Irrigation Strategy for South Africa
IRRIGATION STRATEGY FOR
SOUTH AFRICA

MARCH 2015
FOREWORD

The Irrigation Strategy for South Africa is informed by the National Development Plan and the National Water Resources Strategy 2. This strategy will provide direction on realising the outcomes and activities as outlined in Outcome 7 (Comprehensive Rural Development and Land Reform) of Medium Term Strategic Framework by contributing towards food security whilst protecting and enhancing our environmental assets and natural resources.

Creating economic opportunities in the rural areas in the face of the overwhelming migration to the urban areas has been a major challenge for government. The Agriculture, Forestry and Fisheries sectors have been identified as some of the main drivers for economic growth with potential for creating jobs and contributing towards rural development. Irrigation can play a significant role because, by its very nature, it is concentrated in the rural areas. This is particularly applicable in the revitalization of existing irrigation schemes and in the development of new irrigation schemes.

The successful implementation of this Strategy will bring about great benefits through coordinated effort in expansion and revitalization of irrigated agriculture, targeted funding towards irrigation initiatives, alignment of objectives and goals to achieve national targets thereby resulting with an increased food production, improved water use efficiency, proper maintenance of infrastructure and improved management of natural resources.

I hereby present it to guide the implementation of agricultural irrigation efforts.

Ms Edith V. Vries
DIRECTOR GENERAL: AGRICULTURE, FORESTRY AND FISHERIES
EXECUTIVE SUMMARY

The Irrigation Strategy identifies objectives, priorities, allocates responsibilities and ensures coordinated efforts and estimates realistic funding, as well as sets out the principles for initiatives which are being undertaken to revitalize and expand irrigation schemes in the country.

The Irrigation Strategy is a response to the call for the sector to increase its contribution to agricultural production thus ensuring food security, poverty alleviation and job creation. This document includes directives from recent policy changes and provides directions for institutional reform and guidelines on public investment in irrigation initiatives.

This Strategy aims to coordinate, align and avail all programmes that target support and development of irrigation farmers towards achieving optimum utilisation of resources for sustained food security and economic returns. The focus is on subsistence farmers so as to address the inequities resulting from past policies, but this has a number of important dimensions, which will be explored in this document.

Most importantly the Strategy recognises that the Department of Agriculture, Forestry and Fisheries’ (DAFFs) policy initiatives have been aimed at achieving the objectives of Outcome 4, Outcome 7 and Outcome 10 of the Medium Term Strategic Framework (MTSF) relating to job creation, food security and rural development. Furthermore the Strategy provides a link between policy and practical implementation in a structured way. It ensures coordination by inclusion of important areas such as Strategic Infrastructure Project (SIP) 3, 4, 5 and 11.

Irrigation has a potential to increase food production thus contributing to the Agricultural Policy Action Plan (APAP) which is guided by the 2030 Vision statement of the National Development Plan (NDP) and the New Growth Path (NGP). The plan is based on the model of the Industrial Policy Action Plan (IPAP) and seeks to translate the high-level responses offered in the Integrated Growth Development Plan (IGDP), into tangible, concrete steps.
ACKNOWLEDGEMENTS

The Department would like to acknowledge and thank all those who contributed to the Irrigation Strategy.

DAFF would like to thank Mr Felix Reinders for the use of the irrigation pictures.
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<td>Agricultural Production Action Plan</td>
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<td>ARC</td>
<td>Agricultural Research Council</td>
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<td>ARC-IAE</td>
<td>Agricultural Research Council - Institute for Agricultural Engineering</td>
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<td>BFAP</td>
<td>Bureau for Food and Agriculture Policy</td>
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<td>CASP</td>
<td>Comprehensive Agricultural Support Programme</td>
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<td>CEO</td>
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<td>Coordinating Committees on Agricultural Water</td>
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<td>Department of Agriculture, Forestry and Fisheries</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>EXCO</td>
<td>Executive Committee of the DAFF</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<td>FEW</td>
<td>Food, Energy and Water Nexus</td>
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<td>GCIS</td>
<td>Government Communication Information System</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>Greenhouse Gasses</td>
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<td>Gross National Product</td>
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<td>GSSA</td>
<td>Geological Society of South Africa</td>
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<td>HDIs</td>
<td>Historically Disadvantaged Individuals</td>
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<td>IGDP</td>
<td>Integrated Growth and Development Plan</td>
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<td>IPAP</td>
<td>Industrial Policy Action Plan</td>
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<td>MAFISA</td>
<td>Micro Agricultural Financial Institution of South Africa</td>
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<td>MAR</td>
<td>Mean Annual Rainfall</td>
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<td>MTSF</td>
<td>Medium Term Strategic Framework</td>
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<td>NDP</td>
<td>National Development Plan</td>
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<td>National Environmental Management Act</td>
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<td>Non-Governmental Organization</td>
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<td>New Growth Path</td>
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<td>Acronym</td>
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<td>NWA</td>
<td>National Water Act</td>
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<td>Provincial Departments of Agriculture</td>
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<td>PDALF</td>
<td>Preservation and Development of Agricultural Land Framework</td>
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<td>PICC</td>
<td>Presidential Infrastructure Coordinating Committee</td>
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<td>RESIS</td>
<td>Revitalization of Small-Scale Holder Irrigation Schemes</td>
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<td>RWH</td>
<td>Rain Water Harvesting</td>
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<td>SANCID</td>
<td>South African National Committee on Irrigation and Drainage</td>
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<td>SAPWAT</td>
<td>South African Procedure for Estimating Irrigation Water Requirements</td>
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<td>SIP</td>
<td>Strategic Infrastructure Projects</td>
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<td>SIS</td>
<td>Smallholder Irrigation Schemes</td>
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<td>WAR</td>
<td>Water Allocation Reform</td>
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<td>WARMS</td>
<td>Water Registration Management System</td>
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<td>WMA</td>
<td>Water Management Area</td>
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<td>WRC</td>
<td>Water Research Commission</td>
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<td>WUAs</td>
<td>Water Users Associations</td>
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<td>WUE</td>
<td>Water Use Efficiency</td>
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<td>WUIWG</td>
<td>Water Use and Irrigation Working Group</td>
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Chapter 1: INTRODUCTION

The Republic of South Africa covers an area of 122 081 150 ha in total of which approximately 14 million ha (13%) is cultivated land (BFAP, 2011). It is estimated that about 35% of the people in South Africa are directly or indirectly dependent on agriculture for employment and income (GCIS, 2011). The sector contributes about 2.6% to the GDP and 7% to formal employment. The agricultural sector is made up of commercial farmers, smallholder and subsistence farmers (DWA 2013, now DWS).

It is estimated that 1.6 million ha is under irrigation where about 50 000 ha is located in the previous homelands and is allocated to smallholder farmers.

According to the National Water Resources Strategy 2 (NWRS2), the agriculture sector uses about 60% of the water withdrawals.

The Irrigation Strategy will act as a link between policy and practical implementation of the policy in a structured way and will further outline the approaches and steps required to achieve the policy objectives. The strategy aims to prevent uncoordinated, fragmented development that would lead to inefficient and conflicting resource use.

The following focus points of the Irrigation Strategy will take into consideration the natural resource base and remain as thrusts that ensure that the objectives are achieved:

- Institutional arrangements;
- Irrigation research, training, extension and advisory services;
- Revitalization;
- New development; and
- Increased management and efficiency of water use.
1.1 Purpose and objectives of the Irrigation Strategy

The purpose and objectives of the Irrigation Strategy are to:

- Increase the contribution of irrigated agriculture to the Gross Domestic Product (GDP) (at least in absolute terms), poverty alleviation, employment creation and skills development.
- Increase equity of access by historically disadvantaged individuals (HDIs) to irrigated agriculture, especially commercial irrigated agriculture, without compromising irrigation water use efficiency in the process.
- Contribute to food security and improved socio-economic conditions at household and community level by means of small-scale irrigation projects.
- Optimize irrigation water use efficiency with a view to long-term sustainability of irrigated agriculture.
- Improve planning and investment co-ordination in the following:
  - Revising and refining revitalisation of irrigation schemes programmes;
  - Scaling-up scheme-based interventions to expand irrigation areas; and
  - Phasing in and expanding systemic interventions of water use efficiency and management.
- Increasing investment in skills and training of farmers, extension officers and irrigation specialists.
- Increase investment in relevant research.

During the drafting of a strategy, the methodologies for its practical implementation are implicitly considered. Detailed guidelines for these do not form part of a strategy, however, development of such guidelines is an essential.

In order to achieve its goals, a strategy must be realistic. Thus, two main aspects were considered during the drafting of the strategy, viz.

- The policies underpinning it and their objectives; and
- The properties, characteristics and qualities of the available resources, including natural resources, as well as economic, socio-economic and human resources.
The Irrigation Strategy seeks to support irrigation initiatives based on revitalisation of irrigation schemes, development of new irrigation schemes, as well as management and efficient use of water for irrigation purposes.

Figure 1 illustrates the main aim of the Irrigation Strategy underpinned by the core objectives of the agricultural sector. In order for the sector to achieve the objectives, the sector needs to put in place mechanisms that will act as thrusts that will drive the irrigation initiatives. All this needs to happen within the limitation of natural resources and further ensure water efficiency. The execution of the Strategy will operate within the confines of the current legal frameworks pertaining to water, land, environment and research.

Figure 1: Overview of the Irrigation Strategy
The Irrigation Strategy seeks to practise irrigation within the confines of limited suitable natural resources to unlock the potential of people as well as land. Opportunities to expand irrigation areas will be sought where possible, however it must be taken into consideration that South Africa is a water scarce country wherein additional opportunities to irrigate are not substantial. In terms of farmers, the Irrigation Strategy recognises the talent and knowledge of subsistence and smallholder irrigation farmers given more opportunity to express it through addressing the many constraints that hold small-scale irrigation farmers back. In terms of land, the irrigation strategy recognises the large amount of under-utilised irrigation land within the former homelands as a key resource, while also acknowledging that land reform should be contributing much more to creating opportunities for the smallholder irrigation sector than is presently the case.

South Africa has the natural and human resource potential to expand agricultural output and therefore create more employment opportunities. However, the expansion in production and thereby increased employment is not something that will happen without a favorable, committed and aligned social, political and economic environment. (BFAP, 2011)

The Irrigation Strategy will operate within policies and strategies which refer to agricultural water that are well developed in South Africa at National level. These include documents developed by DAFF, namely:

- The draft National Agriculture Development Strategy;
- The Integrated Growth and Development Plan for Agriculture, Forestry and Fisheries,
- The draft Irrigation Strategy for South Africa of January 2007;
- The Revitalization of Irrigation Schemes – Irrigation Infrastructure progress 2012/2013; and
- The draft strategy document entitled “National guidelines for integrated management of agricultural water use – an integrated approach to up-liftment and local economic development through the transformation of State support for agricultural water use”.

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Those developed by the Department of Water and Sanitation (DWS) include the following:

- The National Water Act, Act 36 of 1998;
- The Water for Growth and Development Framework; and
- The draft position paper for water allocation reform in South Africa: Towards a framework for water allocation planning etc., as well as other national strategic imperatives which will be discussed in the document.

The Irrigation Strategy acknowledges that meeting the ambitious targets of the expansion of irrigated areas and revitalisation of smallholder irrigation schemes, will require learning to do new things, as well as scaling up existing practices while making them more effective. The Irrigation Strategy thus consciously seeks to be reflective, that is, to learn through practice so as to improve as rapidly as possible. As such, this document is offered not as final and thus static description of the Irrigation Strategy, rather it is a living document which will adjust and improve over time as the irrigation develops.

1.2 Alignment with National Strategic Imperatives

New Growth Path

The NGP targets opportunities for 300 000 households in agricultural smallholder schemes, plus 145 000 jobs in agro-processing by 2020, while there is potential to upgrade conditions for 660 000 farm workers.

Strategic Infrastructure Projects

Government recently adopted a National Infrastructure Plan that is intended to transform the economic landscape of South Africa, create a significant number of new jobs, strengthen the delivery of basic services to the people of South Africa and support the integration of African economies. It sets out the challenges and enablers that South Africa need to respond to in the building and developing of infrastructure. It provides the background to Cabinet’s decision to establish a body to integrate and
coordinate the long term infrastructure build, namely the Presidential Infrastructure Coordinating Commission (PICC) with its supporting management structures. It reports on the PICC’s work to assess the infrastructure gaps through spatial mapping which analyses future population growth, projected economic growth and areas of the country which are not served with water, electricity, roads, sanitation and communication.

Based on this work, seventeen SIPs have been developed and approved to support economic development and address service delivery in the poorest provinces. The Irrigation Strategy will be linked to three of the SIPs, namely:

**SIP 3: South Eastern node & corridor development**
Promote rural development through construction of a new dam at the Umzimvubu River. Water is allocated from this dam for irrigation projects.

**SIP 4: Unlocking the economic opportunities in North West Province**
Facilitate development of agricultural activities and open up beneficiation opportunities in the North West Province, especially the Taung Irrigation Scheme.

**SIP 5: Saldanha-Northern Cape Development Corridor.**
The raising of the Clan William Dam wall located in this area will play an important role to supply water for the possible expansion of the irrigation.

**SIP 11: Agri-logistics and rural infrastructure**
Improve investment in agricultural and rural infrastructure that supports the expansion of production and employment, small-scale farming and rural development, including facilities for storage (silos, fresh-produce facilities, packing houses); transport links to main networks (rural roads, branch train-line, ports), fencing of farms, irrigation schemes to poor areas, improved R&D on rural issues (including expansion of agricultural colleges), processing facilities (abattoirs, dairy infrastructure), aquaculture incubation schemes and rural tourism infrastructure. The Makhathini, Taung and Ncora Irrigation Schemes are included in the investment in agricultural and rural infrastructure that supports the expansion of irrigation schemes.
National Development Plan Vision for 2030

The NDP identifies the need for the rural communities to participate fully in the economic, social and political life of the country. It includes that “the better integration of the rural areas can be achieved through successful land reform, job creation and poverty alleviation”. It mentions that there is evidence that 1.5 million ha is under irrigation and this area can be expanded by a further 500 000 ha through better use of existing water resources and development of new schemes.

The following NDP outcomes, objectives and actions are intricately linked with the availability of water resources for irrigation:

**Action 37**
Rural economies will be activated through improved infrastructure and service delivery, a review of land tenure, service to small and micro farmers, a review of the mining industry commitments to social investment, and tourism investments

**Action 38**
Substantially increase investment in irrigation infrastructure in the Makhathini Flats and Umzimvubu River Basin.

**Action 39**
Create tenure security for communal farmers, especially women, investigate different forms of financing and vesting of private property rights to land reform beneficiaries that does not hamper beneficiaries with a high debt burden.

Medium Term Strategic Framework

The Cabinet Lekgotla in January 2010 adopted 12 government outcomes which are the key indicators for the national government’s programme of action for the period 2010-2014. The following national government outcome is intricately linked with the availability of water resources for the agricultural sector:
Outcome 7: Vibrant, equitable and sustainable rural communities with food security for all

In the Strategic Plan for DAFF 2011/12 to 2014/15, the Department identified irrigation schemes which would be revitalized. These included the Vaalharts/Taung and the Makhathini Irrigation Schemes.

National Water Resource Strategy 2

The NWRS has indicated that additional water for an increase in irrigation would be very limited. A detailed study conducted by the Department in 2006 shows that about 80 000 ha can be developed based on the current available surface water resources.

The NWRS2 also makes provision for infrastructure development to support the implementation of this Strategy, sets targets for water use efficiency by the agriculture sector, and sets targets for water reallocation to historically disadvantaged water users.

Comprehensive Agriculture Support Programme (CASP) and Ilima/Letsema Programme

The CASP and Ilima/Letsema Programmes are funding mechanisms of the DAFF which support project initiatives in the provinces. Since the 2008/9 financial year, funding has been allocated from these programmes for the revitalization and expansion of irrigated areas. CASP has six pillars which include the following:

- on- & off-farm infrastructure;
- technical & advisory support;
- information & knowledge management;
- regulatory services;
- training & capacity building; and
- marketing & business development and finance which has since been branded MAFISA.
Agriculture Policy Action Plan

The APAP seeks to translate the high-level responses offered in the IGDP into tangible, concrete steps and it is based on the model of the IPAP. The Plan is planned over a five-year period and will be updated on an annual basis. Aligning itself with the NGP, the NDP and the IPAP, APAP seeks to assist in the achievement of Outcome 4: Decent Employment through Inclusive Growth, and that of Outcome 7: Comprehensive Rural Development and Food Security. Given the finite availability of water and suitable land, agriculture and forestry are under increasing pressure to increase output per unit of land.

1.3 Scope and benefits of irrigated agriculture in South Africa

It is estimated that approximately 1.6 million ha are presently under irrigation in South Africa (WARMS data, DWS). This amounts to about 1.5% of South Africa’s agricultural land (including both cultivated areas and rangeland), or 10% of the cultivated area (BFAP, 2011).

Irrigation is an important factor in the South African economy although this is often masked by the official Gross National Product (GNP) statistics. Agriculture, Forestry and Fisheries presently contributes about 2.6% of South Africa’s GDP, with irrigated agriculture contributing over 30% of the gross value of the country’s crop production (DoA, 2007). Over the last few decades irrigated agriculture in South Africa has undergone major changes in terms of switching from grain, fodder and similar crops to high value horticultural and industrial crops, coupled with drastic intensification of production. On some irrigation schemes the changes have been dramatic where production has decreased substantially or ceased in some cases, often in areas with limited other economic activities or potential.

Irrigation is essential for the South African fruit industry, which ranks amongst the most important export commodities, with about 90% of the country’s fruit and wine being produced under irrigation (Nieuwoudt et al, 2004). Vegetables are not as important export crops as the fruit and wine crops, but by producing 90% of the country’s vegetables, irrigation is essential for ensuring a healthy diet for the nation
and is making a very important contribution to national food security (DoA, 2007).

Wheat deserves special mention. It is one of the most important staple foods of the country. The country’s dry land wheat potential is very poor and South Africa has to import wheat every year. Although only 12% of the total area planted to wheat is under irrigation, irrigated wheat contributes 30% of the national production. Thus, increasing wheat production under irrigation could contribute significantly to improving national food security and reduce spending of foreign exchange on food importation (DoA, 2007).

At least of 35% of South Africa’s economically active population are directly or indirectly dependent on agriculture (Backeberg & Sanewe, 2006). South African agriculture is relatively labour intensive, especially irrigated sectors such as fruit and vegetable farming. Agriculture, and especially irrigated agriculture, creates more jobs per R1 million invested than the other sectors. Agriculture also creates more than twice the number of jobs (direct and indirect) per R1 million production as are created by mining and manufacturing. Although agriculture requires large amounts of water, the number of jobs created by 1 million m$^3$ of water in agriculture is of the same order of magnitude as that created in mining, with both being far lower than the number created in industry (Nieuwoudt et al, 2004).

Nearly 60% of the total value of agricultural production is used as raw materials in secondary industries, such as processing plants. The South African food processing industry contributes about 14% to the country’s GDP and contributes significantly to job creation in the industrial sector. Much of this comes from irrigated agriculture. Agriculture also creates strong demands for goods and services, such as various production inputs, machinery and implements, transport, financial services, etc. Thus, the impact of agriculture on other sectors in terms of the forward and backward linkages is considerable, with the impact of irrigated agriculture being relatively large (DoA, 2007).

Irrigated food plots on small-farmer irrigation schemes fulfill important roles in terms of household food security.
A major challenge to addressing rural poverty is how to create economic opportunities in the communal land tenure areas in the face of the overwhelming trend to urbanization. Here irrigation can play a significant role because by its very nature it is concentrated in the rural areas. This is particularly applicable in the case of some of the new irrigation developments, as well as the revitalization of the existing irrigation schemes that have been identified in the national strategic initiatives.

1.4 History of Irrigation in South Africa

The development of irrigation schemes is distinctly separated by the Water Research Commission (WRC) into that of the commercial sector and that of the smallholder irrigation schemes (SIS) that will be discussed in this section.

During the great depression in the 1930s, there was a tremendous loss of jobs and money, thus creating a problem where “Whites” migrated into towns in search of employment. In an effort to reverse this trend and to address poverty in this sector of the population, the then government of the day decided to establish a number of government irrigation economy schemes where White farmers could be settled. This era saw the establishment of the Vaalharts and the Loskop Irrigation Schemes which remains the two largest government irrigation schemes in the country (WRC 2008).

1.4.1 History of Irrigation Development – Commercial Sector

The WRC (2008) quotes the South African National Committee on Irrigation and Drainage (SANCID) (undated) that describes the three phases of irrigation development in the commercial sector. These include the following:

Phase 1 – Agriculture Phase

According to the WRC (2008) up until 1875, government did not provide any assistance to water resource development. Water abstraction occurred where natural circumstances permitted. This phase was characterized by a subsistence economy where markets were often a long distance away from where the agricultural
crops were grown. There was little incentive for capital investment.

**Phase 2 – Agricultural - Mining Phase**

The Cape Colony was the first to initiate a policy in 1877. This was undertaken to promote irrigation, using a strategy of collaboration between producers, combined with unsubsidized loans for individuals or co-operative weir diversion and flood irrigation. Initially the co-operative flood scheme development was slow, but quickly gained momentum after 1906 with the demand for ostrich feathers, together with the development of lucerne pastures that were grown under irrigation. On the onset of the drought between 1914 and 1916, more water conservative methods and practices were used in those areas.

**Phase 3 – Agriculture – Mining – Industrial Phase**

This phase was characterized by the development of public storage schemes which were due to the unreliable rains and the variable rain flows that necessitated the storage of water. During this phase the number of the existing population in the irrigation schemes were few and subsequently more settlers were brought in, in order to establish cooperative developments. The crops that were targeted in this phase included tobacco, cotton, citrus, etc. The financial strategy was also revised where loans were written off with partial subsidization of private and cooperative schemes, as well as the introduction of completely subsidized public schemes.

**1.4.2 History of Smallholder Irrigation Schemes**


**19th Century: Peasant and Mission Diversion Scheme Era**

This era was characterized by the development of river diversion technologies by private individuals or groups of individuals. A majority of these developments were rendered non-functional by the end of the 19th century.
1930 – 1960: The Smallholder Canal Scheme Era

The majority of these canals were constructed after the 2nd World War and the main objective of this development was to provide Black families in the “Bantustans” with a livelihood. By 1955, an estimated 122 small scale irrigation schemes were developed that covered 11 406 ha, which comprised of 7 538 plots ranging from 1.28 ha to 1.71 ha, that were comparatively small compared to the sizes of that developed for White irrigation schemes which ranged from 8 – 20 ha.


All homelands were characterized by poverty, low development and a largely rural resource base. The government of the day funded the development of additional irrigation schemes in these homelands. Sixty-four smallholder irrigation schemes were developed that covered 13 000 ha during this era and included the Keiskammahoek, Tyefu, Xonxa and Ncora irrigation schemes. The use of modern technology distinguished this era where pressurized overhead irrigation schemes were used. Parastatals were established to ensure the centralization and diversification of management.

However, problems soon arose that included social unrest, high maintenance costs, management problems (due to the centralized nature thereof) and resulted in the parastatals being withdrawn from the homeland. This, in turn, resulted in many of these schemes becoming unproductive as they could not be sustained.

1990 - The Irrigation Management Transfer and Revitalization Era

The development of smallholder irrigation schemes in this era was based on improving the lives among the previously disadvantaged populations in the rural areas and in the formal settlements. The focus was on poverty alleviation and food security at community level. Sixty-two schemes covering 2 400 ha were developed where the main irrigation technology included the use of mechanical pumps and sprinkler technology.
When a lot of these smallholder irrigation schemes collapsed due to various reasons, the new South African government undertook a programme to revitalize the smallholder irrigation schemes in the late 1990s. At this stage the smallholder irrigation schemes included those located in the former homelands and those that were located in commercial farming areas where White farmers were settled previously.

The Limpopo Province undertook to revitalize the smallholder irrigation schemes under firstly the Revitalization of Smallholder Irrigation Schemes (RESIS) Programme between 2001–2004 and subsequently the RESIS–Recharge Programme from 2005-2007. The RESIS Programme focused on infrastructure rehabilitation and ‘joint ventures’ as a means to rebuilding and ensuring the upliftment of communities in the irrigation schemes, through the stimulation of profitable agribusiness through a comprehensive programme that would include the training and capacity building of farmers to run their businesses profitably and sustainably. The RESIS–Recharge Programme focused on infrastructure development and strategic partnerships.

In the recent Eastern Cape Infrastructure-Centered Interventions, the familiar pattern of rehabilitation, degradation and the inability of scheme institutions to maintain recently funded repair initiatives, are discussed in Denison and Manona (2008). Another major issue is the fact that no substantive planning or soil suitability tests were undertaken and the concern is that the soils are completely unsuitable to some types of irrigation technology, e.g. center pivots.

**Lessons learnt**

Lessons learnt from recent government-led irrigation support initiatives have shown that:

- the main challenge of supporting small scale irrigation projects is due to the lack of involvement of the members of communities central to development from the onset,
- the dualistic nature of the agricultural sector,
- lack of institutional capacity of government,
• the lack of influence on policy by smallholder producers, and
• the problematic land reform planning processes amongst other things.

Some solutions will be discussed in the chapter which deals with the revitalization of irrigation schemes.

According to DAFF’s IGDP (DAFF, 2012), other challenges which have been identified include:

• the fact that smallholder producers’ production inefficiency is linked to the poor management skills with respect to natural resources, production and infrastructure; and
• added to poor management skills is the poor and uncoordinated support services directed to smallholder producers.

The Irrigation Strategy seeks to promote alignment and coordination of support services, including financial services, technical support and access to on- and off-farm infrastructure.
Chapter 2: NATURAL RESOURCE BASE FOR IRRIGATED AGRICULTURE IN SOUTH AFRICA

2.1 Rainfall and runoff

South Africa has low levels of rainfall relative to the world average. Its climate is characterized by low, unreliable and insufficient rainfall, high temperatures, low humidity and very high evapotranspiration. Rainfall is unevenly spread across the country’s catchments leaving most of the northern and western parts dry (Figure 2).

Average rainfall ranges from < 100 mm/a to over 1 500 mm/a, with an average of approximately 450 mm/a. Linking this low rainfall rate to the high level of aridity results in a mean annual runoff (MAR) of less than 10% - a very low percentage when compared to countries with similar average rainfall. Rainfall patterns and subsequent runoff, are highly seasonal (with short wet seasons and long dry seasons in many parts of the country) and variable from year to year.

Runoff is low, especially in areas where irrigation is needed most. The amount of water that reaches and flows through our rivers is estimated in the region of 49 040 million cubic meters per annum (Mean Annual Runoff – MAR in Mm$^3$/a). A portion of the MAR needs to remain in the rivers and estuaries to support ecological functioning of the catchments. The amount of water that can be abstracted at high assurance (the yield) from surface water resources are estimated at 10 240 Mm$^3$/a which is approximately 20% of the MAR. This inter- and intra-annual variability of the hydrological system complicates water resource management in South Africa.
2.2 Groundwater

Despite the groundwater’s relative small contribution to the total water supply in South Africa, it represents an important strategic water resource. Being stored underground where evaporation is minimized, it is a more reliable source than surface water in times of drought. According to the Ground Water Division of the Geological Society of South Africa (GSSA) the ground water contribution is about 13% to the total water requirement. Owing to the lack of perennial streams in the semi-desert to desert parts, two-thirds of South Africa’s surface area is largely dependent on groundwater. In these water-scares areas, groundwater is more valuable than gold. Although irrigation is the largest user of groundwater, groundwater still provides the water supply to more than 300 towns and smaller settlements in the country.
Due to the predominantly fragmented and scattered nature of groundwater occurrence in South Africa, it has presented considerable difficulties in quantifying its availability with any certainty. In 2010 the DWS published the Ground Water Strategy that represents for the first time the authoritative figures for the volumes of groundwater that can be sustainably extracted for use, not only for the country as a whole, but also for each of the 19 water management areas (WMA). The most recent scientific estimates place groundwater in South Africa in the same league, volumetrically, as our stored surface water resources: The total volume of available, renewable groundwater in South Africa is 10 343 million m$^3$/a or 7 500 million m$^3$/a under drought conditions. South Africa is currently using between 2000 and 4000 million m$^3$/a of this ground water. Therefore there is potential to considerably increase ground water supplies in the country.

The groundwater's resilience to drought has been known for years and often one of the first responses in times of serious drought is to drill boreholes. The advantages of groundwater are low evaporation as volumes are stored underground and less direct impact to climate change as compared to surface water since floods and droughts are quickly reflected in river water levels. Only after prolonged droughts will groundwater levels show declining trends.

Although the information on the extent of the use of groundwater for irrigation is scarce, the Groundwater Division of GSSA has reported that agricultural irrigation remains the largest user of groundwater compared to other sectors. In 2010, the DWS published the Ground Water Strategy that is designed to ensure that groundwater is recognized, utilized and protected as an integral part of South Africa’s water resource. This strategy further paves way to the development and implementation of better groundwater management programmes at water resource management levels, tailored to local quantity and quality requirements.
Since groundwater has been used for various purposes ranging from irrigation, livestock watering, mining, etc., the DWS profiled the use of groundwater per WMA - see illustration on Figure 3 above. The use of ground water for irrigation increases towards the western side of the country compared to the east.

2.3 Soils

The dominant soils of South Africa differ widely from those of the other world regions, like the fertile soils of the high latitude developed countries (North America and Europe) and the highly weathered, infertile soils of the humid tropics. Because South Africa’s rivers are small, and those with highest runoff flow through narrow deep gorges over short distances to the ocean, South Africa does not have any large alluvial plains with deep, fertile irrigable soils. South Africa’s soils predominantly
have poor quality (see Figure 3) and are inherently exceptionally vulnerable to various types of degradation, with low resilience (recovery potential). In irrigation agriculture these include extreme vulnerability to subsurface soil compaction (traffic pans and plough pans) under intensive cultivation and soil crusting (surface sealing) under overhead irrigation systems, in some cases including micro-irrigation systems such as drippers and micro-sprinklers (Laker 2006 & Van Zyl & Van Huyssteen 1998).

Figure 4: Land Capability in South Africa

Although it is generally considered that South Africa has very little areas left with irrigable soils that can be put under irrigation, there are a number of substantial areas with soils of relatively good irrigation potential close enough to rivers and at low enough elevation above them to make irrigation development on them a possibility.

Where water is limited, it is preferable to use only the criteria for Land Capability I and II (also see Annexure A - Land Capability Categories). In South Africa, large
areas of deep, well-drained soils that are very suitable for irrigation (Capability I and II) are found in the drier climatic regions which are characterized by higher irrigation demands. The majority of the soils in the wetter climatic regions, where the irrigation demand is lower, are prone to water logging during seasons with above average rainfall. It is the exception rather than the rule to find large areas of Capability I and II soils in the wetter climatic regions.

2.4 General strategies relating to resource surveys, land suitability and land use planning

Successful, efficient farming, especially intensive high input/high value irrigated farming is not possible without high quality land use planning based on correct land suitability evaluation and high quality detailed resource maps and information. High quality land suitability evaluation and land use planning is particularly important in a country like South Africa where water and good quality soils are scarce, soil patterns are complex and climatic conditions are not ideal. Land suitability evaluation and land use planning is not only required when new areas are to be put under irrigation, but each time changes to existing land use are considered. This would include each envisaged change in enterprise (e.g. type of crop, or even cultivar), irrigation system or general management practices. Unfortunately irrigated agriculture often fails because of inadequate resource information and/or poor land suitability evaluation and consequently poor land use planning (Laker, 2004 & Laker 2006). It is extremely important that all the necessary feasibility studies and resource information collection, especially detailed soil surveys must be completed before the final planning of the siting of dams, canals, etc. is done and definitely before construction is begun.

Land suitability evaluation for irrigated agriculture must include the following:

- Crop requirements and tolerances;
- Irrigation system requirements and tolerances;
- Environmental requirements; and
- Management requirements.
2.4.1 Crop requirements and tolerances

Each crop has specific requirements (conditions ideal for it) and tolerances of specific non-ideal conditions. For example, different deciduous fruit crops (peaches, apricots, apples, pears, etc.) all have very different tolerances for specific soil conditions. Some soils on which peaches will just absolutely die, are almost ideal for pears, for example. For any specific one of the above crops the requirements and tolerances even differ greatly between different rootstocks and different rootstock-scion combinations. The same is true for all other types of orchard crops, vegetables and agronomic crops. Different crops also have specific climatic requirements and tolerances. Even the presence or absence of persisting diseases, pests or weeds can affect a suitability rating (DAFF 2007).

The FAO (1985) guidelines on land suitability evaluation stress that the aim should always be to use local knowledge about the requirements and tolerances of crops when parameters and criteria for land suitability evaluation are compiled. These should include both research data and the empirical knowledge of field researchers, extension officers and farmers, including traditional small-scale farmers. Only if no local information is available for a specific crop, may international criteria be used as a poor alternative, but then it must be ensured that only information from an overseas area with similar soils and climatic conditions as the area for which evaluation is done, is used. Experience has shown that even highly experienced overseas soil scientists often “misreads” the quality of South African soils and make greatly erroneous recommendations.

Misleading, totally unrealistic, over-optimistic projections of potential crop yields and especially gross margins, are common in feasibility studies for irrigation development in South Africa – often despite the fact that good actual data are available – with disastrous consequences. This is presently still being done (Laker, 2006).

2.4.2 Soil and climatic requirements and tolerances of different irrigation systems

Before the introduction of overhead irrigation systems, land suitability evaluation for
irrigation was simple. It was just a matter of suitability for flood bed, and sometimes furrow, irrigation. The differences in requirements and tolerances of the two are quite small. Nowadays suitability evaluation and planning has to be done for a variety of different irrigation systems with widely different requirements and tolerances in terms of factors such as climate, soil and slope. A situation that is highly suitable for one irrigation system may be totally unsuitable for another.

Drip irrigation is often regarded as a highly efficient water saving irrigation system. Yet, it is not suitable for all soil conditions. On the one hand it requires lateral water distribution in the soil through capillary action. In a coarse sandy soil this does not happen and the water runs straight through in a narrow band. It is known that mature orchards died when converted to drip on such soils, because an inadequate portion of the root system was wetted. At the other extreme, it is extremely inefficient on soils that are chemically highly dispersive and form dense surface seals even under zero energy water application, as are found quite widespread in South Africa (Laker 2006 and DAFF 2007). Surface puddling leads to excessive evaporation losses of applied water and the poor infiltration leads to excessive drying of subsoils towards the end of the season and poor crop performance. On such soils similar problems have been found under micro-sprinklers, e.g. in a citrus orchard in the Eastern Cape. On the widespread crusting soils in the country, including the physically disaggregating ones, this type of situation is even worse under more aggressive types of overhead irrigation, like ordinary sprinklers and especially center pivots and floppy irrigation. There are several unique factors that make South African soils different in this regard, and thus South African models for predicting these scenarios and criteria for adapting the design and management of overhead irrigation systems based on local research must be used (DAFF, 2007). These are available and there is no reason for using outdated incorrect and irrelevant American criteria. On the other hand, there are many situations where overhead, drip or micro-irrigation will be technically better than flood or furrow irrigation. It is also important to ascertain whether the minimum required technical support infrastructure is available for a specific irrigation system before it can be decided to implement it. The key is to realize that there is no such thing as a best “state of the art irrigation technology” that is suitable for all circumstances, each case must be evaluated on its own.
Finally, it is important to determine the familiarity of a farmer with a specific technology and his/her potential capability to manage it successfully, before it is recommended.

### 2.4.3 Climate change

It is becoming increasingly clear that climate change is an inevitable process. With likely long-term changes in rainfall patterns, rising temperatures and shifting climate zones (IPCC 2013), climate change is expected to increase the frequency of climate-related shocks, which in turn will put pressure on food, energy and water supply. The impact will be amplified through the interconnections and interdependence among these three resources, popularly known as the Food Energy Water (FEW) Nexus.

South Africa’s energy system is the major source of greenhouse gas (GHG) emissions, accounting for about 83% of the total emissions in the country (DEA 2011). These GHG emissions are the main drivers of climate change. A staggering 86% of the country’s electricity-generation capacity is derived from coal, which is the biggest source of GHG emissions as far as electricity generation is concerned. Altogether 95% of the country’s crude-oil requirement is imported and the consumption of oil is steadily rising.

Climate change will exacerbate the challenges of meeting FEW needs. It will affect food availability and accessibility and the stability of the food system directly through changes in productivity, quality of yield, crop failures, loss of livestock, farming costs and the effects of changing weather conditions on agricultural practices; and indirectly through the potential effects on water resources and the distribution of pests/disease.

Water supply is impacted by rising temperatures through higher rates of evapotranspiration and decreasing run-off. Changes to the frequency and intensity of rainfall lead to the increased incidence of droughts and floods. Evidence indicates that more frequent and more intense extreme weather events, rising sea levels and increasing irregularities in seasonal rainfall patterns are already having an immediate
impact not only on food production but also on food distribution infrastructure (FAO 2008).

Adverse changes in the quality, quantity and accessibility of water resources would require increased energy inputs to purify water of lower quality or pump water from greater depths or distances, and would intensify the competition between the energy and food sectors for the existing water resources.

### 2.4.4 Assessment of environmental requirements in irrigated agriculture

Assessment of environmental requirements in irrigated agriculture is critically important because irrigated agriculture can have profound off-site environmental impacts, as well as on-site environmental and socio-economic impacts. The most common impact is downstream salinization of water. Apart from negative impacts for other water users, this could be very serious for other irrigation farmers downstream. It is worse if the saline drainage water flows into a dam from which downstream irrigators abstract their water.

Occasional floods form the life blood of most rivers. Floods also provide essential support for the livelihoods of floodplain communities along some rivers. Dams that eliminate floods or drastically reduce their heights have disastrous impacts for such communities, unless artificial floods that are big enough are released at appropriate times of the year. A typical South African example is the floodplain of the Pongola River below the Pongolapoort Dam, with indications that the new Bovane Dam above the Pongolapoort Dam is having even bigger negative impacts than the latter. Floods also serve to flush salts from irrigated areas along river terraces, thus preventing them becoming saline.

Possible pollution effects should also receive attention.
Chapter 3: INSTITUTIONAL ARRANGEMENTS

In terms of the importance of irrigation agriculture in South Africa it is evident that effective communication, co-ordination and cooperation between various stakeholders, including government, research institutions, private sector and the farmers will be required. Some of the role players and their functions are described below.

3.1 Role Players and their functions

3.1.1 Department of Agriculture, Forestry and Fisheries

The DAFF will take the responsibility of guiding irrigated agriculture in the country. DAFF has recognized the importance of irrigation and the desirability of supporting irrigation farmers.

DAFF as the coordinator of the Irrigation Strategy will undertake to perform the following functions:

- Coordination and effective communication on irrigation related matters through the establishment of institutional arrangements including:
  - Chairing the Water Use and Irrigation Working Group
  - Establish a senior level committee at national level between DAFF, DWS, Provincial Departments of Agriculture (PDAs) and the Department of Rural Development and Land Reform (DRDRLR). Chaired by the Director General (DG) and Deputy Director Generals (DDGs) to review/revise policy, make decisions and create policy around land, water, irrigation. The committee to meet once a year or once in two years.
- Develop general documentation for the sourcing of funding for irrigation schemes in South Africa.
- Develop basic implementation guidelines for revitalization of government irrigation schemes, expansion of new irrigated areas and water use efficiency and management.
- Consult with research institutions such as the WRC on research needs and funding of research projects relevant to irrigation in South Africa.
- Create a favourable or enabling environment through which the private sector and other organisations can get involved.
- Support and monitor the implementation of irrigation projects which have been provided funding by DAFF.
- Review the Irrigation Strategy every 10 years.

3.1.2 Provincial Departments of Agriculture

PDAs will undertake the following:
- Development of feasibility reports and subsequent business plans for irrigation and drainage projects.
- Compile business plans for sourcing of funding for implementation of irrigation projects through DAFF.
- Development of irrigation, surface and subsurface drainage designs for irrigation projects.
- Implementation of irrigation projects
- Establishing of Coordinating Committees on Agriculture Water (CCAW) and chairing of the meetings, at least 4 meetings per year.
- Permanent members of the Water Use and Irrigation Working Group (WUIWG).
- Provide extension support to irrigation farmers on maintenance, management and scheduling of irrigation and drainage systems.
- Allocation of budget for irrigation initiatives.

3.1.3 Department of Water and Sanitation

The National Water Act (No. 36 of 1998) specifies that Government is the trustee of the nation's water resources and requires that the DWS should act as custodian of these resources. The NWRS2 provides the implementation framework for the Act.
DWSs role will include the following:

- Consult with DAFF on dealing with unlawful water users, legal actions where needed, water pricing, increase of water tariffs, etc.;
- Authorisation and licensing of water use;
- Construction, repair and maintenance of bulk infrastructure according to existing agreements with Water User Associations (WUA) and Irrigation Boards;
- Implement the Water Based Rural Livelihoods and Food Security Implementation Framework;
- Accelerate validation and verification process; and
- Consult with DAFF on policy developments in order to ensure proper alignment between departments (DAFF, DWS and DRDLR).

3.1.4 Other Departments

DRDLR is responsible for land allocation, rural development and land reform. This Department currently supports revitalization of irrigation schemes in various provinces.

Department of Environmental Affairs (DEA)
DEA is currently responsible for the implementation of environmental laws, the National Environmental Management Act (NEMA) and adherence to these laws including Environmental Impact Assessments (EIAs).

3.1.5 State Owned Entities

Agricultural Research Council (ARC)
Provide research information and support and possible enterprise related training.

Water Research Commission
Coordinate and fund research on issues related to the use of water by the sector. Information on projects which were co-funded by DAFF and the WRC are available from DAFF on request.
3.1.6 Private Sector

Private Sector will include institutions such as Commodity Organizations, Financial Organizations, Academic Institutions, Research Institutions, Farmer Organizations and other Non-government Organizations (NGO).

The private sector should play the following role:
Participate in the development and support of small irrigation farmers and subsistence irrigation farmers on food plots through the provision of linkages and technical support.

3.2 Institutional Structures – Government structures

A number of national structures and institutions addressing issues relating to irrigation and water use by the sector have been in place previously. Some of these structures like the Irrigation Action Committees have been reviewed and changed to what is now called the CCAWs. This section will discuss some of these structures briefly.

3.2.1 Water Use and Irrigation Working Group

This forum was established by the then Department of Agriculture in 2008. It has since been revised and is chaired by the DAFF and the ARC - Institute for Agricultural Engineering. This forum focuses mainly on water use and irrigation development issues in the country. Participants include all nine PDAs, officials from DWS, DRDLR and the ARC.

3.2.2 Coordination Committees on Agriculture Water

This forum has evolved from the previous Irrigation Action Committees. These forums are chaired by the respective official who is responsible for irrigation in the PDAs. DAFF is represented on each of these committees.
3.2.3 Cooperative decision making committee between senior officials in DAFF and DWS

These committees are held on an *ad hoc* basis between senior officials from DAFF and DWS. These are usually high level meetings and meet on national strategic imperatives relating to the impact of agriculture on water or vice versa.

3.2.4 DAFF, DWS and DRDLR committee

This committee will need to be established. The focus of this committee will be to ensure cooperation and coordination on irrigation projects.

3.3 Institutional structures – between government and other stakeholders

DAFF conducts several of these forums, one particular mention is that of the Chief Executive Officer (CEO) Forum where one of the standing agenda items is water availability and quality.

3.4 Financial assistance

There is no dedicated funding towards irrigation within DAFF. The Department currently coordinates the following funding programmes, namely:

- **CASP**: A Schedule 4 Conditional Grant allocated to PDAs annually to supplement the funding of programmes or functions funded from provincial budgets.

  The purpose of this grant is to provide effective agricultural support services, promote and facilitate agricultural development by targeting beneficiaries of land restitution and redistribution, and other previously disadvantaged producers who have acquired land through private means and are engaged in value-adding enterprises domestically, or involved in exports; and to address damage to infrastructure caused by floods.
One of the conditions of this grant is that the PDAs need to allocate 70 per cent to food production initiatives (crop and livestock production) in support of the Fetsa Tlala Programme among others (The Presidency, 2013).

- **Ilima/Letsema Project Grant:** A Schedule 5 Specific Purpose allocation to PDAs to assist vulnerable South African farming communities to achieve an increase in agricultural production and invest in infrastructure that unlocks agricultural production. This grant (100%) is also allocated to support food production (crops and livestock production). This also includes infrastructure that unlocks production such as the rehabilitation of irrigation schemes.

Both funding programmes support a wide array of initiatives in provinces. The PDAs need to apply for funding in order to obtain allocation.

The other direct funding mechanism for irrigation farmers is the Micro Agricultural Financial Institution of South Africa (MAFISA). It is a short to medium term financial scheme to address financial services needs of the smallholder farmers and agribusinesses. This scheme is a loan to farmers who would like to purchase production inputs, implements and small equipment.

The PDAs do support irrigation initiatives with funding from the Equitable Share depending on the priority level of the initiative to the Province.

The DWS has the following funding allocation:

- **Water Services Operating Subsidy Grant:** A Schedule 5 grant to subsidise, refurbish and restore the functionality of water services schemes previously owned and/or operated by the department or by other agencies on behalf of the department.

- **Water Based Rural Livelihoods and Food Security Implementation Framework:** The grant is aimed at subsidising the smallholder’s payments for water.
The DRDLR has the following programme:

- **Rural Infrastructure Development**: Facilitates improved access to basic services, and provides economic and income generating opportunities through improved physical infrastructure in rural areas particularly sanitation, irrigation and roads.

### The challenges currently facing the funding of irrigation initiatives

- PDAs apply for Ilima/Letsema Conditional Grants annually in order to obtain funding for irrigation initiatives.
- The competition for funding between projects in Provinces is very high, irrigation infrastructure has proved to be costly compared to other agricultural inputs, costing approximately R200 000 per hectare or more depending on the area.
- The DRDLR has the Rural Infrastructure Development Programme that PDAs can access to develop and revitalize irrigation. Both departments report directly to Outcome 4 and 7 and do not report or share the plans with DAFF.

### 3.5 Institutional structures - Joint ventures

Historically, joint agricultural production between White and Black South African farmers was a common phenomenon. However, while arrangements such as sharecropping, rental and labour tenancy were pervasive, joint ownership was rare.

Since 1994, more formalized joint ventures have been established, mostly in the Western Cape and other areas where high value agriculture is important to the local economy. These have usually been in the form of labour equity schemes, but examples are increasing of co-ownership and co-management by previously disadvantaged individuals.

Joint ventures offer an option for the transformation of commercial parastatal schemes and for the revitalization of farmer settlement schemes.

In essence, joint ventures seek to leverage private sector expertise and capital for investment in business opportunities that simultaneously empower previously...
disadvantaged individuals. At present inequalities still exist between established commercial farmers and previously disadvantaged individuals seeking to enter commercial farming. However, by providing new farmer-entrepreneurs with title deeds to land, water use allocations, and a range of grants and subsidies, the State can improve the bargaining power of these entrepreneurs to enter into joint ventures. This in turn provides those with capital and infrastructure with real incentives to enter into joint venture arrangements.

However, reports on joint ventures between White and Black farmers have shown limited success. In some instances, after rehabilitation interventions were undertaken by government, Black farmers were encouraged to enter into joint ventures and ‘strategic partnerships’ as a means of promoting entry into an agricultural commercial enterprise. However, this has rendered many beneficiary farmers to become landowners who only collect rent. A study will need to be conducted to determine what the challenges are, how one can address these challenges and a decision must be made on whether these institutional structures can be supported.

### 3.6 Intervention measures

In order to address the coordination and alignment of irrigation and agricultural water use in general it will be most important for DAFF to set up a national level coordinating institution. That can be achieved by:

- Elevation of the current WUIWG to include DWS and DRDLR as permanent members of the institution;
- A Memorandum of Agreement between DWS, DRDLR and DAFF on planning, implementation and coordination of irrigation and water use;
- Involvement of DAFF in DRDLR’s programmes;
- Allocation of dedicated funding towards irrigation initiatives and alignment of funding from various departments towards irrigation training, research, awareness and infrastructural development;
- Alignment of the Terms of Reference (ToR) and Memorandum of Understanding (MoU) of the CCAWs with the Irrigation Strategy.
Chapter 4: IRRIGATION RESEARCH, EXTENSION AND ADVISORY SERVICES

4.1 Irrigation research

Large amounts of excellent irrigation and irrigation-related research have been done in South Africa over the years. These include research on a variety of aspects, such as irrigation system design and management, irrigation scheduling, soil physical problems in irrigated agriculture (e.g. crusting and compaction), soil fertility aspects in irrigated agriculture, reclamation of saline and sodic soils, land suitability evaluation and land use planning in irrigated agriculture, social and socio-economic aspects of small-scale irrigation, economic aspects related to commercial irrigated agriculture, etc. Some of these have led to findings that have been described by top overseas scientists as world breakthroughs in top level international scientific review papers.

Strengths of the research include, *inter alia*

- It was done in South Africa under and for South Africa’s unique conditions.
- Much of it was cooperative research done on-farm in farmers’ fields with inputs and cooperation of the farmers involved and often also in close collaboration with local extension personnel.

There are still gaps in irrigation-related knowledge and information that require new high quality research, and will continue to do so in future. Over the years many workshops and forums aimed at identification of irrigation-related research needs and priorities have been held in South Africa. The various proceedings of these should be studied and their recommendations evaluated in terms of present needs.

Because of South Africa’s particular resource (soils, climate, etc.) and social and socio-economic conditions, we cannot simply import technologies and knowledge generated elsewhere. In particular technologies and information generated in the high latitude rich northern countries (USA, Canada, Europe, etc.) or in countries in the humid tropics (Brazil, East Asia, Central Africa, etc.), with climates and soils that
differ so widely from the Southern African situation, are often not applicable. Some may become applicable after suitable adaptation, based on local research. Even within South Africa research findings from a specific region is often not applicable to another region, because of major climatic and/or soil differences or even cultural and socio-economic differences (DoA 2007).

The challenge for future irrigation-related research is to develop an agenda and design projects that address real-life problems. Such research can only be done if research funders are committed to it. It must be realized that this type of research is much more expensive than laboratory research and also much more long-term, but it must be done if solutions to real-life problems have to be found. There must also be incentives for researchers, in terms of future promotion and career opportunities, to devote themselves to such research, which is presently not the case in South Africa.

To be effective, the research must preferably been done by South Africans that were trained in South Africa and understand the country’s resource and socio-economic situations.

4.2 Irrigation extension and advisory services

Because of the complex and high-input nature of irrigated agriculture, irrigation farmers need strong, efficient support from expert specialist irrigation extension and advisory services. Unfortunately persons with this expertise and the required attributes are virtually non-existent in South Africa (Laker 2004). In the few exceptional cases where an efficient advisory service is in place, e.g. at Douglas, it has made major improvements to irrigation water use efficiency and the profitability and stability of irrigated agriculture.

At several workshops over many years in South Africa there has been repeated identification of a great need for irrigation specialists. The workshops have repeatedly recommended that the problem must receive urgent attention. One of the identified reasons for this need has been the lack of university training for these types of specialists. In addition, adequate numbers of appropriate posts for such experts are needed. Although private advisors attached to service providers are
important, they have vested interests and it is important to balance them with an adequate corps of well-qualified governmental extension officers.

An important category of scientist that has been neglected in South Africa, both in terms of training and posts, is that of “subject matter specialist”. The subject matter specialist is an important link between researchers and extension officers/advisors. The role of the subject matter specialist is to collate and “digest” research data and present it in a form that is useful for extension officers/advisors and high level commercial farmers. If research data cannot be distributed in a useful form, then the research has been a waste of time, manpower and funds.

### 4.3 Intervention measures

In order to address the gaps in irrigation, DAFF in partnership with research institutions needs to develop an agenda and design projects that address real-life problems.

- Increase investment on locally developed innovative initiatives in irrigation systems.
- The training of subject matter specialists to link the researcher, policy developers and extension services and collate research data.
Chapter 5: REVITALIZATION OF IRRIGATION SCHEMES

Smallholder irrigation schemes have the potential to make a significant local socio-economic impact by contributing to improved food security, poverty alleviation and increased employment. Indeed, in many instances, they are the main economic activities in their areas. Unfortunately, a large number of smallholder irrigation schemes have collapsed while the rest are suffering reduced efficiency due to various reasons. Due to the importance of these schemes, their effective revitalization is extremely important.

A number of irrigation revitalization initiatives have previously, and are currently, being undertaken in South Africa. These initiatives range from rehabilitation initiatives to the more broad-based initiatives, with multi-disciplinary teams tackling the wide-ranging issues linked to agriculture production in smallholder irrigation schemes. However, the main intervention practiced currently in South Africa at present, has focused on the rehabilitation of infrastructure and not on the more holistic development philosophy of revitalization.

The revitalisation of smallholder irrigation schemes comprises an integral part of the land and agrarian reform and food security objective of DAFF, but lessons must be learnt from previous initiatives. The Business Plan on Revitalization of Irrigation Schemes draws up from these lessons and a summary of these lessons is included in this document.

Initially, DAFF set a target to revitalise 2% of small-scale government irrigation schemes that amounts to a total of 1 000 ha as its contribution to Outcome 7, where it was envisaged that 250 ha would be revitalised every year. This decision was mainly due to financial constraints as revitalization of irrigation schemes at that time was estimated to cost about R200 000 per hectare. Funding for this initiative was sourced mainly from the CASP and Ilima/Letsema programmes.

In July 2012, DAFF had a meeting with officials from the PDAs responsible for water use and irrigation to develop a business plan to obtain funding either from
government and/or the private sector to fund the revitalization of smallholder irrigation schemes. The Business Plan for the Revitalization of Irrigation Schemes was approved by the Minister of DAFF in 2013. Annexure B is obtained from the business plan for revitalization that includes a list of smallholder irrigation schemes to be considered for funding. A summary of budget required per province is also included.

Subsequent discussions with the PDAs have indicated that the budget requested for the revitalization of smallholder irrigation schemes indicated in the Table in Annexure B should be over a 10–20 year period. This is based on current expenditure patterns due to various challenges faced in the various provinces.

The main issue at stake is how to change deeply-rooted agricultural development philosophies, many which stick to modernist paradigms (infrastructure and mainstream agricultural production approaches) and to consider the merits of other ways of addressing the complexity of the revitalization of small holder irrigation schemes. The challenge lies in finding strategies that can steer the systems to implement the multi–sectoral revitalization programs and resist the pressure to drive the easy, but almost certain, road to failure of infrastructure-centered projects.

5.1 Lessons learnt from revitalization initiatives of the recent past

Successful revitalization requires that all relevant stakeholders be identified and their roles and responsibilities must be clearly spelled out. A key requirement is to involve beneficiary participation in the planning of revitalization for their specific scheme. This is essential to ensure sustainability and to avoid conflict.

The familiarity of farmers with different crops and different irrigation systems and the preferences of farmers with regard to selection of both crops and irrigation systems are important factors to consider. Great flexibility in this regard is required by those who drive the revitalization process.

Also with regard to the models used for farmer settlement there must be great
flexibility, enabling selection of the most appropriate model for each case. For achieving sustainable success, the preferences of the farmers must again be the main guiding principle. Although the PDAs are the initiators and drivers of the revitalization process, they must never try to enforce any model, process or technology that is not acceptable to the specific farmers. That would be a trigger for conflict between the provincial department and the farmers and a guarantee for failure.

The ideal is to have individual independent farmers. “Diversity in livelihood and farming among plot holders should not be resisted politically. Instead, policy content and practice should aim at optimizing institutional flexibility on smallholder irrigation schemes in order to create the necessary social room for plot holders to pursue their particular farming objectives.” (Van Averbeke & Mohamed, 2006)

Where, for some reason, the involvement of a strategic partner is considered, both the partner and the envisaged enterprise and technologies must be acceptable to and formally accepted by the farmers. The provincial department must also take the responsibility to ensure that the farmers are involved as decision-makers and that the strategic partner does not move into a position of decision-making monopoly. If the latter happens, the farmers become no more than “glorified labourers” and have no control over the profitability of their farming enterprises. Current measures of training and skills transfer with the strategic partner should be supported and should include an annual monitoring and evaluation process on these measures.

The latter type of situation often leads to conflict between the farmers and the strategic partner. Since a PDA would have been the body that negotiated the partnership, they should assume the responsibility of mediator to resolve any such conflict.

Studies on a few small-farmer irrigation schemes in Limpopo and KwaZulu-Natal showed that farmers prefer that conflicts between farmers on a scheme should be resolved internally through community structures. The most difficult conflict to resolve is one that develops between a farming community on a scheme and a PDA
– especially where the farming community resists a system being imposed on them by the department. This type of conflict has led to at least one farming community already instituting a high court case against a PDA. The question is who should assume the role of mediator in such a case to first try to resolve the conflict without the unhappy party having to resort to legal action.

5.2 Intervention measures

- To ensure that social facilitation becomes part of the process through the involvement of relevant social experts and departments.
- To develop together with the PDAs, guidelines for the revitalization and upgrading of under-utilized irrigation schemes to promote water use efficiency and economic growth.
- To support revitalization through CASP and Ilima/Letsema funding.
- To monitor the implementation of revitalization in the various irrigation schemes.
Chapter 6: DEVELOPMENT OF NEW IRRIGATION SCHEMES

The NDP indicates that irrigation can be expanded by 500 000 ha through the better use of existing water resources in irrigation schemes and the developing of new water schemes. As previously indicated, the Irrigation Strategy seeks to practise irrigation within the confines of limited suitable natural resources especially with regards to the availability of water, taking into consideration that South Africa is a water scarce country wherein additional opportunities to irrigate are not substantial.

6.1 Possible areas

Information from various studies indicates that only 34 863 ha is available for expansion as indicated in Table 1.

A business plan is currently in the process of being developed which will address the expansion of irrigated areas. Similar challenges to those that were identified in the revitalization of irrigation schemes are expected. Additional challenges will be the impact of the environmental legislation to planned developments and more importantly the social dynamics of communities which will be impacted by this development. As is the case of many developmental projects, expansion and development of irrigation schemes will be long term projects ranging from 5–10 years depending on the community dynamics and extent of the area amongst other things.
<table>
<thead>
<tr>
<th>Province</th>
<th>Scheme/Area</th>
<th>Potential Expansion (ha)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>Upper Orange River Catchment</td>
<td>4 000</td>
<td>Orange River re-Planning Study (ORRS) by DWS (DWS 2014)</td>
</tr>
<tr>
<td></td>
<td>Umzimvubu Dam</td>
<td>2354</td>
<td>According to Mzimvubu and Foxwood Water Projects Feasibility Studies</td>
</tr>
<tr>
<td></td>
<td>Foxwood Dam</td>
<td>1 250</td>
<td></td>
</tr>
<tr>
<td>Free State</td>
<td>Upper Orange River Catchment</td>
<td>3 000</td>
<td>Orange River re-Planning Study (ORRS) by DWS (DWS 1990)</td>
</tr>
<tr>
<td>Gauteng</td>
<td></td>
<td></td>
<td>No possible expansion</td>
</tr>
<tr>
<td>Kwa-Zulu Natal</td>
<td>Makhathini Irrigation Scheme</td>
<td>10 000</td>
<td>Makhathini Master Plan</td>
</tr>
<tr>
<td>Limpopo</td>
<td></td>
<td></td>
<td>Over allocation of water resources (DWSA reports)</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td></td>
<td>3 000</td>
<td>Information supplied by official from Department of Agriculture in Mpumalanga.</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>Upper Orange River Catchment</td>
<td>5 000 (Indications are that most of these have already been allocated)</td>
<td>Orange River Planning Study (ORRS) by DWS (DWS 1990)</td>
</tr>
<tr>
<td>North West</td>
<td>Taung Irrigation Scheme</td>
<td>1 259</td>
<td>Budget Planning Report by Endecon Ubuntu (Pty) Ltd 2011</td>
</tr>
<tr>
<td>Western Cape</td>
<td></td>
<td>5000</td>
<td>Availability of the hectares will depend on the increased capacity with the raising of Clanwilliam Dam wall.</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>34 863</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Possible area for expansion based on the information provided by the respective provinces
The social dynamics have always been on the blind side of government irrigation initiatives. The measuring or quantification of the impact of social aspects on agriculture as a whole has been a challenge. When we think about the social dynamics we should think mostly about advancing and growing social assets through learning and developing skills and mindsets associated with resilience and long term sustainable vitality by developing skills and knowledge to adapt to the challenges that life brings. If the latter, this might bring an interest in strategies such as learning in different life stages, health promotion, community development, quality of life development, etc. (Matthias et al, 2013).

While South Africa has made significant institutional progress in becoming a food secure nation, there remain, however, a number of challenges that need to be overcome, including:

- Lack of mobilization of civil society to implement agricultural projects and processes/technologies;
- Poor integration between government departments in terms of projects and programme implementation;
- Lack of institutional capacity to implement existing programmes; and
- Making agriculture socially acceptable amongst youth.

The implementation of institutional capacity building programmes is critical in ensuring that these challenges are overcome. Despite many other challenges facing irrigated agriculture in modern age, irrigation remains a central component in producing food for the country’s growing population and in sustaining the livelihoods of farmers. It is therefore very vital that engineers and economists establish new and rehabilitate irrigated lands effectively and give due attention to long term social, as well as environmental impacts (Oosterbaan, 1998).
6.2 Intervention measures

- To ensure that social facilitation becomes part of the process through the involvement of relevant social experts and departments.

- To identify the geographic distribution and approximate hectares of all promising areas with suitable land for irrigation on a broad scale, using the available land type data and all sources of unused surplus water and possible development of additional water sources, using existing reports (DWS responsibility).

- To match available water with available suitable land (Joint DAFF and DWS responsibility).

- To participate in collaboration with various Departments (including DWS, PDAs, DRDRLR and local authorities) and stakeholders from the onset of the planning process.

- To ensure conditional allocation of CASP and Ilima/Letsema funding for the development.
Chapter 7: HOUSEHOLD AND COMMUNITY FOOD GARDENS

Household and community gardens are important in terms of enhancing food security on household and community level. Water required for these purposes does not have to be purified as that which is required for drinking purposes.

At home, garden scale techniques can also be used that will enable vegetable production on soils on which it could not be grown at larger commercial scale. These include not only cultivation techniques, but also special irrigation technologies that are highly efficient. An example is tower gardens, trench gardens and other such technologies which are used world-wide, including in various African countries. Water savings in irrigated vegetable production has been found to range between 50% and 70%, compared with traditional rope and bucket and similar systems.

7.1 Rainwater harvesting (RWH)

RWH is the deliberate collection of rainwater from a surface known as catchment and its storage in physical structures or within the soil profile. Rainwater may be harvested from roofs, ground surfaces as well as from water channels. For agriculture purposes, it is defined as a method for inducing, collecting, storing and conserving local surface runoff in arid and semi-arid regions (Prienz & Singh, 2001). RWH can also provide affordable water for household use, agriculture, environmental flows and prevention of flood damage.

Various technologies to harvest rainwater have been in use for millennia and new ones are being developed all the time. They include macro-catchment technologies that handle large runoff flows diverted from surfaces such as roads, hillsides, pastures, as well as micro-catchment technologies that collect runoff close to the growing crop and replenish the soil moisture. Rooftop harvesting structures have the advantage to collect relatively clean water, while weirs and dams on fleeting watercourses can store relatively larger volumes and for longer periods.

The aim of the RWH is to mitigate the effects of temporal shortages of rain to cover
both household needs, as well as for productive use. It has been used to improve access to water and sanitation, improve agricultural production and health care thus contributing to poverty alleviation, reverse environmental degradation through reforestation and improved agriculture practice, aid groundwater recharge, empower women in the management of water and other natural resources and address floods and droughts by storing excess water (Oweis, 1999; TWDB, 2006).

Although in some parts of Africa rapid expansion of rainwater catchment systems has occurred in recent years, progress has been slower than in South East Asia. This is due in part to the lower rainfall and its seasonal nature, the smaller number and size of impermeable roofs and the higher costs of constructing catchment systems in relation to typical household incomes (the lack of availability of cement and clean graded river sand in some parts of Africa and a lack of sufficient water for construction in others, add to the overall cost). However, rainwater collection is becoming more widespread in Africa with projects currently in Botswana, Togo, Mali, Malawi, South Africa, Namibia, Zimbabwe, Mozambique, Sierra Leone and Tanzania among others. Kenya is leading the way. Since the late 1970s, many projects have emerged in different parts of Kenya, each with their own designs and implementation strategies.

Investment in storage infrastructure is therefore necessary to harness rainwater and exploits the potential of irrigation in Africa. RWH systems also have the potential to ensure food security in the semi-arid environments of Africa.

7.2 Types of RWH

Rainwater technologies have played a role in enhancing livelihood for communities as it provides opportunities for households to produce more crop, more food or income to purchase food.

Although it must be mentioned that in-field water harvesting (surface run-off harvesting) is not considered to be a type of irrigation as it does not conform with the definition of irrigation as “the artificial application of water to the soil for the benefit of growing crops”. We have included it here as demonstration plots served to show the
crop development at different stages of growth have encouraged farmers to take up the technology indeed, it has been expanded to more than 1 000 households in 42 rural villages around Thaba’Nchu in the Free State.

**Roof-top rainwater harvesting**

In rooftop harvesting, the roof becomes the catchment where rain is collected from the roof of the building then it can be stored in a tank. This method is not expensive and is very effective.

**In-situ water harvesting**

This is also referred to as macro-catchment or ex-field rainwater harvesting which occurs outside the farm, field or land boundary. This type of RWH refers to all activities in which rain water is harvested and stored within the soil profile below a surface reservoir for crop production. It may include open-sky RWH systems such as terraces, pitting methods or stone dams.

**Surface runoff harvesting**

This is also referred to as micro-catchment or in-field rainwater harvesting and it occurs within the farm, field or land boundary. This includes techniques used in croplands to increase the infiltration of runoff generated in the same field to stabilize and improve crop production. Runoff is stored directly in the soil profile. It consists of a hard, flat, two meter wide runoff strip that runs perpendicular to the slope from where runoff water is collected in a micro basin. The result is that water is concentrated in the basins and infiltrated deeper into the soil. The crops are planted in two lines next to the basins. Dry land yields are between 30% and 50% higher than conventional tillage. The technique that is used currently is in-field RWH that is available for people in rural communities in the Eastern Cape and in the Free State.
7.2.1 Advantages and disadvantages

Advantages

- RWH provides a source of water at the point where it is needed. It is owner operated and managed.
- It provides an essential reserve in times of emergency and/or breakdown of public water supply systems, particularly during natural disasters.
- The construction of a rooftop rainwater catchment system is simple, and local people can easily be trained to build one, minimizing its cost.
- The technology is flexible. The systems can be built to meet almost any requirements. Poor households can start with a single small tank and add more when they can afford them.
- It can improve the engineering of building foundations when cisterns are built as part of the substructure of the buildings, as in the case of mandatory cisterns.
- It is socially acceptable at grassroots levels.
- RWH systems may reduce revenues to public utilities.
- Construction, operation, and maintenance are not labour-intensive.

Disadvantages

- RWH is not a dependable water source in times of dry weather or prolonged drought.
- Low storage capacities will limit RWH so that the system may not be able to provide water in a low rainfall period.
- Increased storage capacities add to construction and operating costs and may make the technology economically impracticable, unless it is subsidized by government.
- Leakage from reservoirs can cause the deterioration of load bearing slopes.
- Reservoir and storage tanks can be unsafe for small children if proper access protection is not provided.
- Possible contamination of water may result from animal wastes and vegetable matter.
7.2.2 Challenges of implementing RWH in SA

- This technology is used in places where conventional water supply systems are not provided thus, can be too expensive, or fail to meet people's needs.
- Inadequate financial support.
- The absence of a national umbrella body that coordinates this initiative.
- Up scaling to larger areas, since currently only employed on backyard gardens.
- Ensuring the continued and sustained use of the RWH techniques.
- Ensuring that many farmers and extension officers access the demonstration plots.
- Drought jeopardizes the mobilization of household for doing active gardening.
- Uncovered dams are dangerous to livestock as well as the tragedy of children drowning.
- Climate change fears will further complicate an already complex situation.

7.3 Intervention measures

- Agricultural extension officers and farmers should be fully committed and involved in RWH in order for the development projects to be sustainable.
- Responsible departments should supply appropriate tools for the application of RWH techniques to farmers who have already grouped themselves and have proved that they are actively involved in agriculture by making use of sustainable techniques.
- To promote provision of water for home garden food production in rural towns and villages and in peri-urban areas.
- To promote rooftop and field runoff water harvesting and storage of such water for home garden food production.
- To promote efficient, water saving irrigation technologies, such as tower gardens, earth box and trench garden production technologies.
- To initiate and sponsor research on technologies and other aspects relevant to mini-scale irrigated agriculture.
- To promote the use of Schedule 1 water use up to 30 ha for community gardens and Home Food Gardens in WMA with surplus water available like the Usutu to Mhlathuze and Thukela.
Chapter 8: MANAGEMENT IN IRRIGATED AGRICULTURE

8.1 Irrigation water management

Irrigation revolves around irrigation water application. Thus, achieving high irrigation water use efficiency (WUEi) and profitability in irrigated agriculture is to a large extent determined by the efficiency of irrigation water management. There is great room for improvement in irrigation water management.

Water management in irrigated agriculture can be divided into two main parts, viz.
- Water supply management, and
- On-farm water application (“irrigation”) management.

The duty of water supply management is to ensure that adequate supplies of irrigation water are available where and when lawful irrigation farmers need it. The two key aspects are adequacy and assurance of supply. Adequacy of supply is particularly important during the peak water requirement period of the crop season, while assurance of supply is critical during phenological stages at which crops are sensitive to water stress. In the planning of irrigation water supply infrastructure and systems it is important to determine the seasonal (growing period), peak period and sensitive stage water requirements of envisaged crops by means of reliable crop water models, such as SAPWAT (WRC 2007).

The easiest water supply management system is to provide a fixed amount of water to a farmer at fixed time intervals, e.g. once a week. This is also the system that is the easiest to understand and used by less skilled irrigators. It reduces the efficiency of irrigation management by highly skilled irrigators, however. For the latter, the best irrigation water use efficiencies are achieved if they can obtain water according to demand, i.e. if they can obtain the correct amount of water at the correct time when they need it. Such demand-based supply systems are being used successfully in some places.

For efficient in-field water management, correct irrigation system selection, design
and maintenance are, firstly, very important. Secondly, efficient irrigation scheduling is the main key to achieving high irrigation water use efficiency. Irrigation scheduling is simply the decision when to irrigate and how much water to apply. In practice irrigation scheduling generally leaves a lot to be desired, despite the fact that a lot of very useful research in this regard has been done in South Africa.

8.2 General management of irrigation farming

Intensive commercial irrigation farming, especially farming with high value export crops, is probably the most complex and complicated type of enterprise in the world. Management deals with decision-making and implementation of these decisions in all aspects related to farming, i.e. procurement, financing, production and marketing. Decisions must be taken regarding what and how much to produce, when, where and how to produce it and what to do with the product. Thus, intensive commercial irrigated agriculture is also “management intensive” and requires farmers with exceptional managerial capabilities (Backeberg et al, 1996). For success they also need strong support from expert, specialized extension and advisory services.

Even perfect irrigation water management will not give high water use efficiencies and high farming profitability if all other farming practices are not also executed correctly and efficiently. A few of the most important of these include:

- Land preparation and cultivation, especially aimed at overcoming and preventing the serious soil compaction that is characteristic of most irrigated soils in South Africa. Soil compaction leads to poor root development, poor water and nutrient use and increased susceptibility to root diseases. Effective soil fertility management;
- Effective disease, pest and weed control; and
- Effective orchard, vineyard, etc. practices.
8.3 Intervention measures

To promote efficient water supply systems and in-field irrigation management by means of

- Collaboration with DWS and the PDAs regarding the provision of efficient water supply systems;
- Supporting the development and application of effective on-farm irrigation management;
- Support for research on irrigation water management.
Chapter 9: CONCLUSION

Agriculture recognizes that there are serious constraints on the availability of water and that it is competing with other sectors (which are growing faster and contributing more to the GDP) for its allocation. Consideration however, should be given considering the contribution of agriculture to rural economies, livelihoods and food security especially in the recent times where the other sectors are shedding jobs. This can only be achieved through integrated planning and close collaboration of the respective and responsible departments, especially with DWS.

A key role for DAFF is the development of a national center of knowledge and information on irrigated agriculture. A multi-disciplinary team of experts on all the relevant aspects of irrigation should be established, as well as an effective irrigation information center to disseminate irrigation related information and made it available to the public.

To ensure the sustainability of irrigation development, DAFF in collaboration with the PDAs, DWS and other relevant stakeholders should develop guidelines on all aspects of irrigation planning, development and management.
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Annexure A: Land Capability Categories

Background

The classic eight-class land capability system (Klingebiel & Montgomery, 1961) was adapted for use with GIS in South Africa, taking data availability into account (Schoeman et al., 2000).

Land capability classes are interpretive groupings of land units with similar potentials and continuing limitations or hazards. Land capability is a more general term than land suitability and more conservation oriented. It involves consideration of (i) the risks of land damage from erosion and other causes and (ii) the difficulties in land use owing to physical land characteristics, including climate. Social and economic variables are not considered. Class concepts are set out in the table in the right and broad land use options in the table below.

<table>
<thead>
<tr>
<th>Land capability class</th>
<th>Land use options</th>
<th>Land capability groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>W, F, LG, MG, IG, LC, MC, IC, VIC</td>
<td>Arable land</td>
</tr>
<tr>
<td>II</td>
<td>W, F, LG, MG, IG, LC, MC, IC</td>
<td>Arable land</td>
</tr>
<tr>
<td>III</td>
<td>W, F, LG, MG, IG, LC</td>
<td>Arable land</td>
</tr>
<tr>
<td>IV</td>
<td>W, F, LG, MG</td>
<td>Grazing</td>
</tr>
<tr>
<td>V</td>
<td>W, F, LG, MG</td>
<td>Grazing</td>
</tr>
<tr>
<td>VI</td>
<td>W, F, LG, MG</td>
<td>Grazing</td>
</tr>
<tr>
<td>VII</td>
<td>W, F, LG, MG</td>
<td>Grazing</td>
</tr>
<tr>
<td>VIII</td>
<td>W, F, LG, MG</td>
<td>Grazing</td>
</tr>
</tbody>
</table>

W = Wildlife  
F = Forestry  
LG = Light grazing  
MO = Moderate grazing  
IG = Intensive grazing  
IC = Intensive, well adapted cultivation  
LC = Intensively, well adapted cultivation  
VC = Very intensive, well adapted cultivation

Percentage of province occupied by various classes

<table>
<thead>
<tr>
<th>Class</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>0.1</td>
<td>0.5</td>
<td>6.7</td>
<td>8.5</td>
<td>10.4</td>
<td>23.3</td>
<td>27.9</td>
<td>18.1</td>
</tr>
<tr>
<td>FS</td>
<td>0.5</td>
<td>17.2</td>
<td>28.3</td>
<td>25.3</td>
<td>15.7</td>
<td>4.9</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>0.4</td>
<td>30.3</td>
<td>15.4</td>
<td>21.6</td>
<td>15.7</td>
<td>11.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KZN</td>
<td>0.5</td>
<td>24.5</td>
<td>11.1</td>
<td>3.0</td>
<td>29.5</td>
<td>18.2</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>0.7</td>
<td>15.8</td>
<td>29.2</td>
<td>25.7</td>
<td>17.5</td>
<td>6.9</td>
<td>12.2</td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td>0.2</td>
<td>14.0</td>
<td>21.7</td>
<td>19.9</td>
<td>16.9</td>
<td>15.7</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td>0.3</td>
<td>6.9</td>
<td>12.8</td>
<td>4.7</td>
<td>15.8</td>
<td>30.7</td>
<td>27.1</td>
<td></td>
</tr>
<tr>
<td>SCA</td>
<td>0.2</td>
<td>1.6</td>
<td>10.9</td>
<td>11.0</td>
<td>10.7</td>
<td>15.5</td>
<td>6.1</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Implications

56% of the area of South Africa (Class III-VIII) is shown to have severe limitations with respect to climate (rainfall), terrain or soils. The arable land, as represented by Class I, covers 12.4%. Another 11% is covered by marginal land (Class IV).
Annexure B: Funding Requirements for Irrigation

There is no dedicated funding for irrigation at national and provincial levels. The table below illustrates the estimated cost of revitalization of smallholder irrigation schemes.

<table>
<thead>
<tr>
<th>Province</th>
<th>Extent of irrigation area (ha)</th>
<th>Budget requested (ZAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>8 362</td>
<td>1 257 050 000.00</td>
</tr>
<tr>
<td>Free State</td>
<td>150</td>
<td>11 000 000.00</td>
</tr>
<tr>
<td>Gauteng</td>
<td></td>
<td>75 446 980.00</td>
</tr>
<tr>
<td></td>
<td>This costing for Gauteng is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mainly on household food</td>
<td></td>
</tr>
<tr>
<td></td>
<td>security, farmer settlement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and Land reform projects</td>
<td></td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>4 235</td>
<td>317 439 675.00</td>
</tr>
<tr>
<td>Limpopo</td>
<td>22 909</td>
<td>4 664 010 000.00</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>11 139</td>
<td>892 756 800.00</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>(Includes Vaalharts/Taung)</td>
<td>5 002 654 864.00</td>
</tr>
<tr>
<td></td>
<td>44 658</td>
<td></td>
</tr>
<tr>
<td>North West</td>
<td>(Includes Hartbeespoort )</td>
<td>2 817 080 000.00</td>
</tr>
<tr>
<td></td>
<td>20 042</td>
<td></td>
</tr>
<tr>
<td>Western Cape</td>
<td>257</td>
<td>50 050 000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>111 752</strong></td>
<td><strong>15 087 488 319.00</strong></td>
</tr>
</tbody>
</table>

Table 1: Funding requirement for revitalization of smallholder irrigation schemes* (according to data supplied in 2012)