WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY FOR THE AGRICULTURE SECTOR

WATER IS LIFE - SANITATION IS DIGNITY

SOUTH AFRICA IS A WATER- SCARCE COUNTRY

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

WATER CONSERVATION AND WATER DEMAND MANAGEMENT STRATEGY FOR THE AGRICULTURE SECTOR

FOREWORD

South Africa is located in a predominantly semi-arid part of the world. The climate varies from desert and semi desert in the West to sub–humid along the Eastern Coastal Area, with an average rainfall for the country of about 450 mm per year (mm/a), well below the world average of about 860 mm/a, while evaporation is comparatively high. As a result, South Africa's water resources are, in global terms, scarce and extremely limited (NWRS1, 2004).

In addition, South Africa is facing increasing water demands to meet the needs of a rapidly growing and urbanising population, changing lifestyles, and economic growth. At the same time, climate change is driving the country towards a warmer and drier future, with longer and more extreme droughts, and more intense floods. The results are less water available to meet the growing demand, thus a threat to water security. Given constraints and demands on the resource, we cannot afford practices which reduce water supply, such as inefficient water management practices, lack of infrastructure maintenance, non-revenue water and poor governance.

Water demand is likely to grow at about 1.2% over the next ten years, therefore a need to find new ways of reducing water demand and increasing availability – which move beyond 'traditional engineering solutions' of infrastructure development (NWRS2, 2013). Water Conservation and Water Demand Management (WC/WDM) is an integral part of broader strategies needed to reconcile the available supply with the demand for water. It is key to ensure sustainable use of our water resources, and to ensure sufficient water is available for the current and future requirements. The Water Conservation and Water Demand Management Strategy is a fundamental step in promoting water use efficiency as provided in the United Nations Sustainable Development Goal number 6. This is consistent with both the National Water Act (Act 36 of 1998) and Water Services Act, 1997 (Act 107 of 1997) which emphasizes effective management of our water resources and conservation. Water Conservation and Water Demand Management should not be seen as punitive or restrictive but as a responsible approach that will contribute to postponement of infrastructure augmentation, mitigation against climate change, support to economic growth and ensuring that adequate water is available for equitable allocation.

This WC/WDM strategy emphasizes the fact that all consumers and water institutions have a duty towards our country, our environment and themselves to implement adequate measures that contribute to water use efficiency through Water Conservation and Water Demand Management.

Let us work together towards the prosperity of our nation for the benefit of future generations. Let us seize all opportunities of ensuring responsible use of our water resources.

DR SD PHILLIPS
DIRECTOR-GENERAL

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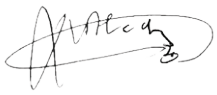

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- South African Independent Power Producer Association (SAIPPA)
- South African Irrigation Institute
- South African Local Government Association (SALGA)
- South African Sugarcane Research Institute
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EXECUTIVE SUMMARY

Water is a critical socio-economic enabler. Water is fundamental in the production of food and energy and, in South Africa, access to water is a constitutional right. Inequality and poverty are widespread in South Africa and the economic growth required to alleviate poverty needs water for the production of goods and services. South Africa is a water-scarce country where water creates significant socio-economic challenges. Population growth is increasing demand for water. Additionally, increased temperatures due to the effects of climate change are likely to exacerbate water scarcity in South Africa in the future. In order to enable economic growth to reduce poverty and inequality in an increasingly water-scarce environment, South Africa needs to maximise the benefit of every drop of water and ensure that not a single drop of this precious resource is wasted.

The National Water and Sanitation Masterplan (NWSMP) puts the National Water Resource Strategy (NWRS2, now updated to NWRS3) into action and comprises a number of interventions with a specific focus on reducing water demand. The Department of Water and Sanitation (DWS) has also developed its first Integrated Water Quality Management Policy and Strategy in support of this. This indicates acknowledgement of the necessity to formulate enhanced water sector strategies in order to improve South Africa's resilience to climate change. A water deficit is predicted for South Africa by 2030 (DWS, 2018) and it is amidst increasing concern regarding water security that the importance of updated strategies targeting water use efficiency (WUE) in various sectors has become apparent.

Water Conservation and Water Demand Management (WC/WDM) constitutes a vital initiative that supports the implementation of integrated water resources management (IWRM) principles in order to strengthen the country's ability to address future water deficits. Water conservation and water demand management (WDM) are respectively defined as follows (DWAF, 2004):

- ***Water Conservation:*** The minimisation of loss or waste, the care and protection of water resources and the efficient and effective use of water.
- ***Water Demand Management:*** The adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services and political acceptability.

WC/WDM is thus concerned not only with reducing water usage and water wastage but also safeguarding the quality and quantity of water resources. Figure i presents a graphical representation indicating how demand can be constrained to within supply augmentation plans and that this can delay the need for augmentation.

The potential benefits of WC/WDM include the following:

- Water security whereby water demand does not exceed the reliable supply or there is balanced water supply and demand.
- Financial sustainability of the water utility, particularly in those instances

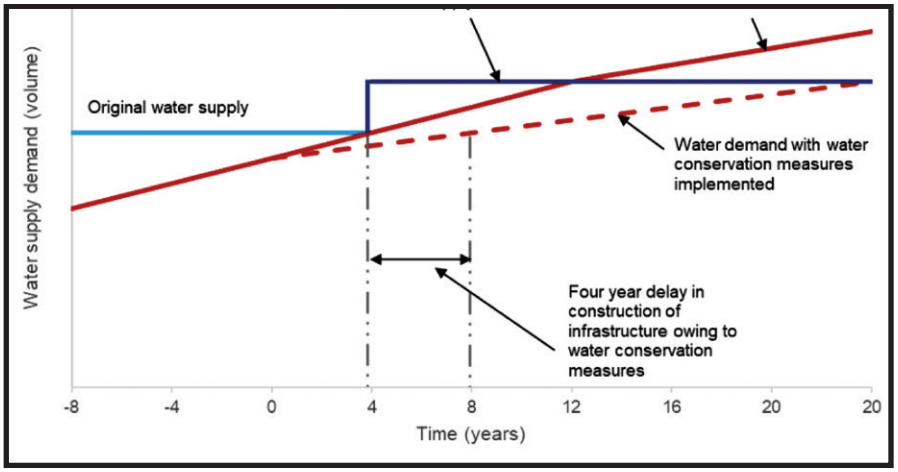


Figure i: Graphical illustration of the positive impact of WC/WDM in a system water balance

where metering, billing and cost recovery are properly implemented.

- Effective operation and maintenance of infrastructure which prevents excessive leakages, avoids deterioration in service delivery, prevents intermittent supply and water rationing, reduced pressures etc. This also prevents intermittent supply which is often caused by excessive leakages as well as depressurisation which damages water supply infrastructure and contributes to water borne diseases due to contaminants seeping into water distribution pipelines.
- Well maintained water supply infrastructure and assets resulting in good service delivery and decreased water leakages.
- Prevention of the creation of unnatural wetlands at micro-environment level which provides a breeding ground for mosquitoes and other health hazards to communities.
- Relatively short timeframes and cost-effective approaches are possible at a macro-level through WC/WDM interventions. By postponing the construction of augmentation schemes such as large dams, WC/WDM can be implemented in a relatively short time span with a relatively smaller budget as opposed to large augmentation schemes which usually require major capital investment with considerable implementation times of 10 to 25 years, with associated environmental impacts.
- Improved water production through reduced pumping and pipe failures, reduction in chemical costs and associated greenhouse gases.
- Reduction in water use which requires less infrastructure, less debt and lower fixed water costs.
- Flexibility in implementation of WC/WDM intervention measures which can be introduced incrementally.
- Build relationships between government and citizens as the community plays an active role in successful WC/WDM projects.
- Cost reflective water charges that support sustainable water services by implementing WC/WDM that creates well measured components of the water cycle. This promotes improved knowledge management and costs reductions.

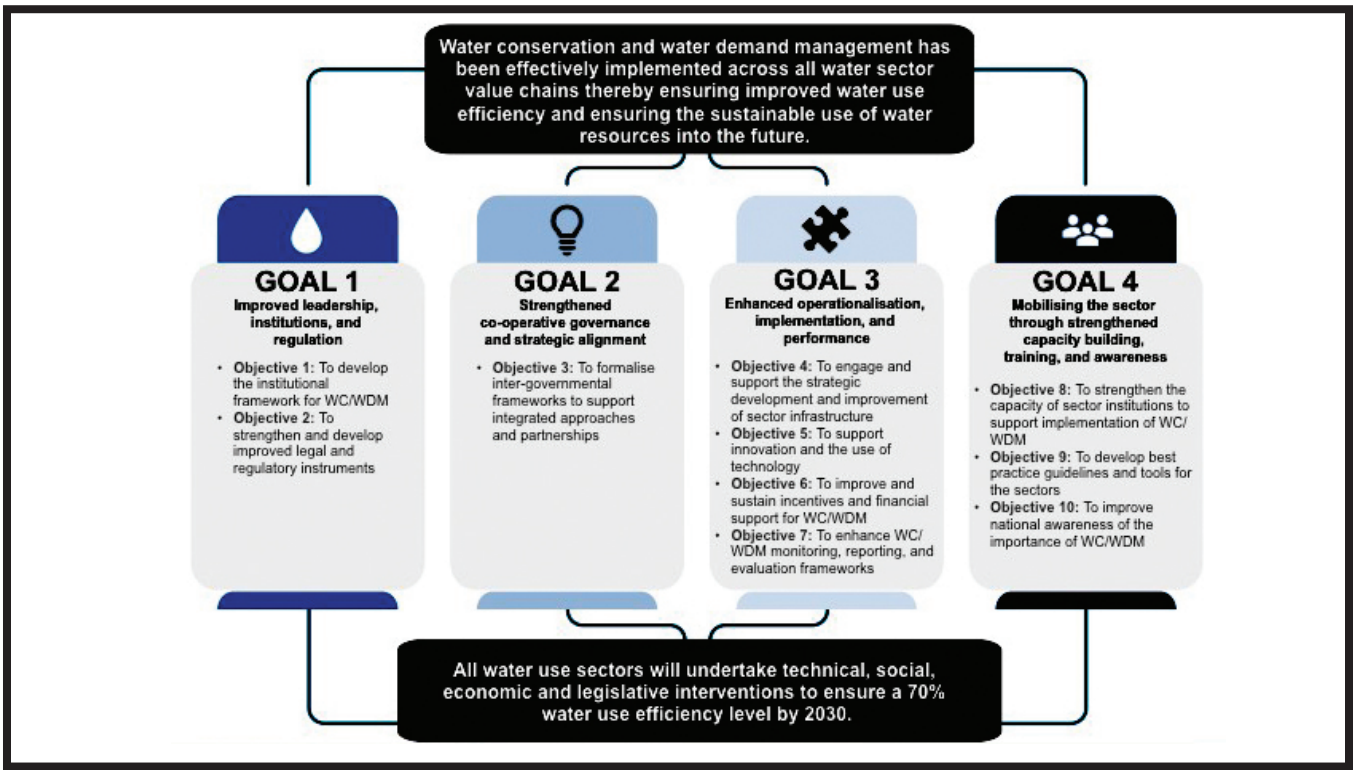
This context led DWS to develop WC/WDM strategies in 2004. The aim of these strategies was to promote sustainable use and management of water resources in South Africa. Since the development of these strategies, new information, concepts and guidelines have been developed which promotes the effective implementation of WC/WDM. To incorporate these advances, the WC/WDM strategies have been updated.

It is important to note that the WC/WDM strategies and implementation plan provide guidance for the water sector as a whole. Although these documents have been developed by DWS, the sector needs to mobilise and work together to implement WC/WDM.

The National WC/WDM strategy provides the overarching framework for the sector strategies. The National WC/WDM strategy provides a number of core purposes:

- To provide a framework against which the more practically focused sub-sector strategies can be structured. This coherence is important in ensuring alignment in approach at local, provincial and national levels, as well as being consistent between sectors.
- To support in unlocking more strategic aspects that enable the sub-sector strategies to be implemented.
- To create an improved enabling environment that will facilitate the implementation of WC/WDM nationally and locally.

Towards this end, the WC/WDM strategies have three core focal areas, namely, 1) effective government structures to oversee and regulate the implementation of WC/WDM; 2) strategic development and management of best practice, supporting tools, and financial instruments that guide the effective implementation of WC/WDM; and 3) knowledge management, capacity building and innovation that are leveraged to support improved WC/WDM implementation. These have been translated into Goals and Objectives, as follows:



There are four WC/WDM strategies with the National Strategy serving as the overarching strategy for South Africa. Three sector strategies have been developed which includes a strategy for the agricultural sector; the industry, mining and power sectors; and the water services sector. These sectors are significant water users in South Africa, and thus sector-specific strategies have been designed to define the way forward to improved water use and management in these sectors. This document presents the agricultural sector strategy.

Agriculture Summary

The increased need for food to feed the growing population will lead to more water withdrawals in the agricultural sector which is the driving force behind economic development in regions such as Africa (Hoekstra et al. , 2012). With agriculture consuming over 60% of the available freshwater resources in South Africa, it can be argued that efficient management of water within the agricultural sector shall be the panacea to addressing the greater challenges of water withdrawals while improving the lives of over 50% of South Africans whose livelihoods depend on agriculture. Unfortunately, only 2.6% of South Africa's land is high-potential arable land for crop production.

South Africa has a vastly diversified agricultural sector which includes the production of all the major grains (except rice), oil seeds, deciduous and subtropical fruits, sugar, citrus, wine, most veges, cattle, dairy, pigs, sheep, broilers, ostriches and eggs (Sikuka, 2019). The main crops are maize, wheat, and, to a lesser extent, sugarcane, sunflower, potatoes, groundnuts, citrus, and grapes. About 48% of the agricultural production value is from animal production (StatsSA, 2021).

Irrigation in South Africa supports 25-30% of the national agricultural production. Agriculture contributes 4% to 5.3% to South Africa's gross domestic product (GDP) directly and between 14% and 30% indirectly. With the rising demand for food, farmers will have to either double their water use or produce more with the current water available by 2050. The latter is more realistic to achieve considering that most of the catchments water is already over allocated. Therefore, the only way to expand land under irrigation is by means of improved water use efficiency (WUE) in the sector (Bonthuys, 2018). Research findings indicate that up to 500 000 ha can be added to land under irrigation through the better use of existing water resources. According to the National Development Plan (NDP),

SA has the potential to create another million jobs in the agricultural sector by 2030 (Matthews, 2017) and increase the area of land under irrigation with 33% (Cilliers & Hedden, 2014). Even though the NWRS2 anticipates an increase of 50% of the land under irrigation, it assumes there will be no increase in the amount of water allocated for irrigation purposes. Unless sufficient advances are made in WUE or water-withdrawal licences are transferred to other sectors, government's intention to increase the area of land under irrigation will increase water demand for the agricultural sector. However, groundwater may emerge as the most important way in which any expansion in the agricultural sector is possible. Groundwater is important, and currently undervalued and under-used, especially in small-scale rural farming (Cilliers & Hedden, 2014).

In 2014/15, 1.1% of SA's land surface was under irrigation constituting 10% of the total cultivated area. This was equivalent to 1 334 562 ha. The total consumptive water use from irrigated agriculture was estimated at 10 221 million m^3 for the same year. A study from 1997 estimated the water use by irrigated agriculture to be 10 740 million m^3 per year. Although land under irrigation increased with 44 430 ha in 18 years, the marginally lower estimate of water use in 2014/15 may imply production of crops with lower water requirements or improved WUEs. Dissimilarities may however be influenced by differences in accuracies and methods between the 1997 and 2014/15 studies (Bonthuys, 2018).

The Theory of Change below builds on the learnings, findings and recommendations arising out of the Strategic Analysis, highlighting the key issues, the barriers that require addressing and the focus areas for change in order to make an impact. This identifies problems both specific to the agricultural sector but also broader issues that link to the National Strategy. The Theory of Change has been translated into the actions for the agricultural strategy and is presented in Table i.

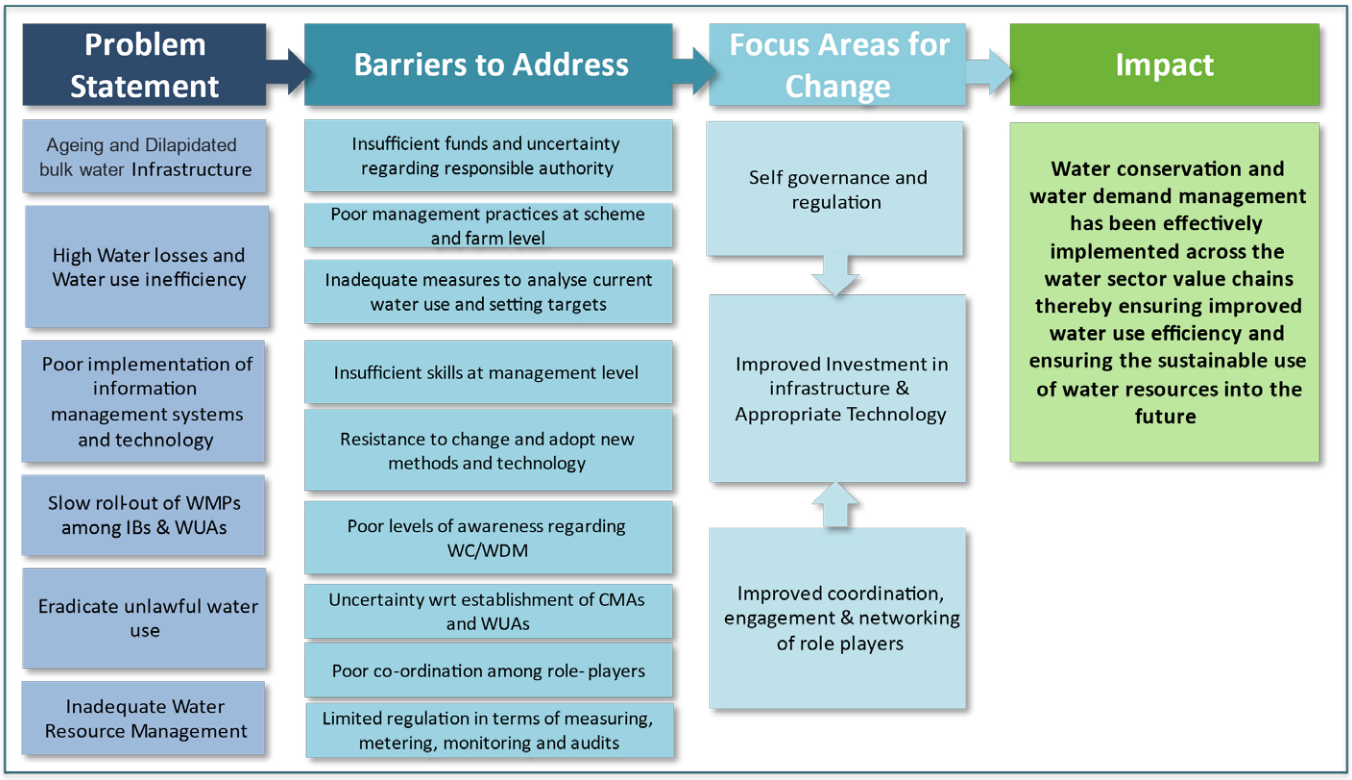


Table i: Agriculture WC/WDM Strategic Goals, Objectives, and Actions

GOALS	OBJECTIVES	STRATEGIC ACTIONS	RESPONSIBLE*
GOAL 1 Improved leadership, institutions, and regulation	**Objective 1:** To develop the institutional framework for WC/WDM	1. 1 Promote WMI (Water Management Institutions) or Irrigation Schemes to develop institutional corporate frameworks that support WC/WDM to achieve Water Use Efficiency at scheme level 1. 2 Strengthen an institutional culture of WUE reporting as part of Annual Institutional Performance Report	DWS, DALRRD, CMAs
	Objective 2: To strengthen and develop improved legal and regulatory instruments	2. 1 Improve water allocation and equity amongst agricultural water users through water allocation audits 2. 2 Improve regulatory frameworks for water use efficiency and monitoring within the agricultural sector 2. 3 Incorporate WUE licensing conditions – both general and specific institutional conditions	DWS, DALRRD, WRC, ARC, CMAs
GOAL 2 Strengthened co-operative governance and strategic alignment	**Objective 3:** To formalise inter-governmental frameworks to support integrated approaches and partnerships	3. 1 Create alignment of the institutional frameworks, agricultural programmes and principles of the relevant government departments and stakeholders in support of WC/WDM 3. 2 Enhance the work of the Coordinating Committee on Agricultural Water (CCAW) in all provinces 3. 3 Develop common shared government strategies or plans towards outcomes-based efficiency improvement plans, i. e. , revitalisation of old schemes or the use of surplus water for irrigation purposes	DWS, WRC, government departments, CMAs, DALRRD, PDAs, NPC, NT, DTIC
GOAL 3 Enhanced operationalisation, implementation, and performance	**Objective 4:** To engage and support the strategic development and improvement of sector infrastructure	4. 1 Develop business cases based on the Infrastructure Asset Management Plan and Asset Register for all schemes to address water losses attributed to inefficient operation and maintenance of agricultural conveyance systems, i. e. , canals, pipelines, and channels 4. 2 Promote efficient operation and maintenance of irrigation infrastructure, from source to root zone applications 4. 3 Monitor the implementation of the asset management plans of the DWS Infrastructure branch to reduce physical water losses from DWS conveyance systems 4. 4 Monitor the implementation of private sector (WUAs & Irrigation Boards) asset management plans to reduce physical water losses	NWRIA**, DALRRD, DWS, CMAs, sector bodies (AgriSA, etc), SAAFWUA

GOALS	OBJECTIVES	STRATEGIC ACTIONS	RESPONSIBLE*
	Objective 5: To support innovation and the use of technology	5. 1 Support ongoing research by the Water Research Commission and the Agriculture Research Council on WC/WDM to improve Water Use Efficiency 5. 2 Support sector initiatives aimed at improving water use efficiency 5. 3 Facilitate the transfer and uptake of evidence-based technologies, such as those developed by the WRC and ARC 5. 4 Work with organised agriculture to continue innovative work especially cooperation	DWS, DALRRD, government departments, PDAs, WRC, ARC,
	Objective 6: To improve and sustain incentives and financial support for WC/WDM	6. 1 Develop an investment framework for the renewal and maintenance of bulk water infrastructure in irrigation schemes 6. 2 Review the pricing mechanisms for agriculture water use to promote water use efficiency 6. 3 Improve metering, billing, and revenue collection to promote Water Use Efficiency in Agriculture 6. 4 Improve metering, billing, and revenue collection to promote Water Use Efficiency in Agriculture 6. 5 Reinstate WC/WDM incentives, such as the WC/WDM Sector Awards, innovation recognition awards	DWS, NWRIA**, DALRRD, CMAs, WRC
	Objective 7: To enhance WC/WDM monitoring, reporting, and evaluation frameworks	7. 1 Improve incentives that would facilitate the implementation of WC/WDM by strengthening data collection, monitoring, and evaluation 7. 2 Enhance Water Use Efficiency Accounting Reporting (WUEAR) by all major Irrigation Schemes and produce an annual state of Water Use Efficiency Report for the Irrigation Schemes 7. 3 Continue with the development of Irrigation Regulatory Support Monitoring System called the Irri–Drop System 7. 4 Promote the use and adoption of Water Administration Systems by all Irrigation Schemes especially Government Water Schemes	DWS, DALRRD, ARC, WRC, WMIs, CMAs

GOALS	OBJECTIVES	STRATEGIC ACTIONS	RESPONSIBLE*
GOAL 4 Mobilising the sector through strengthened capacity building, training, and awareness	**Objective 8:** To strengthen the capacity of sector institutions to support implementation of WC/WDM	8. 1 Improve skills development in WC/WDM to improve water use efficiency in the irrigation agricultural sector 8. 2 Participate in sector information and knowledge sharing platforms like SANCID, SABI, and organised agriculture conferences 8. 3 Strengthen institutional capacity through the provision of accredited Water Control Officer training courses	DWS, DALRRD, ARC, WRC, Energy and Water Sector Education Training Authority (EWSETA), SAAFWUA, WMIs, CMAs
	Objective 9: To develop best practice guidelines and tools for the sectors	9. 1 Develop guidelines for water use data collection and reporting 9. 2 Develop standards for WUE and WC/WDM performance management criteria as part of the Irri-Drop System 9. 3 Develop best practice guidelines for small irrigators and irrigation schemes	DWS, CMAs, ARC, WRC
	Objective 10: Improve national awareness of the importance of WC/WDM	10. 1 Develop and implement (behavioural change) programmes/campaigns to systemically embed a water stewardship mindset 10. 2 Develop and publish annual reports on status quo of WC/WDM 10. 3 Participate in agricultural events such as NAMPO and Irrigation Scheme open days to promote Water Use Efficiency and WC/WDM 10. 4 Promote knowledge-based systems on water measurement in irrigation schemes	DWS, DALRRD, CMAs, ARC, WRC

*The parties listed as responsible for these actions may not comprise an exhaustive list.

**NWRIA not yet established

There is a suite of interventions required for achieving the Vision for WC/WDM in the country. Given the current resources available, it is not possible to address all of WC/WDM Strategic Actions simultaneously; human, technical and financial resources as well as information and systems constraints will inhibit this. Nevertheless, it is critical that all water use sectors undertake the necessary interventions to improve the levels of water use efficiency that currently exist. As such, the strategic target is that all water use sectors must ensure a minimum of 70% water use efficiency by 2030, understanding that there is an obligation on all water use sectors to be continually seeking for improvements in these levels.

Therefore, the focus of the implementation plan is to be on delivering change for prioritised challenges. This does not mean that work on other areas pertinent to WC/WDM will not continue, but it serves to guide the allocation of human and financial resources for the 5-year period of the strategy, with the objective of building for longer term improvements. Therefore, a key approach will be to prioritising critical concerns, while ensuring that other issues are addressed through ongoing management or monitoring for future prioritisation and action.

The following aspects are critical to create an enabling environment:

- Political Will and Leadership
- Financing
- Institutionalisation
- Coordination
- Public Support
- Enforcement
- Monitoring and Evaluation.

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DEFINITIONS

Application efficiency: The ratio of the average depth of irrigation water infiltrated and stored in the root zone to the average depth of irrigation water applied, expressed as a percentage.

Aquifer: A geological formation which has structures or textures that hold water or permit appreciable water movement through them.

Avoidable losses: These losses occur as a result of inefficient management in the operation of the canal system and can mainly be attributed to poor canal maintenance (leaks), incorrect headwork and inefficient runtime release determination, inaccurate water measuring structures and other restricting factors such as algae growth, etc.

Catchment: An area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.

Climate change: Changes in climatic conditions due to natural causes or to anthropogenic (man-made) effects such as emissions of greenhouse gases, e. g. , carbon dioxide, nitrous oxide, and methane, from industry, transport, farming and deforestation, that are expected to have significant consequences for rainfall and water availability on earth.

Consumptive use: Consumption Use of water abstracted from any source, such as a river, groundwater or water supply system, for domestic, commercial, industrial, power generation, irrigation or any other purpose and effectively remove that water from the water cycle.

Conveyance loss: Loss of water from a channel or pipe during conveyance, including losses due to seepage, leakage, evaporation and transpiration by plants growing in or near the channel.

Crop root zone: The soil depth from which a mature crop extracts most of the water needed for evapo-transpiration. The crop root zone is equal to effective rooting depth and is expressed as a depth in mm or m. This soil depth may be considered as the rooting depth of a subsequent crop when accounting for soil moisture storage in efficiency calculations.

Crop water requirement: Crop consumptive use plus the water required to provide the leaching requirements.

Demand-side management: Any measure or initiative that will result in the reduction of the expected water usage or water demand.

Development: The systematic use of scientific and technical knowledge, together with traditional knowledge systems and cultural values, to realise the potential of natural resources to support social and economic transformation.

Distribution management: Any function relating to the management, maintenance and operation of any system of structures, pipes, valves, pumps, meters or other associated equipment, including all mains, connection pipes and water installations that are used or intended to be used in connection with the supply of water.

Distribution system: Infrastructure distributing the water from the resource to point of abstraction. In addition, system of ditches, or conduits and their appurtenances, which conveys irrigation water from the main canal to the farm units.

Drip irrigation: An irrigation method in which water is delivered to, or near, each plant in small-diameter plastic tubing. The water is then discharged at a rate less than the soil infiltration capacity through pores, perforations, or small emitters on the tubing. The tubing may be laid on the soil surface, be shallowly buried, or be supported above the surface (as on grape trellises).

Efficient water allocation: A situation in which the available water resources are allocated in a way that achieves maximum benefit.

Evaporation: Water vapour losses from water surfaces, sprinkler irrigation, and other related factors.

Governance: Action or manner of governing by implementing sound rules and procedures.

Groundwater: Rainfall that infiltrates into the soil surface and percolates downwards, seepage from water in streams, lakes and artificial impoundments, and irrigation water that percolates down into the ground and accumulates in aquifers comprising permeable underground layers of sand, gravel and rock.

Inefficient use of water: Water used for a specific purpose over and above the accepted and available best practices and benchmarks or water used for a purpose where very little benefit is derived from it.

Integrated Water Resource Management: This process determines the optimal way of providing water services by analysing the change in water demand and operation of water institutions and evaluating a variety of supply-side and demand-side management measures.

Management: The people who make decisions in an organisation, the effect, impact and outcome of these decisions.

Non-consumptive use: A term used to describe the water that is utilised by businesses in open processes that generate wastewater, and which can be recycled or discharged back into the water cycle for use by other users.

On-farm: Activities (especially growing crops and applying irrigation water) that occur within the legal boundaries of private property.

Operational losses: Losses at the tail ends, sluices not opened or closed on time or opened to big and spills.

Private sector: Those parts of the economy not run by the government, including households, voluntary associations, community organisations, sole traders, partnerships, and privately owned company.

Public sector: Those parts of the economy which are not controlled by individuals, voluntary organisations, or privately-owned companies but mostly Government.

Regulation: A rule or directive made and implemented by an authority, which individuals or organisations are obliged to respect and comply with.

Regulatory agency: A body created to decide on and enforce regulations or rules.

Research and development: The use of resources to create new knowledge, and to develop new and improved products or processes, to enhance economic activities and the quality of life.

Reserve: The Reserve consists of two parts: the basic human needs reserve and the ecological reserve. The basic human need reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, food preparation and personal hygiene. The ecological reserve relates to the water required to protect aquatic ecosystems of the water resource. The Reserve refers to the quantity and quality of the water in the resource and will vary depending on the class of that resource.

Return Flow: That portion of the water diverted from a stream which finds its way back to the stream channel, either as surface or underground flow.

Reuse: Beneficial use of reclaimed or re-purified wastewater.

Runoff: The portion of rainfall on land or on any other surface that drains away to accumulate in a stream or a river, and which does not infiltrate into the surface, get intercepted by vegetation and other covers where it is stored, or evaporate back into the atmosphere. Runoff is also fed by groundwater which moves naturally into streams and rivers.

Supply-side management: Any measure or initiative that will increase the capacity of a water resource or water supply system to supply water.

Surface water: Runoff that occurs in streams and rivers, also in natural lakes and reservoirs, a major resource for water supplies.

Tail end water: This is water at the endpoint of a canal and can indicate that more water has been released than ordered or used when monitored at this point.

Unavoidable losses: Unavoidable losses from canal systems can be attributed to seepage and evaporation and is related to the surface area of water in the canal, wetted perimeter area of the canal and to the structural condition of the canal network.

Water efficiency: Getting any given results such as equity, gravity, and development with the smallest possible inputs, or getting the maximum possible output from given resources.

Water conservation: The minimisation of loss or waste, the care and protection of water resources and the efficient and effective use of water.

Wastewater discharge: Refers to both the quality and the quantity of water discharged. It refers to the discharge to sewer systems as well as to open river systems. Furthermore, the term also covers the diffuse discharge of polluted water into open river systems.

Water demand management: The adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and use of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services and political acceptability.

Water footprint: An indicator of water use that considers both direct and indirect water use. The water footprint of a product (good or services) is the volume of fresh water used to produce the product, summed over the various steps of the production chain.

Water Institutions: Water institutions include both Water Management Institutions and Water Services such as Catchment Management Agencies, Water User Associations, Water Boards, etc.

Water licence: A general authorisation issued by a responsible authority for water use is authorised by a licence under the National Water Act, 1998.

Water resource: Water that can be used to contribute to economic activity, including a water course, surface water, estuary and ground water in an aquifer.

Water resource strategy: A plan for dealing with uncertain future circumstances with respect to the availability of clean and sufficient water for domestic and commercial use. This is the set of rules by which the action to be taken depends on the circumstances, including natural events such as climate change and the actions of other people.

Water wastage: Water lost through leaks or water usage that does not result in any direct benefit to a consumer or user.

Water utilisation: Used to describe both the consumptive and the non-consumptive uses of water by businesses, whether it is raw or po water.

LIST OF ABBREVIATIONS

ARC	Agricultural Research Council
BFAP	Bureau for Food and Agricultural Policy
BLSA	Business Leadership South Africa
BMP	Best Management Practices
CARA	Conservation of Agricultural Resources Act
CCAW	Coordinating Committee for Agriculture Work
CMAs	Catchment Management Agencies
CSIR	Council for Scientific and Industrial Research
DALRRD	Department of Agriculture, Land Reform and Rural Development
DPME	Department of Planning, Monitoring and Evaluation
DTIC	Department of Trade, Industry and Competition
DWS	Department of Water and Sanitation
EWSETA	Energy and Water Sector Education and Training Authority
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GWS	Government Water Scheme
ICID	International Committee on Irrigation and Drainage
IWRM	Integrated Water Resource Management
LEPA	Low Energy Precision Application
M&E	Monitoring and Evaluation
MISA	Municipal Infrastructure Support Agent
mm/a	mm Per Annum
NDP	National Development Plan
NSoW	National State of Water
NT	National Treasury
NWRIA	National Water Resources Infrastructure Agency
NWRS	National Water Resource Strategy
NWSMP	National Water and Sanitation Masterplan
NWSF	National Water Security Framework
OECD	Economic Co-operation and Development
PDA	Provincial Department of Agriculture
SAAFWUA	South African. Association of Water User Associations
SABI	South African Irrigation Institute
SDG	Sustainable Development Goal
SIPs	Strategic Infrastructure Projects
SWAP	Sector Wide Approaches
SWPN	Strategic Water Partners Network
SWOT	Strengths, Weaknesses, Opportunities and Threats
WARMS	Water Use Authorisation and Registration Management System
WAS	Water Administration System
WASAG	Water Scarcity in Agriculture
WASH	Water, Sanitation and Hygiene
WC/WDM	Water Conservation and Water Demand Management
WDM	Water Demand Management
WMA	Water Management Area
WMI	Water Management Institution
WMP	Water Management Plan
WRC	Water Research Commission
WSLG	Water Sector Leadership Group
WUA	Water User Association
WUE	Water Use Efficiency
WUEAR	Water Use Efficiency Accounting Reporting
WUL	Water Use Licence

1 Introduction

1.1 Background

The developmental imperatives of South Africa are significant and challenging in the face of increasing socio-economic pressures, climate change and ever-increasing demands on a limited water resource. South African livelihoods are dependent on water which is essential to day-to-day life as well as a broader economy that requires water as part of processes and production. Due to the uneven distribution of water resources across the country, the water sector has developed extensive infrastructure to transfer water between catchments to address supply deficits, particularly for key economic nodes. Nevertheless, South Africa falls within the top quarter (25%) of the world's most water-stressed nations (Water Resources Institute, 2023). South Africa is situated in a region that is predominantly semi-arid with an average rainfall for the country of about 450 mm per annum (mm/a), which is well below the world average of about 860 mm/a, while evaporation is comparatively high (DWS, 2004). According to the 2020/2021 National State of Water (NSoW), 98% of the country's available water resources are already allocated (DWS, 2022). The third edition of the National Water Resource Strategy (NWRS3) highlights that South Africa is currently over-exploiting its renewable water resources on a national level and requires both demand-side and supply-side interventions to address a projected supply deficit of 17% by 2030 (DWS, 2021). There are also limited opportunities to supplement future water requirements with conventional surface water resources.

South Africa is ranked amongst the top half of most vulnerable countries in terms of climate change vulnerability and particularly with regards to water-related climate change vulnerability (University of Notre Dame, 2023). It is also ranked amongst the top half of countries that have suffered the most climate change-related historic losses in the last two decades (Eckstein, Kunzel, Schafer, & Winges, 2019). Therefore, the need to develop improved levels of climate resilience in conjunction with efforts to address developmental objectives will be important for the medium- to long-term.

This will require a coherent multi-sectoral response, undertaken with the leadership of the Department of Water and Sanitation (DWS). A climate resilient water sector, that underpins the country's sustainable development objectives, will require the combined efforts of public sector, private sector and civil society stakeholders.

While the national strategic framework sets the overall direction, its development was the result of concurrent top-down and bottom-up approaches in which the emerging issues from the sectors were taken into account at the national level while the national context also informed the sectoral frameworks. This allowed for alignment between the national and sector frameworks, while allowing for the sectoral frameworks to capture the sector-specific nuances that may not be applicable across all sectors at a national level. The strategy development process incorporated an ongoing dialogue with key stakeholders.

The agriculture sector contributes to food security, employment and job creation in the country, emphasising its social value. Smallholder farmers play a key role in sustainable livelihoods in terms of food security in rural and peri-urban regions (DWAF, 2004). The increased need for food to feed the growing population will lead to more water withdrawals in the agricultural sector which is the driving force behind economic development in regions such as Africa (Hoekstra et al., 2012). The irrigation sector is by far the largest water user in South Africa. Any percentage reduction in water use in this sector will therefore have a significant effect on the total water requirements. Efficiencies can be targeted both in terms of distribution networks (leaking pipelines and canals) and application (choice of crops and technologies employed) (NWRS3, 2022). Water losses in the sector are high, especially because of conveyance losses and canal leakages due to old infrastructure which indicates a huge potential for the implementation of WC/WDM. An unaccounted proportion of irrigation water returns to the river systems by overland flow and return seepage. This can contribute negatively to the water quality in receiving river systems. One of the main aims of the strategy is to promote the equi and efficient use of water while also providing regulatory support and an incentive framework

to improve irrigation efficiency and to increase productivity. The strategy also seeks to promote the optimal use of water which can be achieved by means of allocation and compulsory licensing (DWAF, 2004).

For optimal control and management of the irrigation water use, the importance of developing a WC/WDM Strategy for the agricultural sector cannot be over emphasised. Liaising with sector stakeholders and departmental officials as well as summarising key findings and implementation plans from existing water sector related strategies, have been fundamental in the development and updating of the Agriculture Strategy.

1.2 Rationale

South Africa falls within the top quarter (25%) of the world's most water-stressed nations (Water Resources Institute, 2023). According to the 2020/2021 NSoW, 98% of the country's available water resources are already allocated (DWS, 2022). The second edition of NWRS2 (issued in 2013, now in its third revision) already highlighted that South Africa is currently over-exploiting its renewable water resources on a national level and requires both demand-side and supply-side interventions in order to address a projected supply deficit of 17% by 2030 (DWS, 2018). There are also limited opportunities to supplement future water requirements with conventional surface water resources.

Water has been identified as key to ensure social, economic and environmental viability, sustainability and growth. The water–energy-food interrelationship is critical to building more resilient and sustainable economy. Not taking water insecurity into account when planning can – apart from affecting a country's economic growth - also lead to fragility and conflict. Ensuring that the available water supplies are optimally utilised, and the current resources are optimally stretched is important in ensuring equi access to and sharing of resources. This contributes directly to the National Development Plan (NDP) 2030 goal of **"reducing demand rather than increasing supply",** particularly when considering the impact of climate change that will continue to disrupt the already stressed water resources.

Water demand in South Africa is expected to increase over coming years especially in the agricultural, industrial, and municipal sectors. The rising demand is driven by a combination of population growth, urbanisation, rising incomes, irrigation expansion, non-renewable electricity generation and a growing manufacturing sector (Donnenfeld, et al. , 2018). Despite this, South Africa has managed to enable continued socio-economic development through the strategic use of bulk water transfers and the ongoing development of large-scale infrastructure. Nonetheless, the national water resource system is under pressure.

The above is further exacerbated by South Africa's vulnerability to climate change and is ranked amongst the top half of most vulnerable countries in terms of climate change vulnerability overall, and water-related climate change vulnerability in particular. The increased frequency and severity of droughts in recent years – such as Cape Town's 'Drought of the Century' between 2016 and 2018 – and other similar extreme weather events such as the Cape storms and occasional flooding in Gauteng and Kwa-Zulu Natal have exacerbated the situation. At the time of publishing the NSoW, water restrictions were still applicable for all water supply systems in the Eastern Cape (which is currently experiencing a drought), the Polokwane system in Limpopo, and the Bloemfontein system in Free State Province (DWS, 2022). While the water required for human consumption (including commercial and industrial use), is not as large as other uses, it can be highly significant in catchments where there are high levels of allocation, and this is exacerbated in drought conditions which are expected to increase in frequency and severity due to climate change.

When water resources become scarce, domestic water supply will generally be prioritised over agriculture and the environment. This is becoming increasingly important as South Africa works towards the attainment of the Sustainable Development Goals (SDGs) Goal 6, as well as addressing historic imbalances in terms of access to safe and secure water and sanitation services. This while also considering the increasing challenges related to population growth and urbanisation.

While the quantity of water is the main focus in improving water use efficiency (WUE), water quality cannot be removed from the discourse as South Africa is plagued with a range of pollution problems in many of its catchments, further impacting on the water security of the country. Poor water quality impacts upon the fitness for use of water resources and can reduce the volumes of water available for use. As such, effective and efficient use of scarce water resources is becoming increasingly critical. Adaptation actions are considered essential to building resilience to climate change impacts and the WC/WDM strategy is a key strategy to address growing water stress.

There are many dimensions to the business of water resource management that are interdependent and interconnected, and as such this creates considerable complexity in ensuring the attainment of strategic objectives. Towards this end, progressive development of the NWRS (now in its third edition) has endeavoured to provide structured implementation plans to support the national development agenda.

Giving effect to the NWRS3, is the National Water and Sanitation Masterplan (NWSMP), with its rallying "Call to Action", makes a specific note to reduce water demand among other intervention options. In support of this, and the NWRS, DWS is undertaking important studies such as the updating of the water reconciliation strategies and updating the national water balances to provide a more informed baseline from which directed actions can be developed and implemented. This demonstrates the recognition of the need to develop improved water sector strategies that help to build a more climate resilient South Africa. In response, the National Water and Sanitation Masterplan is also being updated to ensure the country is incrementally improving its sectoral resilience. Noting the water security concerns and the projected deficit by 2030 (DWS, 2018), the development of updated strategies to drive WUE across various sectors have become equally important.

At the centre of all these strategic instruments, WC/WDM is an essential part of the national imperative to address all three of the integrated water resources management (IWRM) principles (social equity, economic efficiency and environmental sustainability) and to underpin the country's ability to address future water deficits. According to the 2004 National WC/WDM strategy (DWAF, 2004), water conservation and water demand management (WDM) are respectively defined as follows:

- ***Water Conservation:*** The minimisation of loss or waste, the care and protection of water resources and the efficient and effective use of water.
- ***Water Demand Management (WDM):*** The adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services and political acceptability.

The Organisation for Economic Co-operation and Development (OECD, 2001) defines water conservation as "the preservation, control and development of water resources, both surface and groundwater, and prevention of pollution". According to Brooks, WDM can be seen as any actions that reduce the amount of water used or enable water to be used more efficiently or any action that keeps the water cleaner during that use than it otherwise would be (Brooks B. , Water Demand Management: Conceptual framework and policy implementation. Management of water demand in Africa and the Middle East: Current Practices and future need, 1997). Other scholars have defined WDM as a strategy or approach that stresses making better use of existing water supply rather than developing new ones; and uses a set of incentives to achieve this (Savenije & Van Der Zaag, 2002). From these definitions, it can be concluded that while water conservation has a broader scope which includes the protection of water resources and prevention of pollution, WDM is specifically focused on reducing water use/consumption by water users. WC/WDM intervention are thus concerned not only with reducing water usage and water loss but also preserving the state of water resources both in terms of quality and quantity. Figure 1-1 illustrates graphically how water conservation can be used to constrain demand to levels that align with planned supply augmentation. The reduced demand can also delay the need for increased supply projects.

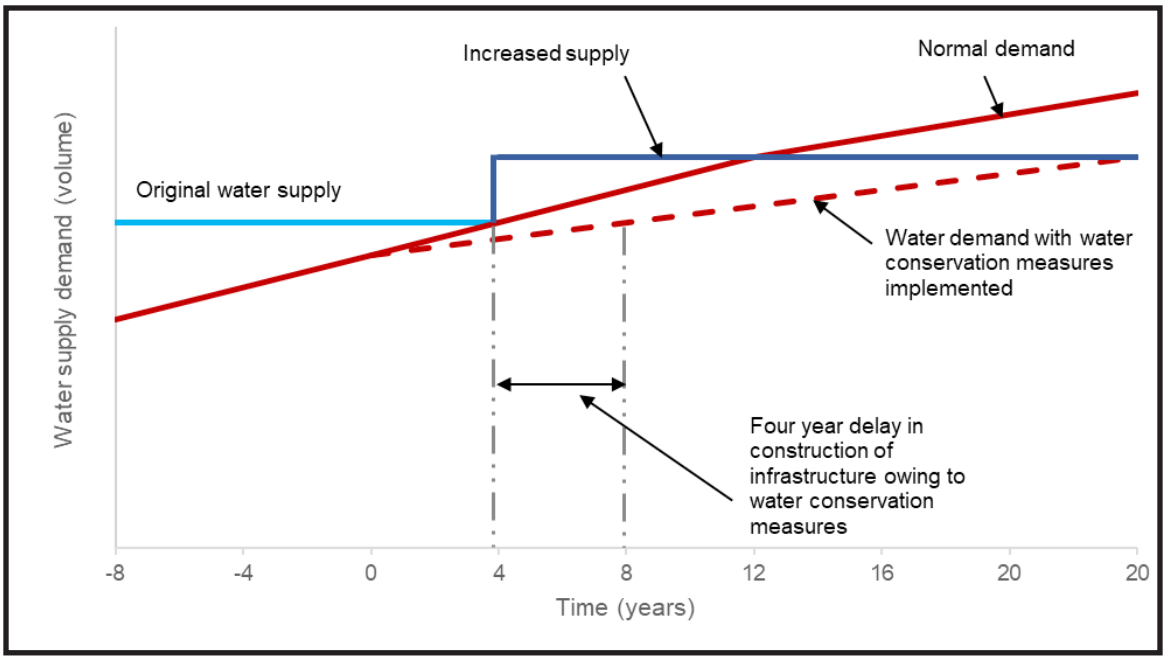

Figure 1-1: Graphical illustration of the positive impact of WC/WDM in a system water balance

Unfortunately, the term 'water use efficiency' is used with different meanings in the literature and by stakeholder groups and sectors, creating confusion. The California Water Code calls water use efficiency "the efficient management of water resources for beneficial uses, preventing waste, or accomplishing additional benefits with the same amount of water. " This aligns with the fact that for many water use efficiency is generally understood to be the ratio between water use and water withdrawn from the resource. In this regard, the NWRS (Editions 2 and 3) both recognise that WC/WDM strategies are an important approach to driving water use efficiency across the various socio-economic sectors.

The current national and sectoral WC/WDM strategies were developed in 2004 with sectoral strategies covering the agriculture, water services, and industry, mining, and power generation (IMP) sectors. Since 2004, it can be appreciated that there have been significant shifts in the status of the country's water resources, both in water availability and quality, as well as a range of changes to the broader social economy of the country. The past decade has also seen significant changes in the understanding of climate change and the detrimental impacts that this is having on water resource globally. The onset of the Covid-19 pandemic has also placed renewed focus on SDG 6 and has specific water, sanitation and hygiene (WASH) implications. With water now being considered Personal Protective Equipment in the fight against Covid-19, and others future pandemics, it becomes even more critical to improve our country's WUE. Additionally, there have also been advancements in technology and innovative approaches to water management. It is in this regard that the 2004 WC/WDM national and sectoral strategies have been updated.

Parallel to the updating of the WC/WDM strategies, DWS has undertaken the development and finalisation of the NWRS3, is updating of the National Water and Sanitation Masterplan, is updating and revising the country's National Water Balances which looks to support the reconciliation of water supply and demand, is undertaking processes to establish Catchment Management Agencies while reforming other elements of the institutional framework, as well as a significant range of other essential interventions to improve water security and ensure sustainable growth and development. The water sector is inherently complex and as such these concurrent processes create the unique opportunity for improved levels of alignment that provide the basis for a resilient and sustainable future. The developmental agenda as set out in the National Development Plan (National Planning Commission, 2012) recognises the importance of water and as such this will require horizontal integration between sectors as well as vertical integration between levels of government, the private sector and society. This requirement is well understood by the water sector, albeit complex, and will require active support and guidance. Towards this end, it will be essential to:

- Provide clear sector leadership that fosters engagement and active participation in interventions to ensure a water secure future.
- Progressively establish, develop and capacitate the institutional frameworks that manage and develop water resources to provide effective water governance.
- Improve the levels of cooperative government between the spheres of government to ensure aligned approaches that support development while recognising the criticality of reducing water demand.
- Develop approaches to operational management and development of water resources that underpin improved levels of WUE.
- Undertake initiatives to build capacity and create awareness so that the WC/WDM becomes an entrenched behaviour amongst all South Africans.

1. 3 Agricultural Sector Institutional Context

The **agricultural sector** represents the biggest opportunities in terms of WUE and water saving gains with about 62% of South Africa's national water demand (DWS, 2004) and around 1. 3-million hectares are under irrigation (see Table 1-1 below). There are also potential additional benefits to the environment, as well as freeing up water for other users, particularly for the development of emerging farmers, which is another important DWS objective. The organised agricultural sector makes it easier to introduce and implement WC/WDM measures and significant technical capacity exists within water user institutions. Many WC/WDM instruments have been tried within agriculture albeit with varying results – these can be consolidated within the Agriculture WC/WDM Strategy. There is a need to regularise some WC/WDM instruments such as pricing and water markets. Good practices such as Water Management Plans (WMPs) have been adopted in a few water user institutions but most irrigation bulk water infrastructure require rehabilitation to improve efficiency.

Table 1-1: National and provincial water use by the irrigated agriculture for the 2014/2015 period (Backeberg, 2018)

Region	Total Area (Ha)	Cultivated Area (Ha)	Irrigated Area (Ha)	Irrigated Area (% of total area)	Irrigated Area (% of cultivated area)	ET (million m^3/year)	ET (m^3/ha)	ET (% of total use)
Eastern Cape	16 896 600	1 355 239	152 866	0.90	11.30	1 070	7 000	10.5
Free State	12 982 520	3 796 784	129 077	0.99	3.40	832	6 446	8.10
Gauteng	1 817 831	405 056	20 115	1.11	5.00	154	7 656	1.50
KwaZulu-Natal	9 463 132	1 428 847	177 341	1.88	12.40	1 518	8 560	14.90
Mpumalanga	7 649 469	1 306 403	125 595	1.64	9.60	1 245	9 913	12.20
Northern Cape	37 288 940	272 079	144 579	0.39	53.10	1 135	7 850	11.10
Limpopo	12 575 390	1 251 682	218 302	1.74	17.40	1 930	8 841	18.90
North West	10 488 170	2 183 704	97 211	0.93	4.50	752	7 736	7.40
Western Cape	12 946 220	1 947 345	269 476	2.08	13.80	1 583	5 874	15.50
National	122 081 272	13 947 139	1 334 562	1.09	9.57	10 221	7 659	100.00

Of course, there are greater dividends in WC/WDM within the agricultural sector using already established institutions managing irrigation schemes. For instance, some irrigation schemes already submit WUE Accounting Reports on a monthly basis reporting on their WUE. The Water Research Commission (WRC) report (TT466/10) notes that the average water loss of the applicable schemes is about 30% while the seepage and evaporation loss in concrete canals, which is unavoidable, is about 12% of the total loss. According to the WRC report (TT466/10), the benchmark for operational losses equals 15% of the inflow into the irrigation scheme.

A summary of losses recorded at large irrigation scheme where Water Administration System (WAS) has been deployed is given in .

Table 1-2: Water loss summary among large irrigation schemes (NB Systems Cc, 2017)

Irrigation scheme	Region	Scheduled area (ha)	Allocation (m^3/ha)	Full quota (m^3)	Avg.loss (%)
Impala WUA	KwaZulu Natal	17 012	10 000	170 120 000	13.2
Sandvet WUA (Sand)	Free State	5 181	7 200	37 303 200	22.0
Lower Olifants River WUA	Western Cape	9 212	12 200	112 386 400	23.1
Vaalharts WUA	Northern Cape	35 060	9 140	320 448 400	23.8
Loskop IB: left bank canal	Mpumalanga	14 398	7 700	110 864 600	28.4
Loskop IB: right bank canal	Mpumalanga	1 776	7 700	13 675 200	31.1
Orange-Riet WUA	Free State	15 941	11 000	175 351 000	33.7
Sandvet WUA (Vet)	Free State	7 153	7 200	51 503 256	38.5
Hartbeespoort IB: West canal	North-West	7 083	6 200	43 914 600	52.5
Hartbeespoort IB: East canal	North-West	6 832	6 200	42 385 400	56.0
Total		119 648		1 077 952 056	

At least five of these schemes have significant losses above best management practices (BMP). If these schemes can be prioritised to achieve the target loss reduction as proposed in the , up to 31. 5 million m^3/a can be saved.

Table 1-3: Proposed target loss reductions for large irrigation schemes

Irrigation Scheme	Target loss reduction %	Target loss reduction volume m^3
Hartbeespoort Right	29%	11,198,223
Hartbeespoort Left	26%	12,283,936
Sandvet (Vet)	12%	5,922,874
Orange-Riet	7%	11,748,517
Loskop Right	4%	560,683
Total		31,517,821

In additions to these large schemes, many irrigation schemes experience water losses of between 35% and 45% since these due to the scheme being in a state of disrepair and some have exceeded their economic lifespan. The efforts to save water by this sector should be given high priority. A small percentage improvement in WUE could result in a substantial reduction in water losses. In terms of water delivered on farms, all efforts must be made to use water efficiently from on farm storage, distribution systems to in-field application supported by BMP.

With the declining water resource availability, more attention has been given to improving the efficiency of irrigation practices within the agricultural sector. More efficient use of the available water is needed and therefore the reduction of the irrigated area is not necessarily the solution with regards to a shortage in water supply. Despite the potentially high initial capital costs of the latest software and equipment, its reduced water usage, increased efficiency and higher yielding produce is irrefu.

2 Strategic Imperatives

2. 1 Aligning to development agendas

2. 1. 1 Global

The WC/WDM strategy for the agricultural sector is aligned to the global as well as national development agendas such as the SDGs and the NDP underpinned by the NWRS3 and the National WC/WDM Strategy.

The significance of water in the social – economic development of a country such as South Africa cannot be overemphasised. Several authors have pointed out that water can be an enabler as well as an inhibitor to a nation's wealth and health as it is used in the production of virtually all economic goods and services (Booker, Howitt, R. E. , , Michelsen, A. M. , , & Young, 2012). In line with this, the United Nations has bemoaned the need for proper management of water resources as it brings prospects of poverty reduction and economic growth to most economies (World Water Assessment Programme (United Nations), 2006). The challenges now facing the water sector and the population dependent on water have been around for quite some time and anticipated to get even worse. For instance, scholars such as (Rosegrant, 1997) warned that securing water for the future generation would be one of the critical challenges for water resources managers in the 21st century. When assessing options for managing this challenge, Rosegrant noted that while there was potential of developing new water sources to augment the supply to meet the growing demand, shrinking appetite by large multilateral institutions in providing investments for large water infrastructure development projects suggest a need for identifying new options for securing water supply. Along with many other scholars, Rosegrant asserts that the water resource supply challenges shall require measures that have potential to stimulate efficient use of water, especially within the agricultural sector (Rosegrant, 1997).

The United Nations and many multilateral global institutions such as Food and Agricultural Organisation (FAO), Organisation for Economic Co-operation and Development (OECD), the World Bank etc. have come to an agreement that water scarcity is one of the greatest challenges facing the population in the twenty-first century. As agriculture accounts for the bulk of global water withdrawals, agriculture tends to be at the centre of water scarcity conundrum. Coupled with the impacts of climate change, the growing need to feed the ever-increasing world population has pushed water withdrawals to almost twice the rate of population growth. With the steady economic development in emerging economies, it has estimated that 60% more food will be required to feed a population of more than 9 billion by 2050. Eventually, this shall result in agricultural water use increasing the severity of water scarcity in some areas and causing water scarcity even in areas that are relatively well endowed with water resources. The water scarcity challenge in agriculture is further exacerbated by the sectoral competition over water whereby water fetches higher value than within irrigation such as the new urban and industrial parks.

Realising the risk brought about by water scarcity to water-scarce regions and countries such as South Africa, a partnership called the Global Framework on Water Scarcity in Agriculture (WASAG) was established in 2017. Hosted by FAO, WASAG consists of government agencies, international organisations, research institutions, advocacy groups and professional/membership organisations. WASAG fosters collaboration among partners for the development and deployment of policies, strategies (such as the development of WC/WDM strategies), and programmes, enhancing field capacity for the adaptation of agriculture to water scarcity. A primary objective of WASAG is to support governments and stakeholders in the achievement of the water-related targets of the 2030 Agenda for Sustainable Development, with particular emphasis on SDG 6 'Clean water and Sanitation' and SDG 2 'Zero hunger' among other SDG goals.

The mission of the International Committee on Irrigation and Drainage (ICID) is to promote '. " Water used in crop production should be considered as an agricultural input to be used optimally since it is a scarce and valuable resource. The aim with optimised irrigation water supply is to maximise the component of water abstracted from the source that will reach the root zone of the plant. This fraction of water can be referred to as the beneficial water use component. It is important that water abstracted for irrigation purposes reaches its intended destination (the root zone where the plant can make best use of it) efficiently and effectively. This entails that the least amount goes to waste along the supply system and that the water reaches the plant at the right time, in the right quantity and the right quality. Efficiency does not necessarily relate only to the type of irrigation systems but more specifically to the way a particular system has been designed and is managed. Switching from one system to another would not necessarily yield greater benefits compared to having a closer analysis and refinement of existing systems and water management strategies. When assessing irrigation efficiency, this "water accounting" or "water balance" approach has been recognised internationally as the way forward (Reinders, 2010). A schematic representation of the ICID framework as described by Perry (2007) is shown in the Figure 2-1.

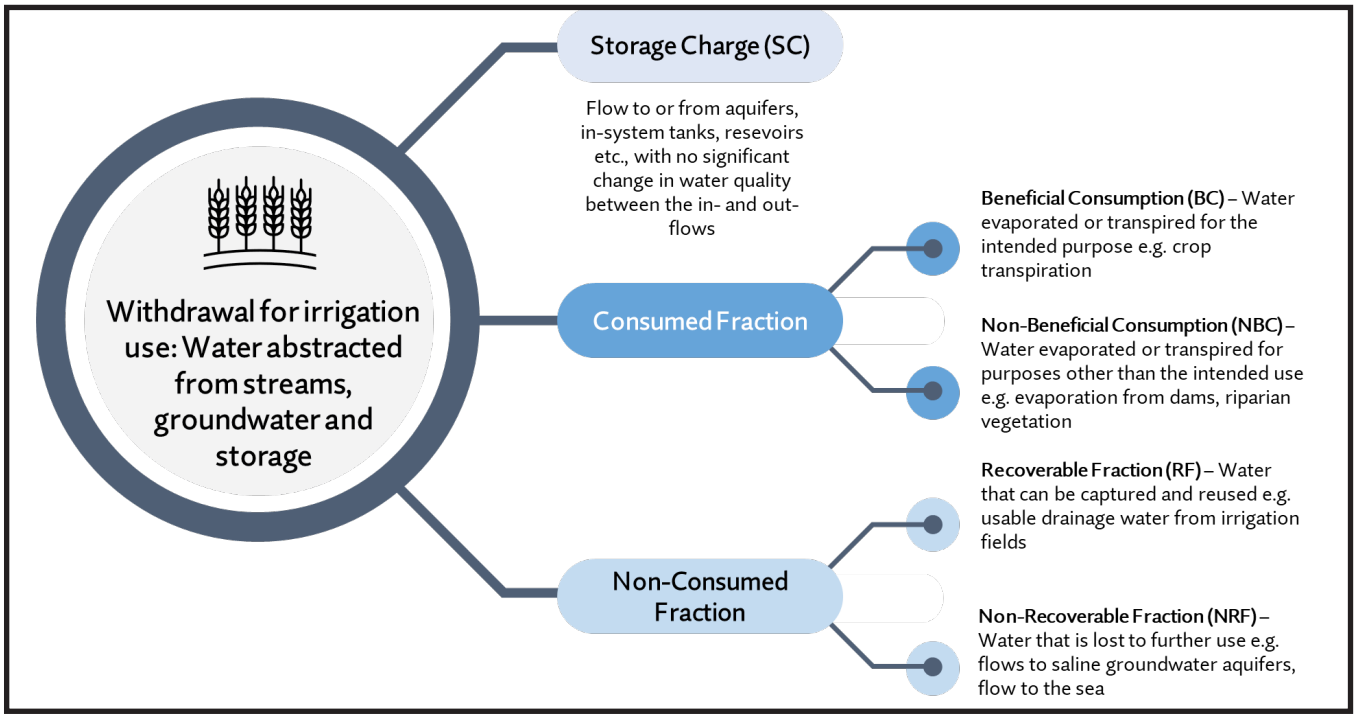

Figure 2-1: ICID water balance framework for irrigation water management (Perry, 2007)

2. 1. 2 National

National Development Plan (NDP)

South Africa's vision for 2030 is presented in the NDP 2030. The primary aim of the NDP is to eliminate poverty and reduce inequality by "". The NDP recognises that access to water and sanitation services are cross cutting issues and necessary enablers for addressing poverty, unemployment and inequality. In terms of water, the NDP envisages that by 2030:

- All main urban and industrial centres will have reliable water supply to meet their needs, while increasingly efficient agricultural water use will support productive rural communities.
- Natural water sources will be protected to prevent excessive extraction and pollution. Water will be recognised as a foundation for activities such as tourism and recreation, reinforcing the importance of its protection.
- Where rivers are shared with other countries, South Africa will ensure that it continues to respect its obligations.
- Before 2030, all South Africans will have affordable, reliable access to sufficient safe water and sanitation. Service provision arrangements will vary in different parts of the country, with different approaches adopted for densely built-up urban areas and scattered rural settlements.
- Water demand will be reduced by 15 percent below baseline levels in urban areas by 2030.

Although the NDP pre-dates the SDGs, there is alignment and a strong resonance. The Department of Planning, Monitoring and Evaluation (DPME) found that 74% of the 169 SDG targets are addressed by the NDP. Of the 26% of targets that are not addressed in the NDP, 19% are addressed in other sectoral programmes and 7% are not applicable to South Africa such as targets related to small islands and fragile states. Thus, working towards the vision of the NDP will also drive progress on achieving the SDGs.

Other Government Imperatives:

The government through the DWS has undertaken several interventions with regards to WC/WDM. These have ranged from management, innovation and technology, infrastructure development, and research and knowledge exchange. Since the development of the 2004 WC/WDM strategy, several initiatives have been implemented across the country within the sector. The assessment of these would bring about several lessons that can be used in updating the strategy.

- Awareness campaigns should be conducted throughout and not only during the drought or period of low water availability.
- Other WDM instruments should be complemented using awareness campaigns to be effective.
- Implementing the WAS at an irrigation scheme for water distribution management and reporting purposes, can reduce annual water losses by 5%.
- The BMP for distribution losses in an irrigation scheme is 15% of the total volume released.
- Target water savings of up to 11% of the total volume released can be achieved in an irrigation scheme by intervention measures such as

refurbishment and reseal, repair of leaking siphons, flow measurement, monitoring and implementation of WAS as well as management of operational spills.

- Drought can have a significant impact on the agricultural sector in terms of economic loss, job losses and a decrease in exports.
- Farmers are prompted to continuously find ways to reduce water use and innovate in order to produce more with less, especially in terms of the availability of freshwater.
- Precision farming is becoming more important and is one of the ways in which farmers can become more resource efficient and water smart by making use of online tools and the latest agricultural technologies to provide insight into water use on their farms.
- Agriculture should become more resilient to climate change and more resource efficient.
- It is vitally important to manage the available water resources at catchment scale and to monitor water use.
- Reducing the growth of alien vegetation in key catchment areas is a priority especially considering the increasing water shortages.
- Water reuse is a key component of longer-term plans to enhance water security; water reuse and investing in facilities such as the Potsdam wastewater treatment plant is critical.

The DWS would like to build upon this strategy by consolidating the gains it has accumulated and lessons generated in the process. The first step has been the updating of the NWRS2 and hence the publication of the NWRS3. Of critical importance here is the intention by the government through the NWRS3 to pursue key interventions, including a plan to expand the agriculture and agro-processing sector, by supporting key value chains and products, developing new markets and reducing reliance on agricultural imports.

Furthermore, the National Water and Sanitation Master Plan is positioned as an implementation plan for the NWRS2 and National Water Security Framework (NWSF). Among the key actions outlined in the National Water and Sanitation Master Plan (2018) in terms of irrigated agriculture, include to reduce the water demands and water losses at all major irrigation and agricultural schemes by 2030, without affecting productions. A R10 billion capital cost is planned to refurbish and rebuild irrigation schemes as most of them are old with infrastructure conditions declining coupled with the lack of proper water measurement. There is also an absence of adequate staff to ensure effective operation and maintenance of schemes as well as direct river abstractions within the schemes. Another key action identified in the National Water and Sanitation Master Plan includes redistributing water for transformation. The supporting action in terms of irrigation entails implementing the WAS on all government irrigation schemes for transformation. The drivers/goals behind these actions include ; as well as the. The magnitude of the impact if these actions are not realised, were all categorised as serious. The fact that irrigation is the responsibility of Department of Agriculture, Land Reform and Rural Development (DALRRD), while DWS is responsible for providing the water, has prevented these actions from being completed to date (DWS, 2018).

The NWSF guides, complements and dovetails with existing national policies and strategies. It enhances the water security component of the NWRS, as well as the National Water and Sanitation Master Plan. It proposes a suite of opportunities and recommendations for sector-wide migration into water security strategies that includes enhancing WC/WDM.

DALRRD has developed its National Strategic Plan for Agriculture for the period covering 2020 to 2025 to guide its efforts in implementing the imperatives of the NDP. The plan outlines 6 outcomes that must be accomplished in line with the government's 2020/21-2024/25 Medium Term Strategic Framework. With reference to the focus of this Strategic Framework, Outcome 4 addresses aspects of increasing agricultural production in yields, volumes and efficiencies, through the sustainable use of natural resources, technologies and management of risks. This outcome would be the measurement of the agricultural output and agricultural input. The White Paper on Agriculture of 1995 and the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) principally aim to build the agricultural sector in South Africa to reduce unemployment and poverty. One of the policy objectives is "". In addition, there was the development of a discussion document on a Policy on Agriculture in Sustainable Development by DALRRD, which deals extensively with water issues, including impacts on water quality arising from agricultural practices. However, the Agricultural Policy Action Plan (2015 – 2019) itself does not make any reference to issues relating to the water quality impacts of agriculture, or of the impacts of agriculture on declining water quality. This reality reiterates a recognition of the fragmented nature of Integrated water quality management and underscores the observation that the issue of water quality is not being appropriately addressed. The National and Provincial Departments of Agriculture are responsible for the implementation of the CARA and for agricultural policy; responsible for promoting agricultural practices that reduce water pollution. In reviewing the CARA, DALRRD will consider the need to reduce the water pollution arising from current agricultural practices. The Department will, in line with the approach outlined in the draft Policy on Sustainable Agriculture, promote sustainable agricultural practices that, amongst other things, will contribute to the reduction of water pollution arising from agricultural areas. The Department will also ensure improved enforcement.

3 Agriculture WC/WDM Context

3. 1 Legal Instruments

The National Water Act (Act 36 of 1998) is the legal foundation for managing water resources in South Africa. The Act gives provision for the development of other policy and legislative frameworks from where WC/WDM strategies fall. In addition, DALRRD has developed and effected some other legislative and policy instruments that have a bearing on the management and utilisation of water resources in agriculture. The following are the key legal instruments that have been considered in the review and development of the current WC/WDM strategy.

3. 1. 1 National Water Act (Act No. 36 of 1998)

The Guide to the National Water Act of South Africa describes the National Water Act as an act that deals with the water resources i. e. , rivers, streams, dams, and groundwater. The act contains rules about the way water resource (surface and groundwater) are protected, used, developed, conserved, managed and controlled in an integrated manner (De la Harpe and Ramsden, 2006). The main purpose of the act is to provide for fundamental reform of the law relating to water resources and to repeal certain laws (Republic of South Africa, 1998). The act takes into account several factors, including meeting the basic human needs of present and future generations, promoting equi access to water, redressing the results of past racial and gender discrimination, promoting the efficient, sustainable and beneficial use of water in the public interest, facilitating social and economic development, providing for the growing demand for water use, protecting aquatic and associated ecosystems and their biological diversity, reducing and preventing pollution and degradation of water resources, meeting international obligations, promoting dam safety, and managing floods and droughts (Republic of South Africa, 1998).

3. 1. 2 Conservation of Agricultural Resources Act (CARA) 1983 (Act No. 43 of 1983)

The Act provides for the control over the utilisation of the natural agricultural resources of South Africa in order to promote the conservation of the soil, the water sources and vegetation, and the combating of weeds and invader plants. This legislation promotes sustainable use of natural resources in order to ensure long-term productivity of the plant production sector.

3. 2 Policy Instruments

3. 2. 1 White Paper on Agriculture (1995)

The White Paper on Agriculture recognises that agriculture is an important primary component in the national economy and for the community. It further recognises that the role of agriculture in the rural community must be coordinated with the roles of the other government departments, non-governmental organisations, and private enterprises involved in and willing to rebuild and strengthen South Africa's rural communities. With that notwithstanding, the White Paper notes that South Africa is a country lacking sufficient water supplies while also characterised by a scarcity of high potential agricultural land. The paper, therefore, demands that agriculture utilises these two resources to ensure the sustainable production of agricultural products.

3. 3 Strategies and Other Instruments

3. 3. 1 WC/WDM Strategy for the Agricultural Sector (2004)

One of the main aims of this strategy was to provide a regulatory support and incentive framework to improve irrigation efficiency and to increase productivity. The strategy also sought to promote the optimal use of water (release water to previously marginalised farmers) which can be achieved by means of allocation and compulsory licensing. Further, the strategy pronounced an attempt to reduce the cost of water as production input to compete with producers in the global markets and encouraged water re-use of treated effluent from urban areas. From this strategy, a plan of action was envisaged which must present the following strategic outputs:

- Appropriate measures that reduce wastage of water.
- Progressive modernisation of water conveyance, distribution and application infrastructure, equipment and methods.
- Preventative maintenance programmes.
- Water allocation processes that promote equi and optimal utilisation of water.
- Generation of sufficient irrigation information which is accessible to all stakeholders.
- Implementation of water audits from the water source to the end user.

3. 3. 2 National Water Resource Strategy (NWRS) (First, Second and Third Editions)

The development of the NWRS is defined in Section 5 of the National Water Act (Act 36 of 1998). The strategy is the legal instrument for implementing or operationalising the National Water Act. The strategy is a document that provides the framework for the protection, use, development, conservation, management, and control of water resources for the country as a whole, at regional or catchment level (DWS, 2004). The NWRS also outlines the future plans and proposes arrangements with neighbouring countries for managing shared rivers (Maharaj and Pietersen, 2004). The NWRS provided the framework within which water resources were to be managed throughout the country, as outlined by section 5(3) of the National Water Act. The development of WC/WDM strategies for all water use sectors such as agriculture has been spelled out in the NWRS2 with a particular emphasis on coordination of departments and institutions in implementation of WC/WDM measures.

3. 3. 3 National Water and Sanitation Master Plan (2018)

The National Water and Sanitation Master Plan is a blueprint for the development of water and sanitation in the country and WC/WDM is a key element and enabler of successful implementation of this master plan. Among the key actions for this plan in terms of irrigated agriculture, include reducing the water demands and water losses at all major irrigation and agricultural schemes by 2030, without affecting productions. Actions are to be implemented at a regional level and some of the major measurable deliverables include:

- Achieve a reduction of total water use per unit of production by 10% over a 10-year period.
- Review and improve the regulatory instruments to promote sound infrastructure operation and maintenance practices and renewal of ageing infrastructure at all major irrigation and agricultural schemes managed by water user associations (WUAs) or private owners to reduce water losses.
- Improve condition of canal infrastructure.
- Water measurement at all irrigation schemes.

3. 3. 4 National Strategic Plan for Agriculture (2020 – 2025)

DALRRD has developed its National Strategic Plan for Agriculture for the period covering 2020 to 2025 to guide its efforts in implementing the imperatives of the NDP. The plan outlines 6 outcomes that must be accomplished in line with the government's 2020/21-2024/25 Medium Term Strategic Framework. With reference to the focus of this Strategy, Outcome 4 addresses aspects of increasing agricultural production in yields, volumes and efficiencies, through the sustainable use of natural resources, technologies and management of risks. This outcome would be the measurement of the agricultural output and agricultural input.

3. 4 Institutional and Governance Framework

The importance of an institutional framework for governing water of any nation cannot be overemphasised, more so in South Africa due to water scarcity. The National Water Act was developed and enacted in 1998 primarily to ensure that the nation's water resources are developed, managed, protected, used, conserved, and controlled in a sustainable and equi manner for the benefit of citizens of the country. Accordingly, the National Water Act (Act No. 36 of 1998) sets the framework for the management and governance of water resources in South Africa; as well as achieving sustainability through integrated management of water resources within the principles of WUE. In order to achieve this objective, the Act provides for the establishment of water management institutions (WMIs) within specified geographical areas.

Within this governing framework, the Minister of Water and Sanitation has the overall responsibility for effective water management as the custodian of the indivisible national water resource. This responsibility is discharged through DWS which is also responsible for overseeing overall implementation of the Act.

The act also allows for the Catchment Management Agencies (CMAs) whose role is water management at a water management area (WMA)/ catchment level and is responsible for the progressive development of catchment management strategies. The Acts also state that the CMAs will use the catchment management strategy consistently with the NWRS, within its WMA. It is important to note that most of this responsibility is delegated by the Minister.

The third tier in this framework is considered to operate at a local level lower than the WMA. This proposition was also supported by the White Paper of 1997 which highlighted the role that Irrigation Boards and WUAs play at this level. Accordingly, Irrigation Boards and WUAs have continued discharge functions related to this objective as well as those delegated to it by the Minister. It is important to highlight that since the promulgation of the Act; these institutions have played crucial roles in managing water supply or distribution to various water users based on their water demands and licence schedule. This suggests that Irrigation Boards and WUAs are critical institutions in the development and implementation of

water demand management programs and initiatives at local level especially within the agricultural sector.

It should, nonetheless, be highlighted that Irrigation Boards were established by the Water Act of 1956 while WUAs are established by the National Water Act of 1998. Generally, most of the Irrigation Boards were established to be in the service of commercial agriculture during the apartheid era. These organisations were historically established in areas sui for irrigation development and often associated with government investment in irrigation schemes by the Department of Irrigation (which eventually became the current DWS) who supported their establishment and maintenance. With respect to the National Water Act, all irrigation boards were supposed to be transformed into WUAs in accordance with the provisions of section 98(4). In general, WUAs perform the following functions:

- Operational functions, related to the management of a service;
- Bulk raw water supply functions, related to the management of a bulk raw water supply system;
- Resource management functions, related to the management of the resource; and
- Representation functions, related to the representation of stakeholder needs at higher institutions of water management.

4 Situational Analysis

4.1 Status Quo

4.1.1 Sectoral Aspects

South Africa is a water-scarce country, and the sustainable provision of water is amongst its most significant socio-economic challenges. The country is located within Southern Africa's 'drought belt' and, according to the World Bank, is the fifth most water-scarce country in Sub-Saharan Africa. Since the 1960s, South Africa has already experienced a rise in average annual temperatures country-wide, by 1. 5 °C. While the temperature has increased more markedly across arid, inland areas of the country, with records showing that daily temperatures have risen, rainfall trends display less clarity, with significant inter-annual variability. There are also considerable geographic variances in historic rainfall patterns.

With mean annual precipitation being only 60% of the global average and with this being spatially and temporally variable, the country has challenges in meeting water requirements with some regional disparities. This is exacerbated by major urban centres and growth nodes not being situated in alignment with water resource availability. These nodes, such as Cape Town, Port Elizabeth, and Johannesburg (amongst others) are therefore interconnected with key water resources through a network of bulk water transfers. These transfers have enabled the continued socio-economic development of the country; however, this also means that the status of water resources within these water supply systems is very dependent on water resources within other catchments in other parts of the country.

Noting this context, the DWS developed a suite of WC/WDM strategies to promote WUE indicating that these strategies would provide guidance as to a responsible approach with multiple water sector institutions playing an important role in the implementation of these strategies.

In terms of agricultural water use, nationally, in 2014/15 the Western Cape used 15. 5% of available water compared to Limpopo's 18. 9% and KwaZulu-Natal's 14.9%. Although the Western Cape has the largest area under irrigation (269 476 ha) it also had the lowest water use per area unit (5 874 m^3/ ha), showing that efficiencies have already been put in place. In the same period, Mpumalanga had the highest water use per hectare irrigated (9 913 m^3/ ha) and Limpopo the second highest water use per hectare (8 841 m^3/ha).

According to the Water Use Authorisation and Registration Management System (WARMS) database (updated in August 2016) the irrigated agricultural sector uses 12.0 billion m^3/a comprising 64.8% of the total freshwater use. This is about a 2 billion m^3/a more compared to the 2014/2015 period as per earth observation method (CSIR, N. D.). The total estimated irrigated area in South Africa ranges between 1.29 and 1.59 million hectares according to the WRC and DALRRED in 2018 while the actual area registered for irrigation use ranges between 1.44 and 1.68 million ha. Updated information around the total area under irrigation remains a challenge and a comprehensive fly-over census for all provinces remains critical to set an accurate baseline. Despite the major water resource challenges which the country faces, research shows that the actual water required to expand land under irrigation by 142 000 ha to contribute to the million job opportunities by 2030, is practicable. This expansion assumes that the WAS is implemented comprehensively on 600 000 ha. Research has proven that more than 20% of savings can be achieved at irrigation schemes where WAS has been implemented. An expansion in the area under irrigation is achievable nationally without allocating more water to the agricultural sector by means of intensification or optimisation of irrigation methods and WUE (BFAP, 2021).

Unfortunately, the neglect of water supply infrastructure is an aspect that is bedevilling South African agriculture. While there is ample evidence to suggest there are problems with this infrastructure, little research has been done to evaluate its extent. The Bureau for Food and Agricultural Policy (BFAP), describes the infrastructure as being in a very poor state. The conveyance of water through bulk infrastructure distribution networks to the point of abstraction at the farm is problematic. It is estimated by WRC that approximately 50% of water is lost between the dam (where it is released) and the farm (where it is

applied). Since these losses are included in the total water demand for irrigated agriculture, the water footprint for food production can be misleading; far less water is used to grow food. Leaking pipes and broken pumps are of particular concern and there is a huge back log with infrastructure maintenance and improvements. The infrastructure of the irrigation schemes in the Hartbeespoort, Douglas and Vaalharts areas is nearly 85 years old. They currently service vast tracts of productive farms that are crucial to South Africa's food supply and are in desperate need of maintenance (Botha, Ailing infrastructure: a threat to SA agriculture, 2021).

According to the Agricultural Survey of 2019, compiled by Statistics South Africa, livestock contributes 48% to the total sales in the agricultural sector. Second in line is horticulture at 27%, field crops at 19% and other products and goods at 3% and 2% respectively. Figure shows the goods that drive South African agriculture (Sikuka, 2019).

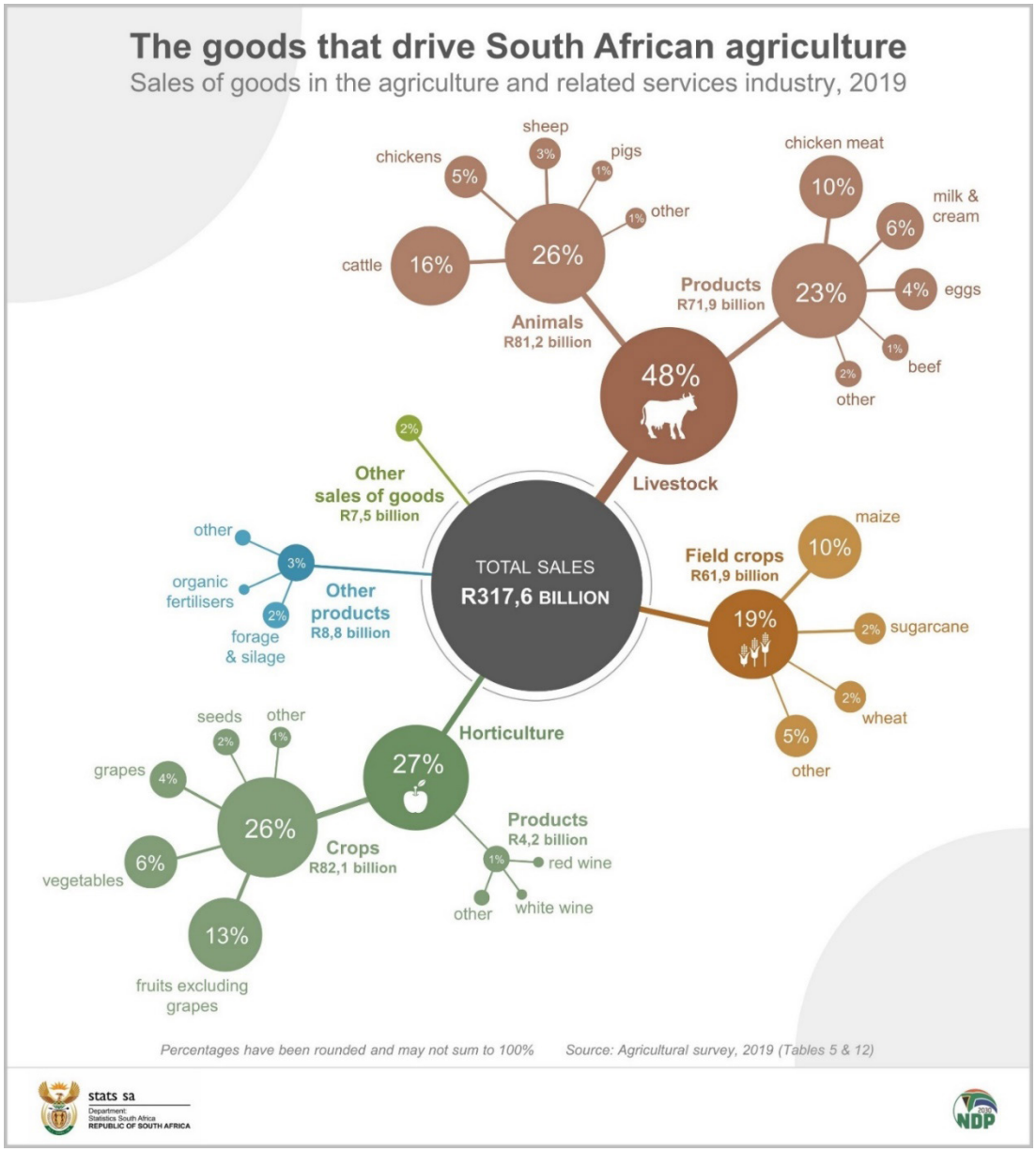

Figure 4-1: Percentage sales of agricultural goods and related services industry in 2019

In the Western Cape, agriculture sustains a R530 billion economy and employs 15% of the labour force. This entails 180 000 workers directly employed and another 126 000 workers employed in the agri-processing sector. In the Western Cape, 43% of available water is used for irrigation. On average, the agricultural water use in the Western Cape was cut by 60% since 2017 (WWF, 2018). The impact of the drought in the Western Cape, has led to an economic loss of R5,9 billion, up to 30 000 job losses and a decrease of 13 to 20% in exports in the agricultural sector alone. Many fruit trees and vineyards had to be removed prior to the normal replanting schedule.

The impact of the increase in water tariffs has led to the need to use water more efficiently on farms. The water requirements of crops as well as the gross margins of crops differ significantly, as indicated by the summary in (Baleta & Pegram, 2014). From the there is quite a variability in water costs, input costs and profitability across a representative range of crops. The water-use and cost columns are based on typical water requirements and charges for a certain crop in a specific part of the country. It is important to note the considerable variation for both water use and charges around this typical value (Baleta & Pegram, 2014).

Table 4-1: Water statistics for different crops (Baleta & Pegram, 2014)

Crop	Gross farm income (R/ha)	Input costs (R/ha)	Profit (R/ha)	Irrigation type	Water abstraction (m^3)	Total water charges (R)	Water charges (% of input)
Maize	7 066. 594	2 500	1 431. 2	Sprinkler	7 800	936	16
Potatoes	58 208	42 395	15 813	Sprinkler	5 122	614	0. 8
Apples	192 720	175 112	17 608	Drip	21 567	2 588	1. 36
Lucerne	3 179. 5	1 589. 83	1 859. 67	Sprinkler	19 383	2 325	18. 4
Sugar	19 228	15 000	4 228. 431	Centre pivot	17 434	2 092	15. 4
Citrus	71 040. 43	12 960	58 080	Drip	16 621	1 944	13. 94

In line with the NWRS3, the Directorate of Water Use and Irrigation Development of DALRRD developed an Irrigation Strategy, as well as the Irrigation Revitalisation Business Plan which indicates that approximately 111 000 ha of irrigated land requires revitalisation and further water availability was identified for a possible 34 000 ha of irrigation expansion ( ). The basic motivation for expansion of land under irrigation remains the same, however recent reports from DALRRD point to the need to better understand the factors that influence the success of revitalised irrigation schemes and the way these programmes are structured. The Irrigation Strategy therefore seeks to practise irrigation within the confines of limited sui natural resources to unlock the potential of people as well as land. Maintenance in the infrastructure of irrigation schemes has fallen behind. The expansion and maintenance of infrastructure in existing irrigation schemes is critical for new entrants to enter the sector successfully, (BFAP, 2021).

Table 4-2: Potential irrigation expansion (BFAP, 2021)

Total expansion potential (new water developments – expanding storage & infrastructure) - Hectares		34 000
Project allocated	Western Cape: Clanwilliam Dam	4 000
No water developments allowed	North West: Taung Irrigation Scheme	1 300
	Northern Cape: Upper Orange River Catchment	5 000
	Mpumalanga: Department of Agriculture in Mpumalanga	3 000
	Makhathini Irrigation Scheme	10 000
	Free State: Upper Orange River Catchment	3 000
	Eastern Cape: Upper Orange River Catchment, Umzimvubu Dam, Foxwood Dam	7 700

The South African framework covers four levels of water management infrastructure – the water source, bulk conveyance system, the irrigation scheme and the irrigation farm as shown in.

Table 4-3: Levels of water management infrastructure (Reinders, 2010)

Water management level	Infrastructure system component		
Water source	Dam/Reservoir		Aquifer
Bulk conveyance system	River	Canal	
Irrigation scheme	On-scheme dam		
	On-scheme canal		
	On-scheme pipe		
Irrigation farm	On-farm dam		
	On-farm pipe/canal		
	Irrigation system		

4.1.2 Sub-sector Aspects

The development of WMPs by WUAs is central to implementing WC/WDM in the agricultural sector. Essentially, the process aims to conserve water, to improve water supply services to irrigation farmers and to enable them to use irrigation water more efficiently. The process involved analysing current water use, setting targets for improved efficiency and planning a realistic means of reaching these targets, all of which is very important within this sector and should be given priority. The DWS promoted and initiated the development of these Plans by all irrigation schemes. A pilot project in 14 irrigation schemes (Kakamas WUA, Boegoeberg WUA, Lower Olifants River WUA, Lower Sundays River WUA, Impala WUA, Sand-Vet WUA, Schoonspruit Government Water Scheme (GWS), Mooi River GWS, Groot Marico GWS, Nzhelele GWS, Levuvhu GWS, Hartbeespoort IB, Hereford IB, and Loskop IB) has identified considerable reductions in water losses to be achieved, essentially through infrastructure asset management and operation. It is thus important that irrigation schemes develop WMPs (DWA, National Water Resource Strategy. Edition 2, 2013). Ideally each Irrigation Board or WUA should develop their own WMP with the examples of the 14 schemes and in collaboration with South African. Association of Water User Associations (SAAFWUA) and the CMA and private sector engagement as required.

From the WMP developed for the Impala WUA, it was estimated that target savings of 11% can be achieved (20. 3 million m^3/a of input volume) by implementing certain intervention measures as per.

Table 4-4: Target savings in the Impala WUA (DWA, Development and Implementation of Irrigation Water Management Plans to Improve Water Use Effeciency in the Agricultural Sector - Impala Water User Association, 2013)

Issue	Target saving	Intervention measure (action)
Leakages	2%	Refurbishment & resealing
Infrastructure condition	3%	Repair of leaking siphons
Operational losses	5%	Flow measurement, monitoring & WAS
Canal tail ends	1%	Management of operational spills at tail ends

The largest potential impact of WC/WDM in the agricultural sector can be achieved by addressing wastage due to conveyance losses and the inefficient use of water, particularly during irrigation. Understanding this need, the WAS was developed and piloted. This system allows for an integrated information management system for irrigation schemes that delivers water on demand through canal networks and rivers and can be used for water distribution management, debit accounts management and for the calculation of canal and dam operating procedures for a given downstream demand. Studies have shown the implementation of WAS to be highly successful and had significant impacts on irrigation water losses and by implication increased water savings in river and canal conveyance networks (Benade, 2014). During the implementation of the first phase of the WAS system, four large irrigation schemes were supported with the roll out of the WAS system water release module (Sand-Vet, Vaalharts, Hartbeespoort (West Canal) and Orange-Riet). As part of Phase 2 of the WAS roll out project, the Strategic Water Partners Network (SWPN) engaged with NB Systems cc to implement the WAS water release module at another six irrigation schemes including the Impala WUA, Loskop Irrigation Board (Left & Right bank), Lower Olifants River WUA, Hartbeespoort Irrigation Board (East canal), the Nzhelele Government Water Scheme (GWS) and measurement activities were supported on the Orange-Riet irrigation scheme (Benadé & Benadé, 2018). With the WAS Release Module, it is possible to release the correct amount of water from a dam (source) according to applications (demand). If more water is released than requested out of our dams, the water will be wasted (DWS, 2021). Building on the successes of the WAS Project Phases 1 and 2, SWPN has supported the upscaling of the roll-out of the WAS to 13 additional irrigation schemes in Phase 3 of the project. The projected water loss reduction of 66 Mm^3 for phase 3 is anticipated. The estimate for the savings in phase 3 is based on a 10% reduction of the full water quota allocations combined. This is a conservative estimate compared to the 15% savings that were realised in phases 1 & 2. The SWPN together with DWS was in the process to try and roll out the WAS nationally, but there are items still to be addressed. All together 37 measuring stations were installed under WAS Phases 1 to 3. The Cello logger that is linked to the Zednet internet interface was found to be the preferred measuring station for the canal inflow measurements. The Landbank donated funds to purchase and install 28 loggers which are used to measure the inflow into the respective schemes where needed (Benadé & Benadé, 2018).

Unfortunately, WAS does not cover the smallholder sector where water losses might be even higher. In order to fill this gap, the Agricultural Research Council (ARC) through its Irrigation and Agricultural Infrastructure Engineering division, together with partners, is developing a framework for reporting canal water losses across the whole spectrum of irrigation schemes in the country.

Government and public agencies invested more than R1 trillion in infrastructure between 2009 and 2014. The investments were in energy, road, rail, ports, public transport, bulk water and sanitation, hospitals, basic and higher education infrastructure and innovative projects such as the Square Kilometre Array and Meerkat telescopes. By January 2013, work had commenced on all 18 Strategic Infrastructure Projects (SIPs). Up to R300 billion was invested in the National Infrastructure Plan by both the public and private sector in 2016/17. Water and sanitation related achievements with reference to the irrigated agriculture in 2016/17 included (South African Government, 2022):

- The raising of the Clanwilliam Dam Wall and Irrigation Scheme in the Western Cape which would increase water storage capacity and support the economic potential of the area.
- The raising of Tzaneen Dam (Limpopo) which started in 2017.
- Phases 1 and 2 of the Hoxane Water Treatment Works in Mpumalanga which has been completed. Phase 3 provided an additional 27 million litres per day of purified water for the benefit of emerging black farmers.

The Vaalharts Revitalisation Scheme covers over 35 000 hectares, which includes the Taung Irrigation portion in the North West Province. The irrigation scheme contributes to supporting agriculture in the province. The scheme seeks to refurbish bulk water and in-farm water distribution

and irrigation infrastructure in the Vaalharts area. It is part of the SIP 11 (SAnews, 2022). SIP 11 - Agri-logistics and rural infrastructure seeks to:

Improve investment in agricultural and rural infrastructure that supports 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 research and development on rural issues (including expansion of agricultural colleges), processing facilities (abattoirs, dairy infrastructure), aquaculture incubation schemes and rural tourism infrastructure (Department of Public Works and Infrastructure , 2020).

Irrigation systems such as low-flow drip irrigation, draglines and micro sprinklers are innovations which have succeeded in using less water to grow crops optimally. New and emerging technologies or solutions in irrigation can be grouped into three main categories: augmenting and improving water supply; improving water productivity; and managing irrigation systems more efficiently (Botha, New irrigation systems: making do with less, 2020).

In addition to the improvement of WUE as a result of increasing prevalence of netting, a significant shift has taken place from implementing typical conventional flood and sprinkler irrigation methods to more efficient types of irrigation systems such as drip irrigation and centre pivots. A 43% increase has been observed in pivot irrigation between the year 2000 and 2010 as opposed to less efficient irrigation methods. In 2018, the total area under pivot irrigation as observed from satellite imagery was 825 000 ha (BFAP, 2021). Efficient irrigation technologies involve the correct application of water at the right time, with the least amount of waste, and as economically as possible. Existing and emerging irrigation systems should be able to accommodate variable and changing climate (Botha, New irrigation systems: making do with less, 2020). Figure shows the irrigation development in South Africa in the last century. The decline in flood irrigation methods has contributed greatly to irrigation efficiency.

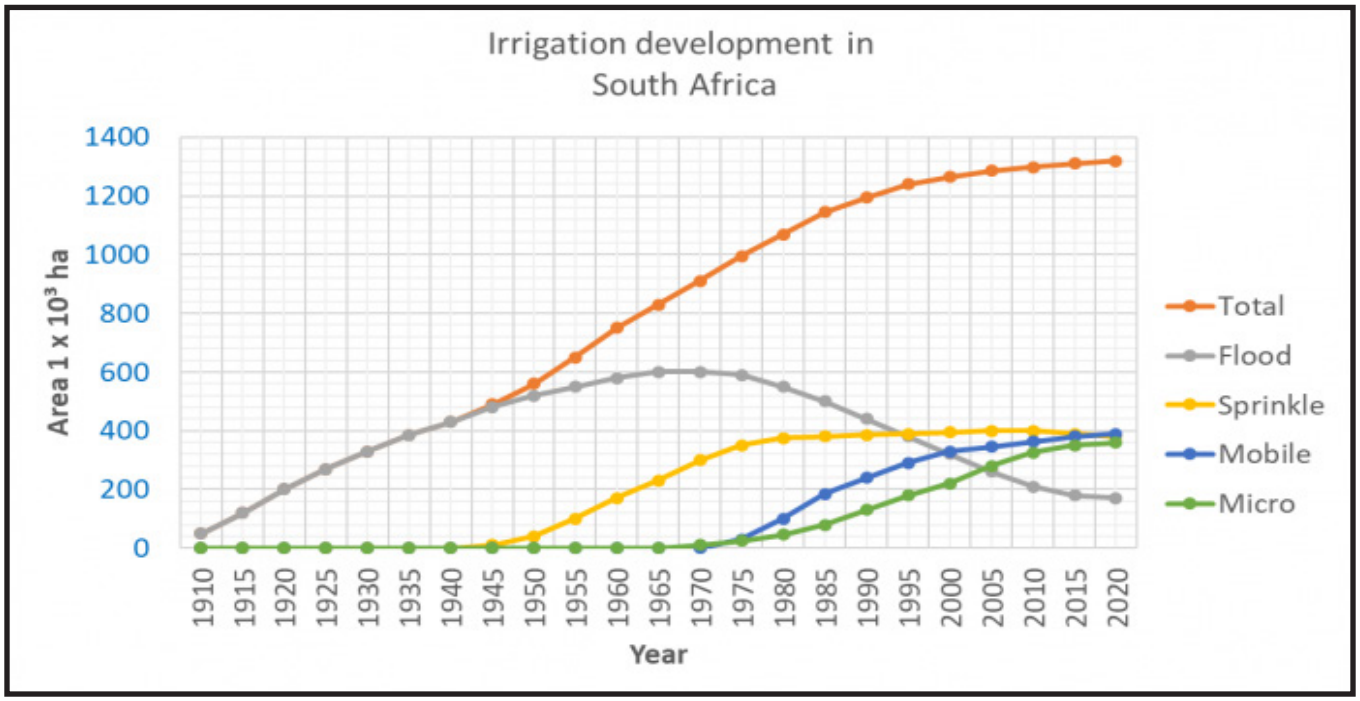

Figure 4-2: Irrigation development in South Africa (Botha, New irrigation systems: making do with less, 2020)

One outcome of low-flow drip technology has been the 'continuous irrigation' concept. With continuous irrigation, low-delivery drippers irrigate at a very low level over a longer time. The biggest change has been moving from several irrigation shifts to one irrigation shift. The greatest advantage of continuous irrigation remains the fact that farmers can better control the depth of wetting and reduce under- and over-irrigation, thereby improving WUE and soil aeration. Other advantages of continuous irrigation include the following (Botha, New irrigation systems: making do with less, 2020):

- Reduced management inputs with regard to irrigation scheduling.
- Less leaching of water and fertiliser in low water-holding capacity soil.
- Centralised automation and fertigation with reduced dependency on sophisticated automation.
- Simplified accommodation of soil and cultivar variation.
- Reduced capital cost and mainline infrastructure.
- Lower water use and increased efficiency overall.

Another innovation in the field of irrigation systems is Low Energy Precision Application (LEPA) irrigation. This is a water-efficient irrigation practice that uses low-pressure LEPA bubble applicators. With LEPA sprinklers, at least 20% more water reaches the soil surface compared to conventional spray heads. LEPA bubblers sprinklers gently deposit water from a height of 20 to 46 cm above the ground, so water reaches the soil quickly. This greatly reduces the chance for wind or evaporation loss due to high temperatures or strong winds. These sprinklers also operate at low pressures ranging from 0.41 to 1. 8 bar, which allows growers to take advantage of energy savings. LEPA close spacing technology ensures 95 to 98% of the water pumped gets to the crop's root zone (Senninger, 2022).

In terms of research in the water sector, it is the vision of the WRC to enable highly informed water decision making through science and technology at all levels, in all stakeholder groups and innovative water solutions through research and development for South Africa, Africa and the world. Numerous studies in the irrigated agricultural sector have been funded by the WRC and among those related to WUE are listed below:

- SAPWAT 4 - Upgrading of SAPWAT3 as a management tool to estimate the irrigation water use of crops.
- Standards and guidelines for improved efficiency of irrigation water use from dam wall release to root zone application.
- Technical aspects and cost estimating procedures of surface and subsurface drip irrigations systems (a guideline for irrigation designers and a guideline for irrigation farmers).
- Irrigation and user design manuals (in collaboration with the ARC).
- Improving the uptake and impact of research-based knowledge in the digital age.
- Knowledge exchange to improve implementation of irrigation water measurement/metering at farming and scheme level.
- An earth observation approach towards mapping irrigated areas and quantifying water use by irrigated crops in South Africa.

4.2 Challenges and Opportunities

This section presents the challenges and opportunities that exist within the sector in the context of WC/WDM. Firstly, it should be highlighted that the transformation of the irrigation boards into WUAs as articulated in the National Water Act faced challenges with interpretation of their purpose and membership as well as a lack of understanding of the different types of irrigation boards. The result has been an increasingly polarised water sector between different players instead of a water sector that expands to provide sustainable water and sanitation supply to all users.

Furthermore, it has become increasingly difficult to find sufficient funds to operate, maintain, rehabilitate, replace and build new bulk water infrastructure for the agricultural sector. There is a need for a renewed focus on restoring ageing infrastructure functionality, since the focus has been on building new infrastructure for too long rather than to refurbish and rehabilitate what is already in place. Given the mammoth task that lies ahead in resolving these infrastructure problems, public-private partnerships will be crucial creating an environment for infrastructure targets to be achieved. The involvement of the private sector is therefore needed to enable broad infrastructure procurement, which will set the country back on the correct trajectory. Business Leadership South Africa (BLSA) says private-sector investment, which averages 12,7% of GDP over the past five years, is relatively less volatile than that of government (Botha, Ailing infrastructure: a threat to SA agriculture, 2021).

It is estimated that over 50 000 ha of irrigation schemes are not functioning (idle irrigation schemes) which can mainly be attributed to political infighting such as with Makatini Flats (KwaZulu-Natal). Proper water management could enhance the productivity of these areas which would otherwise only be wasted potential. Big opportunities can result from this action such as alleviating poverty (access to food for households in these poor communities) as well as sufficient surplus for local and export markets (Botha, Ailing infrastructure: a threat to SA agriculture. 2021).

A challenge in terms of increasing water supply remains climate change which is projected to increase the variability of rainfall throughout the country, and reduced average rainfall is expected, particularly in the western part of the country. Climate change may also increase the agricultural demand for water due to higher temperatures and therefore reduce the country's ability to rely on rain-fed agriculture.

There is a rich diversity of strategic issues and lessons that emerge from the intended implementation of WC/WDM in the agricultural sector. To be able to make sense of these and facilitate their assessment, a strengths, weaknesses, opportunities, and threats (SWOT) analysis is utilised as illustrated in Table 4-5. In practice, there are always constraints, issues and challenges and these inform what is, and what is not possible, in terms of developing implementation plans that will gain traction.

Table 4-5: SWOT Analysis

Strengths	**Weaknesses**
• Availability of WUAs that can champion the implementation. • Available information management systems • Lessons available through research • Innovations in WC/WDM are readily available. • Consensus on the need to manage water demands amongst water users exist. • Existing partnerships (SWPN) • Regulations (metering, water use licence (WUL) conditions and general authorisations) • DWS' good relationship with irrigation sector	• Poor implementation of policy and strategic frameworks by DWS • Poor compliance monitoring and enforcement of water use • WC/WDM not institutionalised in water user institutions. • Ageing water conveyance infrastructure • Non-availability of appropriate means of measuring water use • Lack of capacity in DWS • Lack of technical personnel in the sector • Limited data availability • Weak coordination among key water-related sectors (agriculture, energy and environment)
Opportunities	**Threats**
• Address wastage due to conveyance losses and the inefficient use of water. • The development of a regulatory support and incentive framework will improve irrigation efficiency. • New technologies • Awareness campaigns • Engage with water users • Investment opportunities (case for funding is better motivated; potential for private and public funding)	• Climate Change • Insufficient funds to implement the WC/WDM measures • Resistance by users • Absence of responsible role player • Droughts • Lack of capacity within the sector • Corruption

4.3 Theory of Change

The development of this strategy has been based on a detailed understanding of the lessons learnt in the context of managing and implementing the various similar instruments within the water sector. The starting point was to develop an understanding of the context within which the strategy will be implemented. This involved signposting the key elements of a representative Theory of Change specific to the sector. The proposed Theory of Change for the agricultural sector is set out in Figure 4-3.

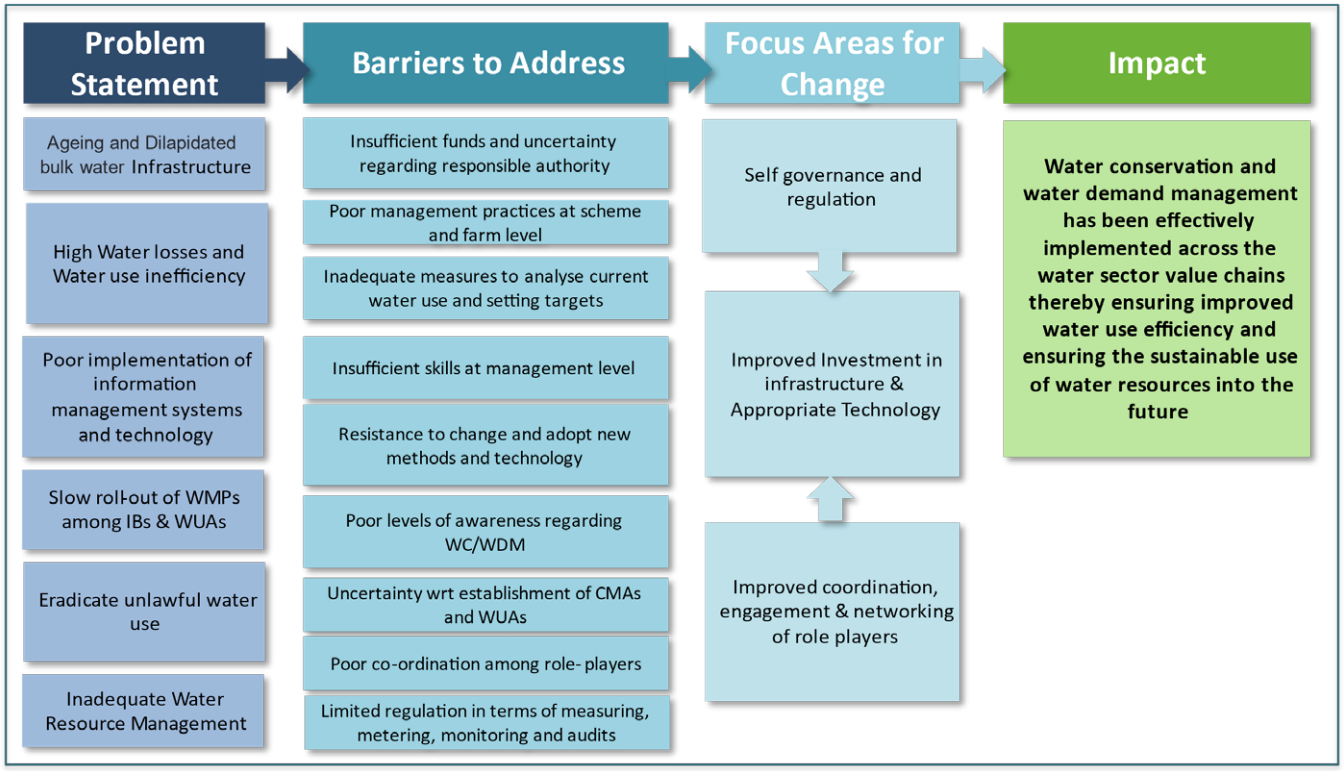

Figure 4-3: Theory of Change for Agricultural Sector

The critical focus areas for change revolve around self-governance and regulation within the institutional framework with respect to WC/WDM. This is combined with the need for improved investment in infrastructure and appropriate technology - noting that the latter is intimately connected to improved coordination, engagement and networking of role players. Combined with the focus on these aspects, the Theory of Change seeks to mobilise the agricultural sector , including all the institutions and the public at large, in sustained and coordinated efforts to enhance WUE.

The ultimate impact will be that WC/WCDM will be effectively implemented across the sector, resulting in enhanced WUE and sustainable use of the resource in the future.

5 Strategic Response

5.1 Vision

The NWRS3 Vision provides the framing for the sector: In support of the overarching Vision above, the vision for the WC/WDM strategies is:

"Water conservation and water demand management has been effectively implemented across all sector water value chains thereby ensuring improved water use efficiency and ensuring the sustainable use of water resources into the future. "

5.2 Strategic Target

Key strategic water sector instruments such as the NWRS and the NWSMP have indicated that with the current water use patterns and developmental trajectory, South Africa will face a 17% water deficit by the year 2030. Indications are that this could indeed be a conservative estimation and as such DWS is undertaking a range of studies to provide an updated assessment of water supply and demand. In the meantime, is critically important that as a country there is collective effort to improve WUE, thereby driving down water demand. Towards this end:

All water use sectors will undertake technical, social, economic and legislative interventions to ensure a 70% water use efficiency level by 2030.

This target is understood as a minimum requirement and that all sub-sectors must strive for continued improvements and innovations that will support the collective effort to drive down water demands and to set new standards in terms of attainable water use efficiency.

5.3 Strategic Principles

The development and hence implementation of the WC/WDM strategy for the Agricultural sector shall be guided by the following principles. It should be highlighted that these principles are meant to be high-level and hence overarching as they translate the Theory of Change.

Principle No 1: The Social, Economic, and Ecological Value of Water (and the Appropriate Pricing and Affordability of Water): Water should be properly valued by users within the agricultural sector, while recognising its role in social and economic transformation as well as maintaining the integrity of the environment. Agriculture water use should be appropriately priced while ensuring affordability for ease of access and affordability for smallholder and emerging farmers.

The Agenda 21 and Dublin Principles elevated the of water onto the global stage. While the principle adopted the word its meaning went deeper to consider the role that water plays in social upliftment as well environmental reconstruction. In developing the current WC/WDM strategy, it is imperative that this role is recognised. Managing the demands for water in agriculture requires the understanding that water is not only an input in agro-production but rather the entire social-economic development.

The pricing of water has been used as an instrument regulate water use while also enabling the water resource managers to augment resources for maintaining the integrity and accessibility of the resource to various users. DWS and CMAs use the revenue collected from water use charges to implement programmes aimed at protecting and developing water resources. However, while there is need to ensure that the water resource users pay for their water use, it is recognised here that water is the primary input into the production of all agricultural products such that any increase in water prices have significant impact on production of agricultural products.

Principle No 2: Governance and Regulation in Agricultural Water Use: Governance and regulation play a significant role in driving the behaviour of actors and water users within the sector.

The success of this strategy shall hinge upon effective governance and regulatory mechanisms within the sector. National as well local institutions play crucial roles in creating and managing norms for user behaviour while also coordinating the implementation of interventions that are crucial for this strategy.

Principle No 3: Water Allocation and Equi Water Use: Equity in water use within agricultural sector hinges upon appropriate and successful water allocation mechanisms.

Appropriate water allocation mechanism allows for water to be allocated to users within a given catchment while considering all factors such as prevailing demand and availability. In order to implement this strategy, it is important that water allocation is reviewed and confirmed in all catchments to ensure equity amongst users, while also taking care of the needs of the environment.

Principle No 4: Investment in Infrastructure Development: Infrastructure renewal requires investments as there are high water losses in ageing conveyance systems.

Water losses in the sector are high, especially because of conveyance losses and canal leakages due to ageing and dilapidated bulk water infrastructure. Most irrigation bulk water infrastructure requires rehabilitation to improve efficiency. There is a huge backlog with infrastructure maintenance and improvements. Government's Infrastructure Master Plan needs to be implemented since a lack of funding for the improvement of the water systems is a big challenge. Infrastructure maintenance and refurbishment needs to be prioritised with sufficient funding mechanisms.

5.4 Goals and Objectives

Four goals have been identified to effectively implement WC/WDM across the various sector value chains. Supporting these goals are ten objectives, which link the key pillars of WC/WDM (legislative, social, technical and financial) as they cut across multiple goals. The National WC/WDM strategy presents the overarching framework for the strategies as shown in Figure 5-1. The goals and objectives are presented in more detail below with a specific focus on how these apply to the Agriculture sector.

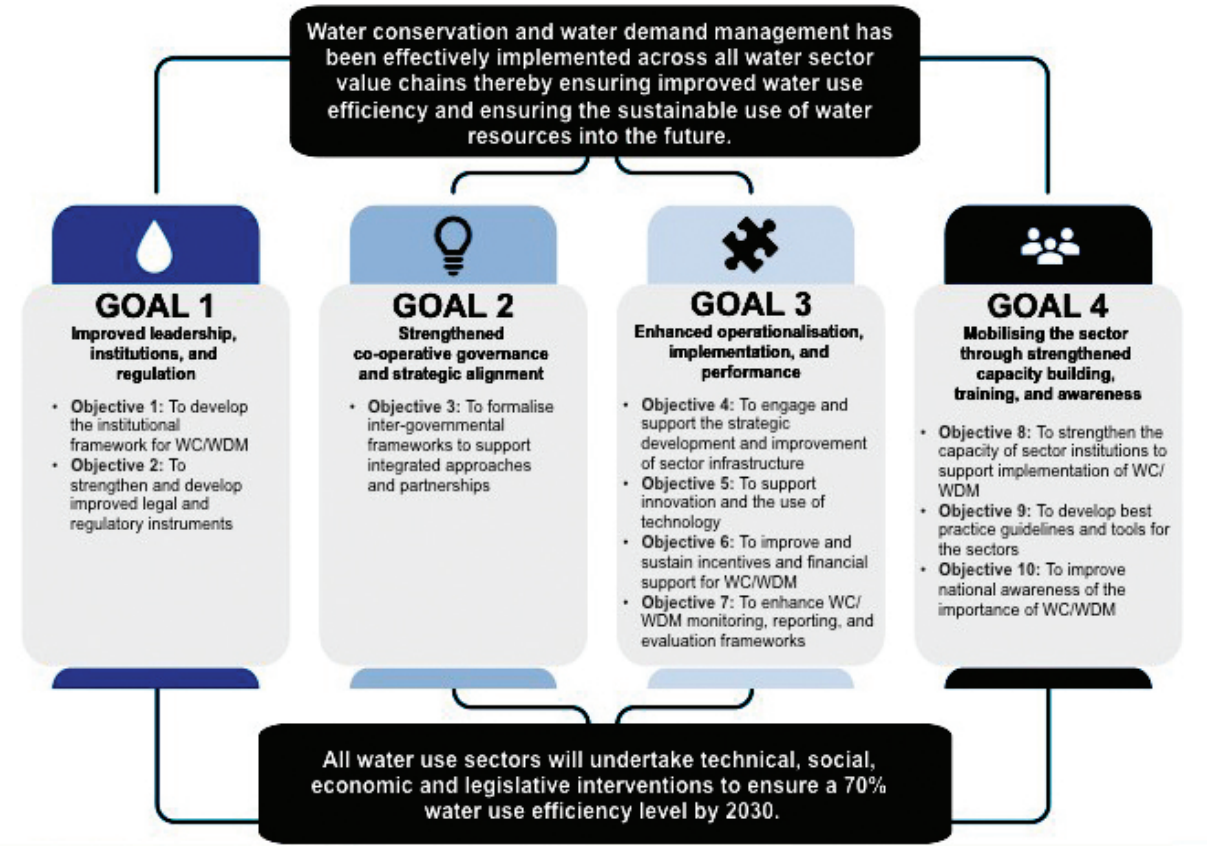

Figure 5-1: WC/WDM Strategy Framework

GOAL 1: Improved leadership, institutions, and regulation

- **Objective 1: To develop the institutional framework for WC/WDM.** Improving the governance and institutional aspects of water resource management and development will provide for the foundation for operational response to WC/WDM strategies. The various sub-sectors have varying and complex institutional arrangements and there is a definite need to ensure that WC/WDM is mainstreamed into the business, planning and resourcing to ensure the implementation of actions. This will require in some instances that interventions to strengthen institutional capacity are required, this particularly the case regarding other sectoral institutions. From a water sector perspective, the institutional arrangements as set out in the NWA and national water policy have been in flux over a number of years. Clarifying the various institutional roles and responsibilities with regards to WC/WDM is important in ensuring effectiveness in the implementation of the various strategies. Ensuring that the necessary powers and duties are delegated to institutions is essential in enabling these institutions to take up these functions. Ensuring that these institutions have sufficient capacity, the appropriate skills as well as the necessary tools and systems will be imperative to support implementation. In addressing these institutional arrangements, it will be critical to also clarify the role of the DWS and ensure that it is equally capacitated.

  Within the Agricultural sector, there are WMI such as Irrigation Boards and Water User Associations (WUAs) specifically overseeing the management of irrigation schemes. It is their responsibility to ensure that institutional corporate frameworks are developed to support WC/WDM to achieve Water Use Efficiency at scheme level. The development of Water Management Plans by all irrigation schemes is therefore promoted. A pilot project by DWS has initiated the development of WMPs in 14 irrigation schemes. With these examples and in collaboration with SAAFWUA, CMAs and private sector engagement, WMIs can develop their own WMPs and update them annually. In the past, many irrigation schemes possessed scheme water use by-laws; these should ideally be updated or developed where they are lacking. Equally as important is to strengthen an institutional culture of regular WUE reporting and the integration of WUE targets into the Annual Institutional Performance Report.

- **Objective 2: To strengthen and develop improved legal and regulatory instruments.** The law and supporting regulations codify policy and provides clear articulation of what is required to ensure WC/WDM is affected. The NWA does provide guidance in this regard, but it is important to strengthen both law and its supporting regulations from time to time based on improved knowledge and developments in practice. It is equally essential to review those legal instruments from other sectors to ensure that WC/WDM is effectively mainstreamed into these sectoral instruments. The review and amendment of these instruments can be lengthy and require significant engagements, however, this can have profound impact upon the water sector. It will be important to consider a range of approaches that look to incentivise behavioural changes rather than using purely "command and control" approaches, and these can be introduced in a phased and progressive manner. The role of the various water sector institutions in supporting and regulating will need to be clarified and developed accordingly. Linked to Objective 1, as these instruments are developed it will be essential to ensure that institutions have the capacity and systems to perform these regulatory roles.

- Since the irrigated agricultural sector utilises such large volumes of water and water use rights in this sector are either linked to an irrigation scheme or property, it is more challenging to keep track of the water allocated to this sector compared to that of the IMP and Water Services sectors. It is therefore important to improve water allocation and equity amongst agricultural water users through water allocation audits to verify water use allocations. Likewise monitoring of water use in catchment areas where institutions do not exist needs to be undertaken to address illegal water use. Water use monitoring regulations and guidelines do exist for the agricultural sector and need to be reviewed and updated accordingly, along with improved regulatory frameworks for water use efficiency and monitoring. Water Uses Licences are also regulatory instruments, and it is important to undertake stakeholder consultation on WUE licensing conditions and to update the general and specific licensing conditions for agricultural users. While there is progress on the verification and validation of the water use licenses, it is important that more effort and emphasis is brought forward to ensure this activity is accomplished if the aspirations of this strategy are to be realised. It is also necessary to ensure that the Compliance, Monitoring and Enforcement strategy is aligned with the requirements for implementing WC/WDM in the agricultural sector.

GOAL 2: Strengthened co-operative governance and strategic alignment

- **Objective 3: To formalise inter-governmental frameworks to support integrated approaches and partnerships.** There is recognition in the NWRS that the management of the national water resource requires the support of a range of public sector institutions and cannot only be the responsibility of the DWS. With the developmental imperative of the country being based upon scarce water and environmental resources, the ability to ensure sustainable and resilient growth will require an integrated approach. The linkages between water and other sectors are inextricable and this, therefore, requires cooperative government support horizontally between sector departments and vertically between the spheres of government. The nature of the approaches used to formalise these relationships will be variable, according to context and may include a number of aspects along the water sector value chain.
- For the agricultural sector it is important to review and align the institutional frameworks between DWS and DALRRD and to align the WC/WDM interventions with their respective priorities. Areas of alignment also need to be identified by reviewing the Water & Sanitation Masterplan, NWRS3 and NWSF 2020. Engagement with the DWS SDG6 Task Team is equally important. Furthermore, it is important that the work of the Coordinating Committee for Agriculture Work (CCAW) in all provinces be enhanced. This can be achieved by developing a Terms of Reference for the CCAW's role in WC/WDM. Common shared government strategies or plans towards outcomes-based efficiency improvement plans such as revitalisation of old schemes or the use of surplus water for irrigation purpose can also be created.

GOAL 3: Enhanced operationalisation, implementation, and performance

- **Objective 4: To engage and support the strategic development and improvement of sector infrastructure.** There are a range of infrastructural solutions that will need to be considered in improving the approach to WC/WDM and that will result in improved WUE within sectors. Infrastructure takes time to plan, develop and finance and requires coordinated effort between sector partners. This process to unlock these solutions will need to start sooner, to realise impact later and will require engagements with key stakeholders such as Municipal Infrastructure Support Agent (MISA), Infrastructure South Africa, DBSA amongst others. The role of the National Water Partnerships Office in supporting and facilitating these solutions is important and will act as a hub in pulling together these various partners.

  In the agricultural sector, business cases need to be developed that are based on the Infrastructure Asset Management Plan and Asset Register for all schemes to address water losses attributed to inefficient operation and maintenance of agricultural conveyance systems, i. e. , canals, pipelines, and channels. This will mainly entail the review and update of the bulk water asset register and the legislative frameworks for bulk water infrastructure development as well as drafting a Masterplan for the Agricultural bulk water infrastructure. Developing business cases for key projects is vital. The promotion of efficient operation and maintenance of irrigation infrastructure, from source to root zone applications, can be actioned by developing annual Operation and Maintenance plans. The monitoring and implementation of the asset management plans of the DWS Infrastructure branch as well as the private sector is crucial to reduce physical water losses from irrigation water conveyance systems. The review of the asset management plans and periodic progress reports for asset management implementation, is vitally important for this sector.
- **Objective 5: To support innovation and the use of technology.** The research and development agenda plays a critical role in gathering knowledge and assimilating best practice and using this to drive innovation. There are a number of key actors in this space that, as a collective, will play a key role in assisting the country to develop game-changing approaches and technologies. Providing opportunities to share knowledge and build competencies will be critical to ensure uptake and replication of the new approaches and best practice.
- In the agricultural sector, a research portfolio in coordination with the WRC and the ARC around WC/WDM can be reviewed and developed to support ongoing research on WC/WDM to improve Water Use Efficiency. It is important that institutions such as DWS, WRC and SWPN monitor sector initiatives aimed at improving water use efficiency. The transfer and uptake of evidence-based technologies, such as those developed by the WRC and ARC should be facilitated. This can be achieved by developing communication mediums and materials as well as reviewing subsidy options through engagement with enablers and private sector stakeholders. Essentially, it is important to work with organised agriculture, especially cooperations, to continue innovative work in WUE initiatives.
- **Objective 6: To improve and sustain incentives and financial support for WC/WDM.** Limited financial resources have been a challenge to the water sector for many years, and this has also been the case for WC/WDM. Putting in place a process to develop a financial investment framework that will support ongoing WC/WDM interventions will be imperative. This will need to consider the economic value of water and the implications on regional economies through

cost-benefit analyses. It will be important to ensure that approaches are financially sustainable, and projects need to be bankable. The development of diverse and innovative financing mechanisms as well as mechanisms to reduce financial risk will be important and the National Water Partnerships Office, working with various partners, can be valuable conduit for realising these approaches. WC/WDM incentives such as the WC/WDM sector awards and innovation recognition awards should be reinstated to encourage the adoption of WC/WDM initiatives.

- A large potential for WC/WDM in the agricultural sector lies in the irrigation water conveyance structures. It is therefore vital to develop an investment framework for the renewal and maintenance of bulk water infrastructure in irrigation schemes. During this process, the infrastructure development frameworks need to be reviewed, stakeholder engagement sessions for actors within the agricultural sector need to be organised and the investment framework for bulk water infrastructure needs to be drafted. In addition, the pricing mechanisms for agricultural water use needs to be reviewed to promote water use efficiency. Likewise metering, billing and revenue collection need to be improved. In order to accomplish this, metering of water use within the agricultural sector needs to be facilitated and the billing and revenue collection system for water use charges needs to be reviewed. Furthermore, the appropriate ring fencing of infrastructure changes per water management area or catchment can be used to promote water use efficiency.

- **Objective 7: To enhance WC/WDM monitoring, reporting, and evaluation frameworks.** The ability to manage processes adaptively is underpinned by data and information, as well as regular reporting. This will require the support of differing government actors and the development of agreed-upon reporting protocols. These approaches need to be relatively easy and pragmatic in order to support regular reporting. Clarification of institutional roles and responsibilities will be imperative with regards to reporting, data collation and information management.

  To improve decision making in WC/WDM implementation in the agricultural sector, it is important to strengthen data collection, monitoring, and evaluation. This can be achieved through developing and implementing WMPs, standards and WC/WDM performance management criteria as well as targets and indicators. Additionally, water use audits as per license conditions should be actively conducted. All major Irrigation Schemes should take part in Water Use Efficiency Accounting Reporting (WUEAR) and an annual report on the state of Water Use Efficiency for the Irrigation Schemes should be produced as a strategic action. Likewise, the Irrigation Regulatory Support Monitoring System called the Irri–Drop System should be further developed and the use and adoption of the Water Administration System by all Irrigation Schemes especially Government Water Schemes must be promoted.

GOAL 4: Mobilising the sector through strengthened capacity building, training, and awareness

- **Objective 8: To strengthen the capacity of sector institutions to support implementation of WC/WDM.** The revised WC/WDM strategies will require staff with capacity and resources to manage and oversee the range of interventions outlined in the various strategies – this will include staff both within DWS and in the supporting sector institutions to understand how to translate these strategic actions into implementation. Typically, this staff would be required within the DWS, the DWS Regional Offices and possibly the CMAs. However, noting the importance of other sub-sector institutions and partners, it will be important to look at the needs more holistically. This undertaking would need to look at the various roles and responsibilities and then to develop the capacity needed within line functions to service these functional needs.

  To improve skills development in WC/WDM for water use efficiency improvement in the irrigation agriculture sector, it is necessary to review the capacity and skills gaps within the sector and explore opportunities for capacity building interventions for WC/WDM. WMIs need to be developed or identified for the implementation of WC/WDM at a local level, and the establishment and operationalisation of WUAs in irrigation schemes needs to be supported. Information and knowledge sharing platforms should be used to promote WC/WDM and share knowledge with stakeholders. Additionally, institutional capacity can be strengthened through the provision of accredited Water Control Officer training courses.

- **Objective 9: To develop best practice guidelines and tools for the sectors.** The DWS has over the years developed various guidelines, performance standards and benchmarking tools for WC/WDM within key sectors. Likewise, other sector focused institutions have also produced such tools. While there is a need to access these various materials and collate these into a broader WC/WDM toolkit, there will be the need to develop

newer and up-to-date tools that consider the various innovative approaches that have been, and are being, developed.

In the agricultural sector, various water use monitoring tools and techniques will need to be reviewed and guidelines for water use data collection and reporting need to be developed. Standards for WUE and WC/WDM performance management criteria as part of the Irri-Drop System need to be developed. Best practice guidelines specifically for small irrigators and irrigation schemes are lacking and need to be developed.

- **Objective 10: Improve national awareness of the importance of WC/WDM.** The development and implementation of a national awareness campaign will be critical in supporting the drive to change behaviours and practices. This will require longer-term programming and the support of senior government actors. The development of supporting materials and knowledge products will be imperative, ensuring that these are accessible through knowledge sharing platforms.

  In the agricultural sector behavioural change programmes/ campaigns to systemically embed a water stewardship mindset need to be developed and implemented through stakeholder engagement, coordination and communication. Additionally, annual reports on the status quo of WC/WDM should be developed and reported on. Furthermore, the sector should promote knowledge-based systems on water measurement in irrigation schemes by collaborating with research partners. Participation in agricultural events such as the NAMPO and Irrigation Scheme open days is important to promote Water Use Efficiency and WC/WDM.

5.5 Strategic Actions

A summary of the Strategic Actions for the agricultural sector in response to the ten objectives are presented below:

Table 5-1: Agriculture WC/WDM Strategic Goals, Objectives, and Actions

GOALS	OBJECTIVES	STRATEGIC ACTIONS	RESPONSIBLE*
GOAL 1 Improved leadership, institutions, and regulation	**Objective 1:** To develop the institutional framework for WC/WDM	1. 1 Promote WMI (Water Management Institutions) or Irrigation Schemes to develop institutional corporate frameworks that support WC/WDM to achieve Water Use Efficiency at scheme level 1. 2 Strengthen an institutional culture of WUE reporting as part of Annual Institutional Performance Report	DWS, DALRRD, CMAs
	Objective 2: To strengthen and develop improved legal and regulatory instruments	2. 1 Improve water allocation and equity amongst agricultural water users through water allocation audits 2. 2 Improve regulatory frameworks for water use efficiency and monitoring within the agricultural sector 2. 3 Incorporate WUE licensing conditions – both general and specific institutional conditions	DWS, DALRRD, WRC, ARC, CMAs
GOAL 2 Strengthened co-operative governance and strategic alignment	**Objective 3:** To formalise inter-governmental frameworks to support integrated approaches and partnerships	3. 1 Create alignment of the institutional frameworks, agricultural programmes and principles of the relevant government departments and stakeholders in support of WC/WDM 3. 2 Enhance the work of the Coordinating Committee for Agriculture Work (CCAW) in all provinces 3. 3 Develop common shared government strategies or plans towards outcomes-based efficiency improvement plans, i. e. , revitalisation of old schemes or the use of surplus water for irrigation purposes	DWS, WRC, government departments, CMAs, DALRRD, PDAs, NPC, NT, DTIC
GOAL 3 Enhanced operationalisation, implementation, and performance	**Objective 4:** To engage and support the strategic development and improvement of sector infrastructure	4. 1 Develop business cases based on the Infrastructure Asset Management Plan and Asset Register for all schemes to address water losses attributed to inefficient operation and maintenance of agricultural conveyance systems, i. e. , canals, pipelines, and channels 4. 2 Promote efficient operation and maintenance of irrigation infrastructure, from source to root zone applications 4. 3 Monitor the implementation of the asset management plans of the DWS Infrastructure branch to reduce physical water losses from DWS conveyance systems 4. 4 Monitor the implementation of private sector (WUAs & Irrigation Boards) asset management plans to reduce physical water losses	NWRIA**, DALRRD, DWS, CMAs, sector bodies (AgriSA, etc), SAAFWUA

GOALS	OBJECTIVES	STRATEGIC ACTIONS	RESPONSIBLE*
	Objective 5: To support innovation and the use of technology	5. 1 Support ongoing research by the Water Research Commission and the Agriculture Research Council on WC/WDM to improve Water Use Efficiency 5. 2 Support sector initiatives aimed at improving water use efficiency 5. 3 Facilitate the transfer and uptake of evidence-based technologies, such as those developed by the WRC and ARC 5. 4 Work with organised agriculture to continue innovative work especially cooperations	DWS, DALRRD, government departments, PDAs, WRC, ARC,
	Objective 6: To improve and sustain incentives and financial support for WC/WDM	6. 1 Develop an investment framework for the renewal and maintenance of bulk water infrastructure in irrigation schemes 6. 2 Review the pricing mechanisms for agriculture water use to promote water use efficiency 6. 3 VImprove metering, billing, and revenue collection to promote Water Use Efficiency in Agriculture	DWS, NWRIA**, DALRRD, CMAs, WRC
GOALS	**OBJECTIVES**	**STRATEGIC ACTIONS**	**RESPONSIBLE***
	Objective 9: To develop best practice guidelines and tools for the sectors	9. 1 Develop guidelines for water use data collection and reporting 9. 2 Develop standards for WUE and WC/WDM performance management criteria as part of the Irri-Drop System 9. 3 Develop best practice guidelines for small irrigators and irrigation schemes	DWS, CMAs, ARC, WRC
	Objective 10: Improve national awareness of the importance of WC/WDM	10. 1 Develop and implement (behavioural change) programmes/campaigns to systemically embed a water stewardship mindset 10. 2 Develop and publish annual reports on status quo of WC/WDM 10. 3 VParticipate in agricultural events such as NAMPO and Irrigation Scheme open days to promote Water Use Efficiency and WC/WDM 10. 4 Promote knowledge-based systems on water measurement in irrigation schemes	DWS, DALRRD, CMAs, ARC, WRC

*The parties listed as responsible for these actions may not comprise an exhaustive list.

**NWRIA not yet established.

6 Implementation Considerations

6.1 Monitoring and Evaluation (M&E)

Successful implementation of this strategy will also be based on the ability of the state, particularly at catchment and local level, to implement a deliberate, systems-based, adaptive management approach. This approach must be inclusive, bringing together state, private sector and civil society players on a regular basis to review and adapt plans and actions. This adaptive management enables the refinement of strategies and plans and the refocusing of financial and human resource allocation once certain actions have been implemented or certain milestones achieved, when the expected results from implemented actions are not achieved or when new information becomes available that informs improved approaches.

The main focus of M&E is on assessing the contributions of various actors and factors to a given activity outcome, with such factors including outputs, partnerships, policy advice and dialogue, advocacy and coordination within the sector. The success of the WC/WDM strategy shall hinge on the effective monitoring of the implementation of the actions that emanate from this strategy. DWS, as a custodian of this strategy, shall put in place a results-monitoring framework that shall guide the implementation of this strategy. The monitoring framework shall among other things provide the actors within the sector with specific indicators and targets. As the strategy is being implemented, it will be crucial for the actors and the DWS within the sector to take stock of the gains or indeed losses that have been made over a given period through a structured evaluation process. This should be done through regular reporting on set targets and indicators. The figure below presents a typical M&E process from which the M&E framework can be developed.

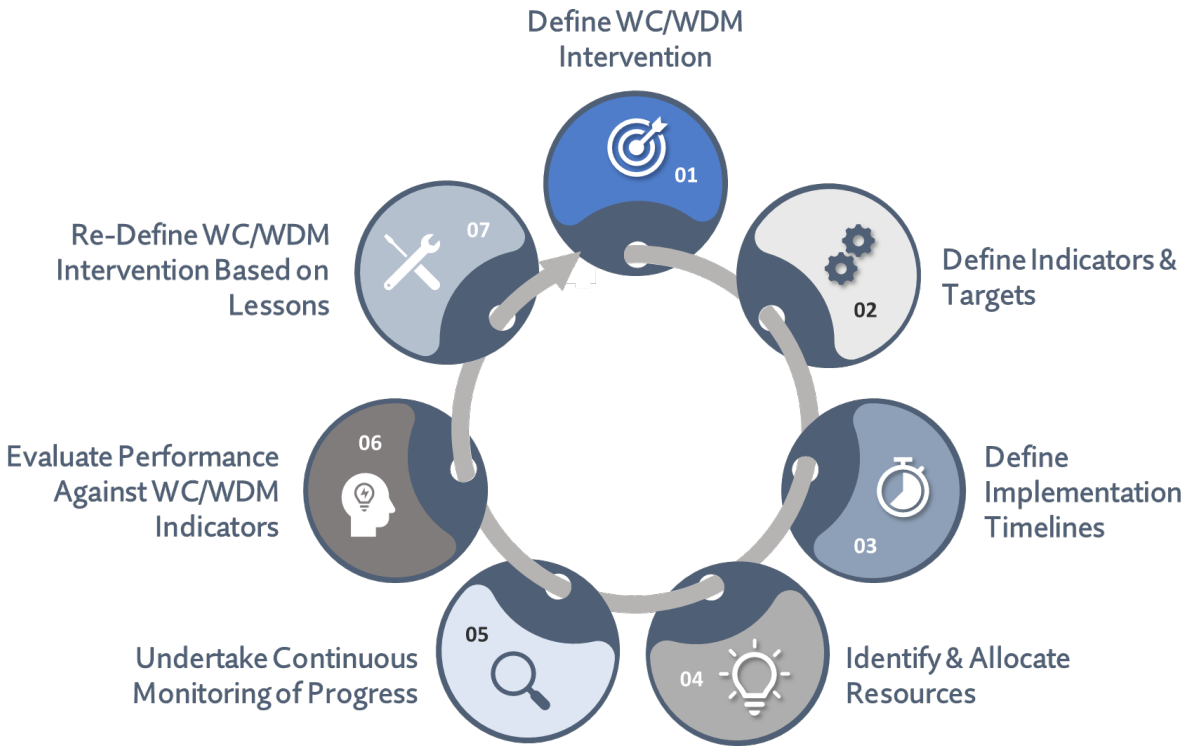

Figure 6-1: Agricultural Sector WC/WDM M&E Process for Implementation

To guide the implementation of the sub-sector strategies, implementation plans have been developed for each and provides for interventions that will require the active engagement and participation of multiple national and provincial government departments, of municipalities, of the private sector and of civil society. Due to the complexity of this, and the fact that it is essential that nothing gets left behind, an effective M&E system is required. This system needs to be structured around a broader programmatic M&E that would include a reflection of impact upon water resources themselves. The DWS Head and Regional offices should be capacitated and equipped to support this M&E approach and plan. This M&E system will be progressively developed, and support could include the following:

- Coordinate forums that will track the planning and implementation of WC/WDM in the region.
- Collect and collate data and information.
- Analyse data and compile reports to report on the progress made with the implementation of WC/WDM in the agricultural sectors and sub-sectors.
- Provide or arrange training on the various aspects of WC/WDM including the water balance calculation, metering, sectorisation, pressure management, funding, auditing, No Drop, leak detection, etc.
- Advise on the development of a WC/WDM strategy and business plan.
- Influence the allocations of funds for project development and implementation based on informed decision making.
- Continuously monitor and evaluate the performance of the agricultural sectors and sub-sectors towards improvement.

6.2 Sector wide-approaches

Sector wide approaches (SWAP) are widely regarded as good or best practice when it comes to coordinating major national initiatives or drives. As the name implies, their focus is sector wide, however one can apply the same philosophy to a narrower initiative such as WC/WDM. The strength of SWAPs lies in the ability to address aspects such as the following:

- High levels of complexity.
- The need to align a multitude of government institutions and hence the need for strong cooperative governance.
- The need to involve a multitude of other institutions and partners such as the private sector, civil society and International Cooperating Partners.
- A requirement for high levels of communication in order to enhance alignment, cooperation and alignment.
- Initiatives involving a wide range of strategies, actions and projects.

The typical design of effective SWAPs includes elements such as the following:

- A sound strategy or master plan that guides implementation,
- A big emphasis on collaborative structures, involving all the key stakeholders,
- Active participation of decision makers on the structures,
- A commitment to high levels of communication, discussion and consensus decision making,
- A strong technical secretariat that supports and facilitates the workings of the various collaborative structures,
- Strong outreach processes,
- A commitment to knowledge sharing and management to facilitate adaptive management,
- A strong emphasis on action orientation to ensure that the structures remain vital and energised,
- Strong M&E processes to support implementation and contribute to adaptive management, and
- Dedicated resources (budgets) to ensure rollout.

As is noted above, the need for an effective collaborative structure(s) is key and is a critical enabler for SWAP. This may require the adaptation of existing structures, as opposed to the creation of new structures. An example of this could be the Water Sector Leadership Group (WSLG). This was originally established as a SWAP mechanism under the Masibambane initiative and was very effective for many years. It has fallen into disuse in recent years; however, it is understood that DWS are keen to revive it. A subcommittee or task team of the WSLG could potentially be established that is dedicated to driving WC/WDM at sector level.

It is important also to emphasise that the SWAP mechanism(s) at national level will have to be mirrored at the provincial level if the WC/WDM strategy is to be implemented effectively. South Africa is far too big and complex to expect that national mechanisms alone will be successful. Again, the same principles apply with respect to the scope, modus operandi and the potential to utilise existing collaborative structures at the provincial level.

In conclusion on this aspect, it is worth emphasising again that WC/WDM for agriculture in South Africa is a complex undertaking, involving a multitude of players. In many respects therefore SWAP, or something similar is almost compulsory if there is to be a reasonable chance of success. It will also require strong, participative and mature leadership that is able to galvanise the support of a wide range of players.

6.3 Enabling Factors

The National Water Act (Act 36 of 1998) recognises the pivotal role that WC/WDM plays in water resource management with the objective of reconciling water supply and demand. An enabling environment is required to implement WC/WDM strategies and legislation. Although local government is ultimately responsible for implementing WC/WDM in the water services sector, other government departments, institutions and citizens all have an important role to play by influencing, through cooperative governance, and implementing WC/WDM in all spheres of government and at home. The following aspects are critical to create an enabling environment.

Table 6-1: Critical elements to create an enabling environment

Factor	Background	Action
Political will and leadership	Whilst WC/WDM appears in all national strategic instruments, it falls short in its implementation. This is not an activity that sits solely under DWS but is a country-wide imperative.	There is a need for strong political will and support to facilitate implementation of this strategy. There should be a high-level champion for WC/WDM in the sector (e. g., Deputy Director-General or above) whose voice should lead the sector's efforts and direction at a higher level. Create awareness and promote WUE in Government. Government institutions must lead by example and fix all visible leaks and internal plumbing leaks with 48 hours as stipulated in the regulations.
Financing	A conducive environment is needed to attract funding for WC/WDM interventions, which is linked to the bankability of the municipality but also innovative financing mechanism and incentives.	Improved cooperative governance and SWAP provide opportunities for stakeholders and departments to pool their resources to fund WC/WDM interventions, in a more coordinated manner. Tapping into global climate financing mechanisms are also a potential way in which to fund a few the interventions required.
Institutionalisation	WC/WDM is included as a key strategic objective in the NDP, National Water and Sanitation Masterplan, NWRS3, and the DWS Strategic Plan. WC/WDM is cross cutting in DWS, let alone other Sector Departments like Department of Mineral Resources and Energy, DTIC, DALRRD, amongst others. It requires strong and focused engagement with various other directorates and Ministries.	Elevate the Directorate WUE to a Chief Directorate to give it the prominence it requires to make a meaningful impact. Establish defined champions in the regional offices that can plan and coordinate WC/WDM regionally. Encourage WC/WDM institutional ownership whereby sector-wide stakeholders bring in extra capacity and technologies to the lead institution in the implementation of the interventions.

Factor	Background	Action
Coordination	Lack of coordination can lead to fragmented WC/WDM efforts within the sector. The implementation of WC/WDM is complex and thus there is an important need for key lessons to be shared with the entire sector. There are 13 key government departments actively involved with various aspects of WC/WDM. The roles and responsibilities of each Department must be clearly defined, and Departments must work together to achieve National objectives.	Strengthen and clarify roles and responsibilities (team effort). Establish coordination meetings[1], with DWS taking the lead, to define roles and responsibilities, understand processes, procedures and programmes to avoid duplication and bureaucracy.
Public support	There are 60 million water users in South Africa. A concerted effort by each water user to fix leaks and use water sparingly could significantly contribute to achieving the national target. Government has an obligation to supply water services to end users. End users have an equal obligation to conserve water and become responsible citizens.	In addition to the Sector WC/WDM, promote WUE in the home, at work and in public spaces. This will require a major outreach programme to be designed using the latest behavioural science and professional marketing techniques.
Enforcement	Clause 82 (1) of The Water Services Act (Act No. 108, 1997) states no person may continue the wasteful use of water after being called upon to stop by the Minister, a Province or any water services authority. Any person who contravenes subsection (1) is guilty of an offence and liable, on conviction, to a fine or to imprisonment or to both such fine and imprisonment.	Government must enforce ALL legislation, Regulations and by-laws[2].
Monitoring and Reporting	Monitoring and reporting are currently very inconsistent in some areas, and piece-meal. Without consistent and up-to-date information, it becomes difficult to make any evidence-based decision making.	A consistent and coordinated monitoring and reporting framework for WC/WDM interventions is needed for the sector to measure its progress. Better quality information, together with widespread publication by the sector lead, will provide impetus for better accountability throughout the sector.

6.4 Implementation Plan

The implementation plan for the Agriculture Sector is presented in Table 6-2. The implementation plan will be key to putting the strategy into action and achieving the WC/WDM target. The implementation plan should be a living document that the various stakeholders engage with and adapt to their needs in order to bring the actions to fruition. The plan also provides an indication of the responsible parties and those that can be enablers of the various actions. The lists of parties provided in these areas is not exhaustive, and additional parties may need to be included.

Table 6-2: Implementation Plan for the Agricultural Sector

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
GOAL 1: Improved leadership, institutions, and regulation								
Objective 1: To develop the institutional framework for WC/WDM								
1. 1 Promote WMI (Water Management Institutions) or Irrigation Schemes to develop institutional corporate frameworks that support WC/WDM to achieve Water Use Efficiency at scheme level	1. 1. 1 Develop water management plans for each irrigation scheme	High	Water Management Plans				DWS, DALRRD, CMAs	SAAFWUA, Sector bodies
	1. 1. 2 Develop scheme water use by-laws	High	Scheme Water use by by-laws				DWS, DALRRD, CMAs	SAAFWUA (WUAs), Sector Bodies
	1. 1. 3 Update Water Management Plans Annually	High	Updated Water Management Plans				DWS, DALRRD, CMAs	SAAFWUA (WUAs), Sector Bodies
1. 2 Strengthen an institutional culture of WUE reporting as part of Annual Institutional Performance Report	1. 2. 1 Develop regular WUE reports	High	Regular WUE Reports				DWS, DALRRD, CMAs	SAAFWUA (WUAs),
	1. 2. 2 Integrate the WUE targets in the Annual Performance Plans and reports for the WMIs	High	Updated Annual Performance Plans				DWS, DALRRD, CMAs	SAAFWUA (WUAs),

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
Objective 2: To strengthen and develop improved legal and regulatory instruments								
2. 1 Improve water allocation and equity amongst agricultural water users through water allocation audits	2. 1. 1 Undertake a water allocation audit within the agriculture sector (to verify water use allocations)	High	Updated public database and or WARMS, completed V&V Report				DWS, CMAs	SAAFWUA, sector bodies (AgriSA, TAU SA, AFASA etc.
	2. 1. 2 Undertake monitoring of water use in catchment areas where institutions do not exist to address illegal water use	High	Public database, periodic status reports				DWS, DALRRD, WRC, ARC	SAAFWUA, CSIR and sector bodies (AgriSA, TAU SA, AFASA etc.)
	2. 1. 3 Prioritise and complete Validation and Verification process in all WMAs	High	Updated V&V reports and WARMS database				DWS, CMAs	SAAFWUA
2. 2 Improve regulatory frameworks for water use efficiency and monitoring within the agriculture sector	2. 2. 1 Review and improve water use monitoring regulations and guidelines for the agriculture sector and ensure alignment with the Compliance, Monitoring and Enforcement (CME) Strategy	High	Revised water use monitoring regulations and guidelines				DWS, WRC	SAAFWUA
	2. 2. 2 Review the water use monitoring and evaluation frameworks for use in agriculture	Medium	Framework Review Report				DWS, CMAs, ARC, WRC	SAAFWUA and sector bodies

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
2. 3 Incorporate WUE licensing conditions – both general and specific institutional conditions	2. 3. 1 Undertake a stakeholder consultation on WUE licensing conditions	Medium	Stakeholder consultation reports				DWS, CMAs	Stakeholders
	2. 3. 2 Update the general and specific licensing conditions for agricultural users	Medium	Updated Licensing conditions				DWS, CMAs	SAAFWUA and sector bodies
GOAL 2: Strengthened co-operative governance and strategic alignment								
Objective 3: To formalise inter-governmental frameworks to support integrated approaches and partnerships								
3. 1 Create alignment of the institutional frameworks, agricultural programmes and principles of the relevant government departments and stakeholders in support of WC/WDM	3. 1. 1 Review and Align the institutional frameworks between DWS and DALRRD	Medium	Review Report				DWS, WRC, government departments, CMAs	SWPN
	3. 1. 2 Align the WC/WDM interventions with the priorities of the DWS and DALRRD	Medium	WC/WDM Interventions Alignment Report				DWS, WRC, government departments, CMAs	SWPN
	3. 1. 3 Review the Water & Sanitation Masterplan, National Water Resource Strategy 3 (NWRS3), National Water Security Framework (NWSF)2020 to identify areas of alignment	Medium	Review Report				DWS, WRC, government departments, CMAs	SWPN

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
	3. 1. 4 Engage with DWS SDG6 Task Team	Medium	Engagement Report				DWS, WRC, government departments, CMAs	SWPN
3. 2 Enhance the work of the Coordinating Committee for Agriculture Work (CCAW) in all provinces	3. 2. 1 Develop Terms of Reference for the CCAW's role in WC/WDM	Medium	Terms of Reference				DWS, DALRRD, PDAs, NPC, NT, DTIC	SWPN
3. 3 Develop common shared government strategies or plans towards outcomes-based efficiency improvement plans, i. e. , revitalisation of old schemes or the use of surplus water for irrigation purposes	3. 3. 1 Create an inter-ministerial Task Team on WC/WDM and develop strategies and plans	High	Quarterly Status Reports, strategies and plans				DWS, DALRRD, NPC, NT, DTIC	SWPN
GOAL 3: Enhanced operationalisation, implementation, and performance								
Objective 4: To engage and support the strategic development and improvement of sector infrastructure								
4. 1 Develop business cases based on the Infrastructure Asset Management Plan and Asset Register for all schemes to address water losses attributed to inefficient operation and maintenance of agricultural conveyance systems, i. e. , canals, pipelines, and channels	4. 1. 1 Review and update the bulk water asset register	Medium	Updated Asset Register				NWRIA*, DALRRD, DWS, CMAs	Sector bodies (AgriSA, etc), SAAFWUA
	4. 1. 2 Review the legislative frameworks for bulk water infrastructure development	Medium	Framework Review Report				NWRIA*, DALRRD, DWS, CMAs	DWS, AgriSA, SAAFWUA
	4. 1. 3 Draft the Agricultural bulk water infrastructure Masterplan	Medium	Draft Masterplan				NWRIA*, DALRRD, DWS, CMAs	NT, Sector bodies (e. g. AgriSA) SAAFWUA
	4. 1. 4 Identify key projects and develop business cases for these	Medium	Business cases				NWRIA*, DALRRD, DWS, CMAs	AgriSA, SAAFWUA

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
4. 2 Promote efficient operation and maintenance of irrigation infrastructure, from source to root zone applications	4. 2. 1 Develop annual operation and maintenance plans for irrigation infrastructure	Medium	O and M Plans				NWRIA*, DALRRD, DWS, CMAs	SAAFWU and sector bodies (AgriSA, TAUSA, AFASA etc.)
4. 3 Monitor the implementation of the asset management plans of the DWS Infrastructure branch to reduce physical water losses from DWS conveyance systems	4. 3. 1 Review the asset management plans for the DWS Infrastructure branch	Medium	Asset Management Plans				NWRIA*, DALRRD, DWS	WMIs
	4. 3. 2 Produce periodic progress reports for Asset management implementation	Medium	Progress Reports				NWRIA*, DALRRD, DWS, CMAs	WMIs, AgriSA, SAAFWUA
4. 4 Monitor the implementation of private sector (WUAs & Irrigation Boards) asset management plans to reduce physical water losses	4. 4. 1 Review the asset management plans for the private sector	Medium	Asset Management Plans				WMIs, sector bodies (AgriSA, etc), SAAFWUA	DWS, CMAs, DALRRD
	4. 4. 2 Produce periodic progress reports for Asset management implementation	Medium	Progress Reports				WMIs, sector bodies (AgriSA, etc), SAAFWUA	DWS, CMAs, DALRRD,
Objective 5: To support innovation and the use of technology								
5. 1 Support ongoing research by the Water Research Commission and the Agriculture Research Council on WC/WDM to improve Water Use Efficiency	5. 1. 1 Review and develop a research portfolio in coordination with WRC and ARC around WC/WDM	Medium	Research agenda bulletins				DWS, DALRRD	WRC, ARC, CSIR, Universities

Strategic Action		Sub-activities		Priority	Deliverables	Timeframe (years)			Responsible	Enablers
						1-3	3-5	5+		
5. 2	Support sector initiatives aimed at improving water use efficiency	5. 2. 1	Monitor sector initiatives aimed at improving water use efficiency	Medium	Reports		■		DWS, government departments	SABI, ARC, SAAFWUA, WRC, SWPN
		5. 2. 2	Improve assessments of the current water use and land use by means of earth observation method (remote sensing)	Medium	Research study report, implementation plan		■		DWS, DALRRD, PDAs	WRC, ARC, CSIR, Universities
5. 3	Facilitate the transfer and uptake of evidence-based technologies, such as those developed by the WRC and ARC	5. 3. 1	Engage with Enablers to develop communication mediums and materials	Medium	Presentations, emails, adverts, articles	■			DWS	SAAFWUA, WRC, ARC, SABI and sector bodies
		5. 3. 2	Review subsidy options through Enablers and private sector stakeholders	Medium	Report on options			■	DWS	SAAFWUA, WRC, ARC, SABI and sector bodies
5.	4 Work with organised agriculture to continue innovative work especially cooperations	5. 4. 1	Engage organised agriculture on innovations in WUE initiatives	Medium	Presentations, emails, adverts, articles	■			DWS, WRC, ARC, government departments	SAAFWUA, SABI and sector bodies (AgriSA, AFASA, TAUSA etc.)
Objective 6: To improve and sustain incentives and financial support for WC/WDM										
6. 1	Develop an investment framework for the renewal and maintenance of bulk water infrastructure in irrigation schemes	6. 1. 1	Review the infrastructure development frameworks	Medium	Framework Review Report, Implementation Plan		■		NWRIA*, DWS, DALRRD	NT, DBSA, DTIC, SAAFWUA, AgriSA

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
	6. 1. 2 Organise a stakeholder engagement session for actors within the agriculture sector	Medium	Stakeholder Engagement Report				NWRIA*, DWS, DALRRD	NT, DBSA, DTIC, SAAFWUA and sector bodies (AgriSA, AFASA, TAUSA etc.)
	6. 1. 3 Draft the Investment framework for bulk water infrastructure	Medium	Draft Investment Framework				NWRIA *, DWS, DALRRD	NT, DBSA, DTIC, SAAFWUA
6. 2 Review the pricing mechanisms for agriculture water use to promote water use efficiency	6. 2. 1 Review and update the National Pricing Strategy for water use charges within the irrigation sector	Medium	Agriculture pricing strategy				DWS, DALRRD, CMAs, WRC	SAAFWUA and sector bodies (AgriSA, AFASA, TAUSA etc.)
6. 3 Improve metering, billing, and revenue collection to promote Water Use Efficiency in Agriculture	6. 3. 1 Facilitate process of metering and reporting of water use as per gazetted regulation	High	Water Use Metering Report				DWS, CMAs	DWS, CMAs, WMIs, SAAFWUA
	6. 3. 2 Review the billing and revenue collection system for water use charges	High	User feedback survey and database				DWS, CMAs	DWS, CMAs, WMIs, SAAFWUA
	6. 3. 3 Update WARMS database	High	Updated WARMS database				DWS, DALRRD, CMAs, WRC	SAAFWUA and sector bodies (AgriSA, AFASA, TAUSA etc.)
6. 4 Ring-fence infrastructure charge as per water management area or catchment area to promote water use efficiency	6. 4. 1 Engage WTE on water charges ringfencing	High	Report on infrastructure charge ringfencing				DWS, CMAs, NWRIA*	DALRRD, WMIs, (CMAs, WUAs)

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
6. 5 Reinstate WC/WDM incentives, such as the WC/WDM Sector Awards, innovation recognition awards	6. 5. 1 Develop incentives programme	Medium	Incentives programme				DWS, DALRRD	Sector bodies, requires DWS high-level support
	6. 5. 2 Host awards ceremony to recognise leaders in the implementation of WC/WDM	Medium	Awards ceremony				DWS, DALRRD	Sector bodies, requires DWS high-level support
Objective 7: To enhance WC/WDM monitoring, reporting, and evaluation frameworks								
7. 1 Improve incentives that would facilitate the implementation of WC/WDM by strengthening data collection, monitoring, and evaluation	7. 1. 1 Develop and implement WMPs, standards, and WC/WDM performance management criteria	High	WMPs, guidelines and standards, regulations, Performance Management Indicators, report, status reports				DWS, DALRRD, ARC, WRC, WMIs	WMIs, SAAFWUA
	7. 1. 2 Develop and implement targets and indicators for WC/WDM in agriculture	High	Report, status reports (similar to No Drop in WS)				DWS, DALRRD, ARC, WRC, WMIs	WMIs, SAAFWUA, NB Systems CC
	7. 1. 3 Review and update the data repository for water use	Medium	Updated Data Repository and or WARMS				DWS, CMAs, ARC, WRC	SAAFWUA and sector bodies (AgriSA, TAUSA, AFASA etc.)
	7. 1. 4 Actively conduct water use audits as per license conditions	Medium	Water Use Audit Reports				DWS, CMAs	Private sector consultants

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
7. 2 Enhance Water Use Efficiency Accounting Reporting (WUEAR) by all major Irrigation Schemes and produce an annual state of Water Use Efficiency Report for the Irrigation Schemes	7. 2. 1 Review WUEAR and potential integration with National Integrated Water Information System (NIWIS)	High	Reporting guidelines				DWS, CMAs	SWPN, SAAFWUA, NB Systems CC
	7. 2. 2 Develop WUEAR guidelines	High	WUEAR reporting guidelines				DWS, CMAs, ARC, WRC	SWPN, SAAFWUA, NB Systems CC
	7. 2. 3 Obtain reliable measurement data and establish baseline loss (or water use efficiency) in the sector	High	Improved WUEAR				DWS, CMAs, ARC, WRC	SWPN, SAAFWUA, NB Systems CC
7. 3 Continue with the development of the Irrigation Regulatory Support Monitoring System called the Irri–Drop System	7. 3. 1 Review and update the Irri-Drop System	High	Updated Irri-Drop System				DWS, CMAs, ARC, WRC	SWPN and others
7. 4 Promote the use and adoption of Water Administration Systems by all Irrigation Schemes especially Government Water Schemes	7. 4. 1 Review the intellectual property for WAS system	High	Report on intellectual property rights for WAS system				DWS, CMAs, WRC	SWPN, SAAFWUA, NB Systems CC
	7. 4. 2 Promote the adoption and implementation of WAS by all irrigation schemes	High	WAS Implementation Report				DWS, CMAs, ARC, WRC	SWPN, SAAFWUA, NB Systems CC

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
GOAL 4: Mobilising the sector through strengthened capacity building, training, and awareness								
Objective 8: To strengthen the capacity of sector institutions to support implementation of WC/WDM								
8. 1 Improve skills development in WC/WDM to improve water use efficiency in the irrigation agriculture sector	8. 1. 1 Review the capacity and skills gaps within the irrigation sector	Medium	Skills and capacity report				DWS, DALRRD, ARC, WRC, EWSETA	ARC, WRC
	8. 1. 2 Explore opportunities for capacity building interventions for WC/WDM in the sector	Medium	Workshops				DWS, DALRRD, ARC, WRC, EWSETA	ARC, WRC, SAAFWUA
	8. 1. 3 Develop WMI institutions for the implementation of WC/WDM at a local level	High	Report on WMI establishment				DWS, DALRRD, WMIs, CMAs	SAAFWUA, SWPN, WUAs
	8. 1. 4 Support the establishment and operationalisation of WUAs in irrigation schemes	High	Report on institutions established and operationalised				DWS, DALRRD, WMIs, CMAs	SAAFWUA, SWPN, WUAs
8. 2 Participate in sector information and knowledge sharing platforms like SANCID, SABI, and organised agriculture conferences	8. 2. 1 Prepare material to be shared during WC/WDM-related conferences	Medium	WC/WDM pamphlets and newsletters				DWS, CMAs, DALRRD	WUAs, SWPN, SABI and sector bodies

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
8. 3 Strengthen institutional capacity through the provision of accredited Water Control Officer training courses	8. 4. 1 Deploy Water Control Officers Training Courses	High	Report on water control officer trainings offered				DWS, DALRRD, ARC, WRC, CMAs, EWSETA	WUAs, SAAFWUA
Objective 9: To develop best practice guidelines and tools for the sectors								
9. 1 Develop guidelines for water use data collection and reporting	9. 1. 1 Review the various water use monitoring tools and techniques and develop guidelines	High	Review report of various tools e. g. , WAS, cell phone application, draft guidelines, remote sensing				DWS, CMAs, WRC	SWPN, NB Systems CC, CSIR and others
9. 2 Develop standards for WUE and WC/WDM performance management criteria as part of the Irri-Drop System	9. 2. 1 Develop standards for WUE and WC/ WDM performance management criteria	High	Draft WUE Standards WC/WDM performance management criteria				DWS, CMAs, ARC, WRC	SWPN and others
9. 3 Develop best practice guidelines for small irrigators and irrigation schemes	9. 3. 1 Develop best practice guidelines for small irrigators and irrigation schemes	High	Draft best practice guidelines for small irrigators and irrigation schemes				DWS, DALRRD, ARC, CMAs	SWPN, WRC, AFASA, GFAR, SAAFWUA
Objective 10: Improve national awareness of the importance of WC/WDM								
10. 1 Develop and implement (behavioural change) programmes/ campaigns to systemically embed a water stewardship mindset	10. 1. 1 Implement the WC/WDM programmes/ campaigns through stakeholder engagement, coordination and communication	Medium	Behavioural Leadership Group, programmes, contracts, road shows, surveys				DWS, DALRRD, CMAs, WRC, ARC	WUAs, SAAFWUA and sector bodies (AgriSA, TAUSA, AFASA etc.)
10. 2 Develop and publish annual reports on status quo of WC/WDM	10. 2. 1 Develop annual WC/WDM reports	High	Annual WC/WDM reports				DWS, DALRRD, CMAs, ARC	WUAs, SAAFWUA

Strategic Action	Sub-activities	Priority	Deliverables	Timeframe (years)			Responsible	Enablers
				1-3	3-5	5+		
10. 3 Participate in agricultural events such as the NAMPO and Irrigation Scheme open days to promote Water Use Efficiency and WC/WDM	10. 3. 1 Organise and participate in WC/WDM-related open-day activities	Medium	Presentations, reports				DWS, DALRRD, CMAs, WRC, ARC	WUAs, SAAFWUA and sector bodies (AgriSA, SABI, AFASA etc.)
10. 4 Promote knowledge-based systems on water measurement in irrigation schemes	10. 4. 1 Collaborate with research partners on water measurement systems in irrigation schemes	Medium	Research reports, bulletins				DWS, DALRRD, CMAs, WRC, ARC	WUAs, SAAFWUA, AgriSA, SABI

7 Conclusions

There is an uneven distribution of water resources across South Africa, with parts of the country having more abundant water resources than others. However, many of the country's key economic areas are not necessarily located close to these water resources. As a result, the country has developed a significant number of dams and bulk water transfer schemes to ensure that water reaches these hubs. Nevertheless, the growth and development trajectory for South Africa will place increasing pressures on these limited supplies, to the extent that there will be a projected 17% deficit by 2030 (DWS, 2018). Climate change will also have significant impacts upon this. There is increasing realisation that infrastructural options for water resource development are declining and hence, WC/WDM interventions that will aim to reduce water demands and improve water use efficiency will become increasingly imperative if we are to avoid water constraining the developmental agenda.

While there are a range of strategic interventions that the DWS must lead and undertake, it is important to understand that this will require the combined efforts of all sectors of government, of the private sector and business as well as civil society and all South Africans. It is imperative that as a nation there is a change in the relationship that we all have with water and that we recognise that this scarce natural resource requires the active control, management, conservation, protection, use and development by each and every citizen.

To strengthen the approach to WC/WDM the DWS has led the development of a National Water Conservation and Water Demand Management Strategy, and this provides the framework for sub-sector strategies for Agriculture, for Industry, Mining and Power, and for Water Services. Each of these sub-sector strategies provides an implementation plan that guides the array of interventions needed to give effect to these sub-sector strategies. This will require the active support and participation of all key sub-sector partners and stakeholders, as emphasised above. Each sub-sector is inherently complex and as such there is a need for considerable innovation and the development of bespoke approaches to ensure the minimum target of 70% water use efficiency is reached. However, the expectation is that all sub-sectors should strive for continual improvements. These implementation plans have outlined priority interventions and have indicated some of the key stakeholders that are important to support these, however, it is not possible for that to be a fully comprehensive list of actors. These interventions will require all stakeholders to "put up their hands" and step forward to engage with these interventions.

To this end, the DWS as water sector lead, will continue to provide the guidance and support required to unlock processes and facilitate successful outcomes, as well as put in place the tools and systems to enable adaptive management approaches towards achieving the goals and strategic objectives that these strategies outline.

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