

Table 2: Reconciliation of water requirements and availability for 2025, base scenario (million m³ p.a.)

Water management area		Local yield	Transfers in	Local requirements	Transfers out	Balance	Potential for development
1	Limpopo	281	18	347	0	(48)	8
2	Luvuvhu/Letaba	403	0	349	13	41	102
3	Crocodile West and Marico	805	901	1 594	10	102	0
4	Olifants	630	210	1 075	8	(243)	239
5	Inkomati	1 073	0	1 088	148	(163)	114
6	Usutu to Mhlathuze	1 011	32	700	114	229	110
7	Thukela	742	0	347	497	(102)	598
8	Upper Vaal	1 818	1 743	1 440	2 042	79	50
9	Middle Vaal	205	775	400	580	0	0
10	Lower Vaal	48	648	645	0	51	0
11	Mvoti to Umzimkulu	555	34	1 012	0	(423)	1 018
12	Mzimvubu to Keiskamma	872	0	413	0	459	1500
13	Upper Orange	4 799	2	1 022	3 496	283	900
14	Lower Orange	(1 001)	1 931	883	54	(7)	150
15	Fish to Tsitsikamma	452	595	979	0	68	85
16	Gouritz	278	0	353	1	(76)	110
17	Olifants/Doring	335	3	371	0	(33)	185
18	Breede	869	1	639	203	28	197
19	Berg	506	203	829	0	(120)	210
Total for Country		**14 681**	**0**	**14 486**	**124**	**68**	**5 576**

Note: In the table, deficits have been shaded and transfers boxed. This does not include flows from WMAs on one reach of a river to another, as in the Vaal and Orange Rivers, although these are accounted for as transfers in the local water balance.

However, while such infrastructural development may be technically feasible, it is not necessarily economically justifiable, affordable, or environmentally or socially desirable. Dams and water transport infrastructure are expensive. In most cases, the cheaper schemes have already been developed and the marginal cost of the next scheme can be as much as ten times that of the previous one. For example, while the current tariff to pay for the Lesotho Highlands Water Scheme is less than R2/m³, that of the Olifants augmentation at De Hoop is estimated at over R10/m³. To pay for increased supplies, users must be able to fund the capital and operating costs of new developments, or make a convincing case for public investment.

3.3.2 Demand management

Once the cheaper supply options have been developed, the alternative approach to reconciliation, namely management of demand, becomes increasingly attractive. In each of the main user sectors, a range of options is available for controlling demand.

Household level: Effective measures at the household level include tariff increases that discourage consumption (but these can affect poorer households disproportionately); changes in settlement patterns, such as smaller plot sizes; and leakage control in the extensive municipal distribution networks that serve households. The latter approach can be particularly effective in large networks. Many more demand management activities can be undertaken, ranging from maintenance of household water fittings to regulating the water use efficiency of domestic appliances, such as washing machines.

Industrial level: Water consumption at the industrial level is often sensitive to controls on the disposal of wastewater. To achieve these targets, consumption has to be reduced. The availability of water and reliability of supply, rather than prices, are usually the main drivers for existing industry. For large new industries, however, the policy that the industry should cover the full costs of making water available has helped decision makers to focus on water efficiency options and alternative locations where water constraints are less pronounced. It has also resulted in many cooperative arrangements where industries treat and reuse municipal wastewater in their processes.

Agriculture: In agriculture, which is still the largest water user, there is often scope for considerable improvements in the efficiency of water use. So, for instance, the technologies for improving irrigation efficiency are well known. However, while the cost of water may be an incentive to greater efficiency, it may not be enough to compensate for the high cost of adopting new practices. Where agricultural markets are favourable, scarcity could be even more effective as an incentive, as improved efficiency in water use would make more water available for production and give a greater return on investment.

Trading of water allocations: This mechanism is often suggested to promote greater water use efficiency through pricing. This can be done within a single sector and region (e.g. among farmers in the same area), between sectors, and/or between areas that are subject to physical constraints.

While trading within a particular sector in a region is relatively common, intra-sectoral and intra-regional trading is regulated in order to manage externalities that would result if a sector or region were to lose an important factor of production.

On the basis of developing new supplies of water through a programme of infrastructure investments, together with the application of management measures, the NWRS concluded that the demands projected for 2025 could be met. As shown in Table 2 above, only three catchments remain in deficit, with a further two being dependent on the transfer of volumes in excess of their local yields.

3.4 Water for growth and development? Productivity and equity

The information presented thus far suggests that there is no immediate intractable water crisis facing South Africa, although this is clearly based on the assumption that the existing system will be managed effectively. It cannot, however, be said that the country's broad social and economic objectives, or even the more specific objective of water security, are being fully met. The Minister of Water Affairs and Forestry has therefore initiated a programme for promoting the WfGD Framework. The need for such a framework can be seen across the dimensions of social equity, livelihoods and productivity.

3.4.1 Water and social equity: Sharing benefits, not water

Given South Africa's legacy of racial and gender discrimination, equity is a strong driver in policy on natural resources. From the start, the approach taken in the country's water policy is that water resources should be managed "in a sustainable and equitable manner, for the benefit of all persons" (DWAF, 1998: Section 3). The various factors to be taken into account to ensure this include the following (DWAF, 1998: Section 2):

- Meeting the basic human needs of present and future generations
- Promoting equitable access to water
- Redressing the results of past racial and gender discrimination
- Promoting the efficient, sustainable and beneficial use of water in the public interest
- Facilitating social and economic development
- Providing for the growing demand for water for use

These factors recognise that a balance has to be struck between direct equity in the allocation between different groups on the one hand, and the broader benefits on the other hand. These benefits will flow when water is used efficiently and beneficially, and facilitates social and economic development.

The principle that the focus should be on the benefits from water use rather than on the distribution of water itself, has been replicated at the regional level in the revised Protocol on Shared Watercourses of the Southern African Development Community (SADC). Article 3, dealing with the general principles of this protocol, states the following:

> **"For the purposes of this Protocol the following general principles shall apply:** 7(a) Watercourse States shall in their respective territories utilise a shared watercourse in an equitable and reasonable manner. In particular, a shared watercourse shall be used and developed by Watercourse States with a view to attain optimal and sustainable utilisation thereof and benefits therefrom, taking into account the interests of the Watercourse States concerned, consistent with adequate protection of the watercourse for the benefit of current and future generations" (emphasis added) (SADC, 2000).

3.4.2 Water and livelihoods

It is not always possible for direct beneficiaries from disadvantaged communities to avail themselves of opportunities for water allocation. It then becomes even more important to ensure that the available water is used to generate sustainable livelihoods in an equitable manner.

Research undertaken by the International Water Management Institute (IWMI) highlights different approaches to evaluating equity (see the box below). It shows that where there is extreme inequality in direct access to water (a Gini coefficient of 0.96), the situation is less severe when the distribution of livelihood benefits is considered (a Gini coefficient of 0.64). The coefficient could be improved further if water were to be made available for smallholder farmers.

This suggests that, in the absence of opportunities for direct "redistribution", one should ensure that water is used productively and efficiently to improve as many livelihoods as possible. Such an approach may still go a long way in ensuring that the objectives of water management are achieved.

A more controversial view is that, even if opportunities for direct redistribution exist, and if poverty reduction, job creation and improved livelihoods are the prime objectives of water management policy, equitable direct access to water should be a secondary consideration. Put simply, this would mean that water is allocated to activities that would generate the maximum number of jobs and income for local people, rather than allocated to disadvantaged users who cannot use the resource as productively.

This approach would not rule out the use of small volumes of water for household gardens or businesses, which are usually allowed under the general authorisation or Schedule 1 provisions of the legislation. Nor does it mean that agriculture should always be expected to sacrifice its share of water. While it is a large water user, agriculture can be relatively labour intensive and an important source of employment and livelihoods.

Measuring inequality in access to, and benefits from, water: "From the 2001 census, it was apparent that there are a total of 54 273 people employed in agriculture in the Olifants WMA and 33 345 employed in mining. As a result, the registered water use by these two sectors (1276 Mm^3/a) is now taken as being representative of the benefit of water use to 87 618 households in terms of direct employment, in addition to the 1672 registered users. This benefit will not be shared equally between all households, both because incomes and benefits vary greatly within one sector and water sectors have different levels of efficiency in terms of the number and type of employment created per cubic meter of water used. Information on the relative efficiencies of different water users is, however, very difficult to obtain. Therefore, for the purpose of this example, it has been assumed that all industries have equal levels of efficiency and as such the total amount of water authorised to these industries is shared evenly between all the people employed in these two sectors."

"The number of households that are dependent on the estimated rural water use for subsistence purposes (74 Mm^3/a) is now equal to the total number of rural households, less the number of people employed in agriculture and mining, i.e. approximately 200 710 households. These assumptions enable us to make a rough plot of the distribution of the benefits of water use in terms of employment in the WMA. The water use Gini coefficient for the beneficial use of water in the rural areas is equal to 0.64, as opposed to 0.96 if only the direct water use is considered."

Reallocating 3% of the basin's water would enable disused smallholder irrigation schemes to be resuscitated. It would also improve employment, if this reallocation did not affect jobs with existing producers:

"By making this water available to the households on the reactivated irrigation schemes, one would then increase the number of households that benefit directly from the water use by some 2480 (i.e. one household per farm)."

A more radical reallocation of 6% of existing irrigation water to the currently unemployed rural residents, for irrigating a micro-garden of 0.1 ha, would potentially create subsistence livelihoods for over 200 000 households, if suitable land and infrastructure were available:

"Again, this assumes that there is no reduction in the employment by these large users. The potential impact on the distribution of direct water use and the benefits of water use in the rural areas are shown. The water use Gini coefficient improves from 0.94 to 0.90 for direct rural water use and from 0.65 to 0.58 for the benefits of water use with regard to direct employment" (Cullis & Van Koppen, 2007).

3.4.3 Water productivity and water use efficiency

Given the importance of water as a critical factor in providing livelihoods, together with its limited availability, the productivity of water use takes on added weight. There are a number of high-level measures of water use productivity that can be applied at a national or sectoral level.

The first is "value of production per unit water". If this were to be adopted as an objective, priority in water allocation would be given to those activities of which the production value is relatively high.

The economic added value of water in urban areas is very high, reflecting the fact that very little water is used to support commercial activity and services. This is demonstrated in the Crocodile West and Upper Vaal WMAs, which account for only 8% of overall water availability, but 43% of the GDP (DWAF, 2004).

Mining and heavy industry consume more water, but also generate very high economic value. With industrial usage, one way to measure efficiency at plant level is to establish best-practice benchmarks of water consumption per unit production and to allocate water accordingly.

Viewed against this criterion, agriculture is almost always less productive. It would therefore be logical, in economic terms, to allow ongoing transfers of water from agriculture to industrial and urban users. This places a high premium on improving the efficiency of agricultural use. However, since returns on water use in agriculture are relatively low, it is often difficult to finance efficiency improvements, except in the case of high-value crops.

One area in which rapid efficiency gains in water use can often be achieved is in municipal distribution networks. Unaccounted-for water (i.e. water that is put into networks and not billed to users or otherwise accounted for) is as high as 40% in many municipalities. While some of the unaccounted-for water is actually an informal welfare transfer (in that it is taken by poor users from unmeasured outlets), a great deal is caused by leakage from distribution systems. If such leakage can be curtailed, input costs can be substantially reduced. This has been done on a large scale in Khayelitsha and Emfuleni. The value of water thus saved covered the cost of leakage control within a few years, offered a high rate of return and also significantly contributed to the municipalities' financial viability.

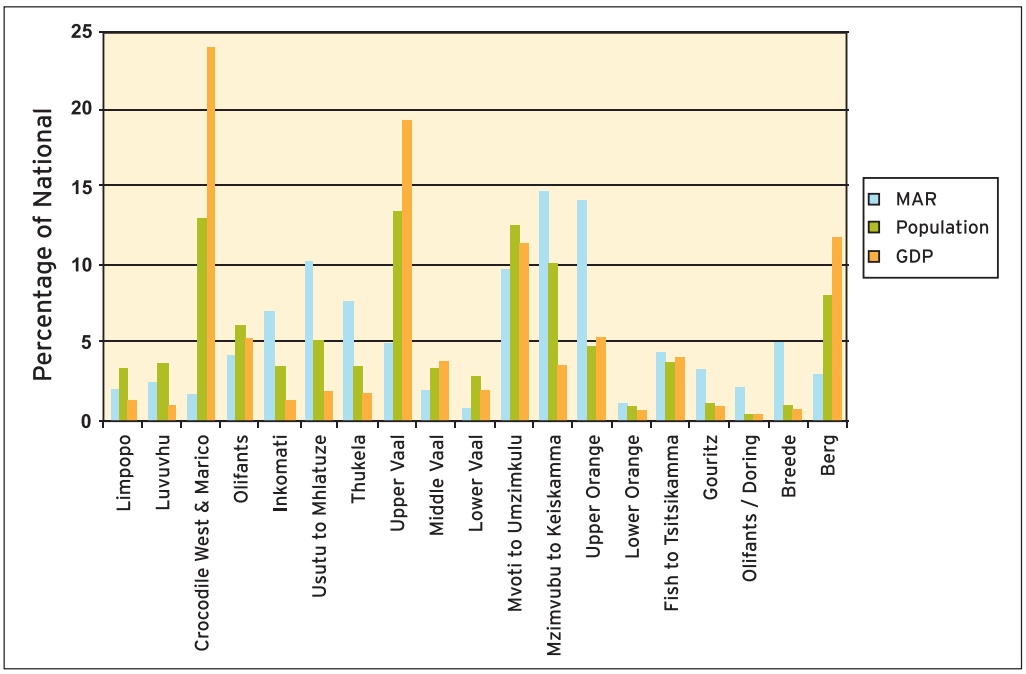


Figure 4: Comparison of the mean annual runoff (MAR), population and economic activity (GDP) per water management area

3.4.4 Water quality – another element of growth and development

Given its impact on water security, water quality has to be considered in the context of water for growth and development.

A pertinent issue is the set of challenges arising from wastewater management at local government level. While domestic water supplies have been expanded and reach more than 90% of the population, the provision of sanitation services is lagging. Approximately 13.4 million people, mainly in rural areas, are still without adequate sanitation (DWAF, 2008).

Sanitation services for urban residents have a negative impact on water resources unless properly managed. According to the DWAF (2008), this is not happening:

> "The first results from the local government self-assessment survey with regard to wastewater quality indicated that 57% of WSAs [water services authorities] do not have the appropriate licences for wastewater works, while 34% of WSAs have indicated that they have the appropriate licences and the remaining 9% indicated that they do not manage the works. Of the 34% of WSAs who have licences 75% indicated that they do adhere to the licence conditions. 36% of WSAs stated that their wastewater works operate over their design capacity, with the majority of these WSAs being in the Eastern Cape, Free State and Limpopo provinces respectively. Of concern also is that only 46% of WSAs reported that they monitor the volume of discharge at all their wastewater works, while only 58% stated that they monitored final wastewater effluent at least on a monthly basis" (DWAF, 2008).

Problems have also emerged following the government's intervention to replace the so-called bucket system in urban townships. This was poorly conceived, in that inadequate funding was initially provided for treating the additional wastewater generated by the new sanitation systems. In some cases, no bulk water supply was provided either. Although this mitigated the pressure on the water resources, it resulted in non-functional systems.

This process also confirmed, albeit informally, the need for a new standard for, and priority given to, urban sanitation. Previously, urban sanitation had been funded only up to ventilated improved pit (VIP) "dry toilet" standard, with the result that substantial increases in sewage flows can be expected. It is unclear, however, whether adequate financial provision has been made for the construction and operation of these facilities. In addition, there is as yet no approved policy on free basic sanitation. When such policy is finally produced, adequate financial provision must be made to ensure that the quality of water resources is not further compromised.

As regards rural areas, there will be less pressure on water resources from rural sanitation development, which is likely to continue to use on-site systems with a limited impact. However, local pollution of streams and groundwater sources may impose costs and constraints on domestic water users, as well as impacting on their health.

Manufacturing and mining industries have significant impacts on water quality. As pollution control and wastewater management can impose considerable costs on individual factories and mines, a firm regulatory approach and oversight are vital for protecting the interests of other water resource users. Best-practice benchmarking approaches have proved to be a valuable tool in establishing appropriate discharge standards, although this is of little help in the case of old mines that were closed before regulatory controls were introduced.

A key issue in this regard is to identify the most cost-effective options for improving the water quality of a given water resource. The NWA establishes the foundation for a more systematic approach, which sets "receiving water quality objectives" for each stretch of a river or stream. It then establishes a charging system to provide economic incentives for industries to clean up their pollution and, in addition, to provide funding for other water quality improvements. This, however, is a complex exercise and it is uncertain whether the DWAF currently has the capacity to introduce the system. It is also unclear what the impact of the waste discharge charging system would be on municipal finances and tariff arrangements.

4. Current responses

4.1 History – the hydrological transition confirmed

The picture presented in the previous section reinforces the conclusion that South Africa's water challenges are less about the availability of water and more about the extent to which society and its economies are adequately and equitably adapted to the country's water resource endowments. The situation in South Africa is typical of that in many other countries. It reflects the growing global understanding that water challenges are about building the capacity of communities and countries to take and implement appropriate decisions about their water resources.

Managing complex water resources would therefore already be a challenge in a society that is relatively stable from a social and economic point of view. South Africa, however, is a society in rapid change. The physical distribution of its people, their social structure and the economies in which they engage are all evolving rapidly. In addition, the nature of the resource may itself be changing in response to the dynamics of a globally changing climate. In these circumstances, the challenge of adapting or aligning the nation to its water resource endowments will be greater than in a less dynamic environment.

The steps being taken to address the country's water resource challenges are described in this section. In considering these, it is important to recognise that this task is not starting from scratch. Given its

limited water resources and the constraints that these have placed on its development alternatives, South Africa has a long history of innovation and investigation in WRM, albeit skewed to the benefit of a minority of the population.

The 20th century saw an extensive programme of infrastructural development in South Africa, as well as important soft management initiatives. Many of these had been identified by the Commission of Enquiry into Water Matters in 1970, but were only implemented by the new democratic government. Since 1994, there have been particular efforts to address the additional challenges that the transition to democracy has brought to bear. The present study should therefore be seen as a review of a programme of work in progress.

Importantly, during this period, South Africa crossed the "hydrological transition" (as shown in Figure 2) and moved from a focus on water resource development for expanding supply, to one of water resource management. The current objective is to enable citizens to live within their water means.

4.2 Post-1994 perspectives

The transition was confirmed by post-1994 policy initiatives. These fundamentally changed the focus on infrastructural development to a more balanced approach, with equal emphasis on measures for "soft" WRM. The shift was accompanied by an explicit emphasis on managing water to derive optimum benefit from its use. This approach has guided government programmes since 1994, and has been repeated as a core theme in Minister Lindiwe Hendricks' WfGD Framework:

> "This strategy discussion document sets out some of the challenges facing government and the water sector in ensuring that water is used optimally in support of sustainable and pro-poor growth and development" (DWAF, 2009: Section 4.6).

Given the complexity of, and regional variations in water endowments, the task remains to translate these intentions into reality.

4.3 Current institutional approaches

The NWA provided an institutional blueprint for the future management of water resources. It was, however, "enabling" legislation in that, for many innovations, no timeframe was set for their implementation. This was done deliberately in order to allow political heads and senior managers to determine their own priorities and implementation programmes.

The first NWRS in 2004 was a step in this direction, establishing a comprehensive agenda for action. In addition to a full list of infrastructure investments, the agenda covered a range of management and institutional activities, including:

- Compulsory licensing
- Establishment of catchment management agencies (CMAs)
- Delegation of operational responsibility for physical infrastructure and transfer of the ownership of infrastructure to water management institutions
- Establishment of new water user associations (WUAs)
- Expansion of existing monitoring networks and information systems, and the establishment of new ones

Three more operational tasks were identified:

- Introduction of revenue collection in terms of a WRM charge
- Completion of the transformation of irrigation boards into WUAs
- Streamlining of the process for individual licence applications so as to reduce delays

In 2005, Cabinet agreed that a National Water Resource Infrastructure Agency (NWRIA) should be established, merging the Trans-Caledon Tunnel Authority (TCTA) with the DWAF's branch for water resources infrastructure. In 2006, it was announced that a waste discharge charging system would be introduced.

4.4 Opportunities for development and redress

Section 2.5.3 of the NWRS identified a range of development opportunities. These pertained to areas where water resources were available to promote economic activity that would create opportunities for historically disadvantaged individuals and communities. Proposed measures included the following:

- Possible expansion of irrigation in the Upper and Lower Orange and Fish to Tsitsikamma WMAs, utilising water from the Upper Orange WMA.
- Utilisation of surplus water available from the Pongolapoort Dam in the Usutu to Mhlathuze WMA.
- Refurbishment of currently underproductive irrigation schemes and exploiting the potential for additional development in the Mzimvubu to Keiskamma WMA.
- Possible forestry development in some catchments in the Usutu to Mhlathuze, Thukela, Mvoti to Umzimkulu, and Mzimvubu to Keiskamma WMAs.
- Expansion of irrigation in the northeastern part of the Limpopo province from the Nandoni Dam in the Luvuvhu River.

These measures were in addition to a range of opportunities created by the process the NWA established for individual water licences. This process requires that:

"[...] a responsible authority must take into account all relevant factors, including –

- existing lawful water uses
- the need to redress the results of past racial and gender discrimination
- efficient and beneficial use of water in the public interest
- the socio-economic impact

of the water use or uses if authorised; or of the failure to authorise the water use or uses ..." (DWAF, 2009: Section 27.1).

This regulation enabled the DWAF to promote enhanced access for previously excluded communities when new applications for using water were considered. This was attempted in a number of locations, notably in the expansion of the irrigated areas of the Blyde River (Limpopo), Impala (KwaZulu-Natal) and Koekedouw (Western Cape) WUAs.

4.5 Slow progress as challenges mount

The agenda set out in the NWRS has proved to be demanding. Although good progress has been made on some of the more operational items, such as the implementation of the WRM charge, there have been substantial slippages in many of the programmes originally presented. Notably, these include the establishment of the NWRIA and CMAs, the transformation of irrigation boards, the compulsory licensing process, and the streamlining of the process for obtaining individual licences.

Many of these slippages relate to the capacity of the DWAF, although there is also a question of administrative will. Some stakeholders at the recent Parliamentary consultation (see Section 4.7 below) noted that, at times, it appeared that DWAF officials were considering whether or not they actually wanted to implement the legislation. Other slippages were the result of problems with institutional partners, notably in local government, but also with the land and agricultural departments.

Delays in some areas have compounded problems in other areas. For example, failure to complete compulsory licensing processes has contributed to the backlog in licence approvals since, in heavily used catchments, it may not be possible to authorise new use without reviewing all existing uses. This has also contributed to failure to implement the reserves in overallocated catchments.

Similarly, delay in establishing the NWRIA (with the draft legislation being rejected by Parliament due to insufficient consultation) has contributed to delays in implementing water supply augmentation projects in the Ethekwini area. The delay may also affect the longer-term ability of the sector to fund and manage major national infrastructure.

One consequence has been that opportunities already identified for direct redress and for promoting equity have not been realised. In the three pilot WUAs mentioned above, approximately 2000 hectares of high-potential irrigated land, with full water supply infrastructure, could have been made available to previously disadvantaged farmers. In reality, however, only a small proportion of land was successfully transferred. This was due to administrative and financial problems related primarily to the land and agriculture functions.

A project covering 10 000 hectares of irrigable land along the Orange River also failed to progress for similar reasons, although other elements of water policy reform facilitated a substantial expansion of commercial agriculture in the area.

4.6 Water for sustainable growth and development

A recent development has been the launch of the WfGD Framework by the Minister of Water Affairs and Forestry. The framework sets out some of the challenges faced by the government and the water sector in ensuring that water is used optimally in support of sustainable and pro-poor growth and development. It generally confirms the objectives and focus of the White Paper on a National Water Policy for South Africa (DWAF, 1997), the NWA and the NWRS. However, it is not yet clear how much progress has been made in putting in place practical programmes of action to address these challenges.

The WfGD strategy highlights not only the need to look for new opportunities to provide water, dams, inter-basin transfers and desalination plants, particularly as climate change intensifies, but also the challenge of maintaining existing current infrastructure in good working order.

4.7 Parliamentary review of the 2004-09 term

In January, the Parliamentary Portfolio Committee on Water and Forestry held a one-day Legacy Hearing. This sought to identify achievements and failures, as well as outstanding challenges in the two sectors for which it has the responsibility to guide incumbents in the next Parliament.

The session was attended by a variety of stakeholders, ranging from water boards and the Water Research Commission (WRC), to representatives of civil society (South African Water Caucus, SAWC), organised labour (South African Municipal Workers' Union, SAMWU) and environmental groups (Wildlife and Environment Society of South Africa, WESSA). Among the key issues raised were the following:

- Water quality challenges
- Lack of equity in new water allocations
- The challenge of municipal debt to water boards
- Uncertainty about the role of water boards in the municipal domain

One organisation also suggested that the DWAF administration appeared to resist the implementation of policies, particularly those which required the transfer of functions and funds to other agencies.

For their part, members of the SAWC raised concerns about the use of prepaid meter technology to enforce credit control in poor communities. Although it was recognised that this concern clashed with the need for water conservation and demand management, there was a call for greater equity in the access to water. There was, however, general agreement that the challenges of water quality affected all strata of society.

4.8 Future approaches

The background presented in the preceding sections raises the question as to what the immediate priorities are in the South African water resources sector. Responses to this question usually fall into either of three interlinked categories:

- Institutional development and capacity building
- Planning
- Capital investment

The water resources sector is complex, given its limited management capacity, the development of which is, in itself, an overarching priority. In all three categories, therefore, the most important objectives would be to identify, prioritise and sequence interventions that could most effectively address immediate challenges, while laying a foundation for effective longer-term management of the resource.

A theoretical sequence might start with planning and institutional development, yet there are substantial, pressing problems on the ground that must be addressed at an early stage. It is therefore prudent to draft an immediate programme of investment that would be coupled with and inform planning and institutional development, in the following respects:

- From a water resource perspective, better planning of investment in, and operation of, services at either municipal or regional utility level is needed. This is essential for providing timeous estimates of future demands for water, so as to guide water resource planning and investment, as well as identifying hotspots for investment in wastewater interventions. Planning should address ongoing operational activities, as investment without consideration of operational implications will lead to suboptimal expenditure.
- Water resource planning and development planning need to be better integrated at all levels. This will ensure that water will support development in other sectors; that interventions for water resource development reflect broader development priorities; and that development opportunities offered by water resources are taken up.
- The capacity of local governments needs to be improved so that they can ensure efficiency in water supply and use, and prevent extensive water pollution. In this context, an institutional option that needs to be investigated is the extent of decentralisation and possible regional approaches to water supply and sanitation. (The precedent of regional electricity distributors in electricity is obvious, although not encouraging.) A successful review might imply that constitutional reform is needed for a regional option to be successful. The alternative is to consider interventions that would enable local governments to operate more effectively.This option would also apply to improving the quality and reliability of drinking water supply.
- Given the extent of investments identified in water supply and wastewater treatment, it remains important to support the implementation of effective institutional arrangements for developing and managing water resources infrastructure. The NWRIA proposal is currently in limbo, in

large part due to inadequate consultation. The delay has already seen some key capital projects (e.g. Durban augmentation) slip into a risk zone, and the opportunity for using this framework to address mining pollution is also being missed.

- The prioritisation and phasing in of specific water management programmes, which are being considered by the DWAF, need to be supported. These include getting the CMAs working; setting tariffs for wastewater discharges; enforcing compulsory licensing and water allocation reform; establishing a national water resource utility; and drawing up a firm implementation programme for capital works, among other things.
- A coherent programme for rural development is needed, in which water resource opportunities can be taken up in support of the government's social and economic objectives. This intervention, which is given added impetus by the ruling party's election manifesto, would require effective coordination between the water, land and agriculture sectors. It would also involve identifying appropriate interventions to provide a supportive policy framework – for areas ranging from marketing to land tenure, as well as areas of specific opportunity.

Many of these issues are addressed in more detail in background papers that were prepared as part of the process culminating in the completion of this study.

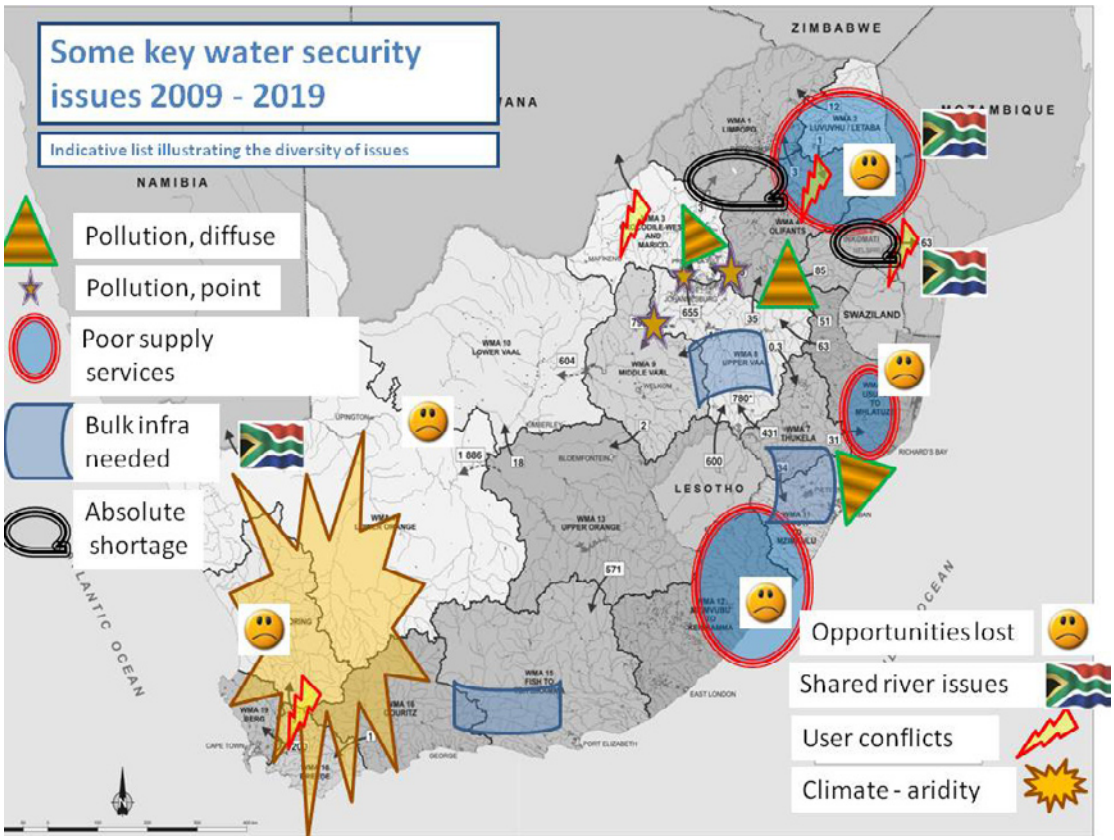
5. Conclusion

This study shows that there is no reason why South Africa should experience a water crisis soon. While the country faces many challenges as a result of the limited and variable nature of its water resources (Figure 5), these challenges need not constrain sustainable growth and development, with the proviso that water management is sound.

These challenges should, however, be addressed as a matter of urgency. In parts of the country, development choices are already being determined by water resource constraints. In many others, poor management of municipal infrastructure and other sources of pollution are causing a worrying decline in water quality. There is also growing competition for, and potential conflict over, South Africa's limited water resources, both within the country and with its neighbours.

One characteristic of the water sector is that the challenges are very different in different parts of the country, and therefore cannot be addressed through simple, generic prescriptions. They require dedicated, ongoing action, informed and supported by the best possible science and engineering, and working with effective local and regional institutions.

Immediate action should include supporting the broader dialogue on water, its use and management. Working together, South Africans can make water a leading sector, using water management's language of cooperation and shared benefits to help the country to reach its development goals.



Diffuse Pollution	Point Pollution	Poor supply services	Bulk infra needed	Absolute shortage	User conflicts	Climate change - aridity	Shared river issues	Dev opps lost
Upper Vaal	Vaal & other municipalities	Limpopo, Mpum.	Lesotho Ph. 2 for Gauteng	Olifants/ Limpopo	Olifants/ Limpopo	W.Cape	Komati	Irrigation: Upper Orange, Blyde, Makatini
Crocodile West	Highveld mines	E Cape (Transkei)	Ethekwini augmentation	Komati	Crocodile West		Olifants/Limpopo	Umzimvubu hydro
Mgeni CMA		KZN (esp northern)	PE and CT next augmentations		W.Cape		Lower Orange	W.Cape Clanwilliam Dam

Figure 5: Some key water security issues, 2009–19

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List of tables and figures

List of acronyms and abbreviations

CMA	catchment management agency
DBSA	Development Bank of Southern Africa
DRC	Democratic Republic of Congo
DWAF	Department of Water Affairs and Forestry
GDP	gross domestic product
IWMI	International Water Management Institute
IWRM	integrated water resources management
m³	cubic metre
MAR	mean annual runoff
NWA	National Water Act
NWRIA	National Water Resource Infrastructure Agency
NWRS	National Water Resource Strategy
PEP	Poverty Environment Partnership
PLAAS	Institute for Poverty, Land and Agrarian Studies
SADC	Southern African Development Community
SAMWU	South African Municipal Workers' Union
SAWC	South African Water Caucus
SEI	Stockholm Environment Institute
TARWR	total actual renewable water resources
TCTA	Trans-Caledon Tunnel Authority
UNCSD	United Nations Commission on Sustainable Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VIP	ventilated improved pit

WESSA	Wildlife and Environment Society of South Africa
WfGD	Water for Growth and Development
WMA	water management area
WRC	Water Research Commission
WRM	water resources management
WSA	water services authority
WSSD	World Summit on Sustainable Development
WUA	water user association
WWAP	World Water Assessment Programme

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Municipal compliance with water services policy: A challenge for water security	Paper prepared by: Laila Smith (Mvula Trust). With acknowledgements to Kathy Eales and David Savage for the valuable comments they provided
Reality check on water resources management: Are we doing the right things in the best possible way?	Paper prepared by: Barbara Schreiner, Guy Pegram and Constantin von der Heyden (Practice Directors, Pegasys Strategy and Development)
Water quality: A vital dimension of water security	Paper prepared by: Marlene van der Merwe-Botha (The Water Group)
Water resources management, rural redress and agrarian reform	Paper prepared jointly by: The International Water Management Institute (IWMI) and the Institute for Poverty, Land and Agrarian Studies (PLAAS), with contributions by Barbara van Koppen and Hilmy Sally (IWMI) and Michael Aliber, Ben Cousins and Barbara Tapela (PLAAS)
Challenges for human capital development and technological innovations in the South African water sector	Paper prepared by: Eiman Karar (Water Research Commission) and Kevin Pietersen (Water Geosciences Consulting)